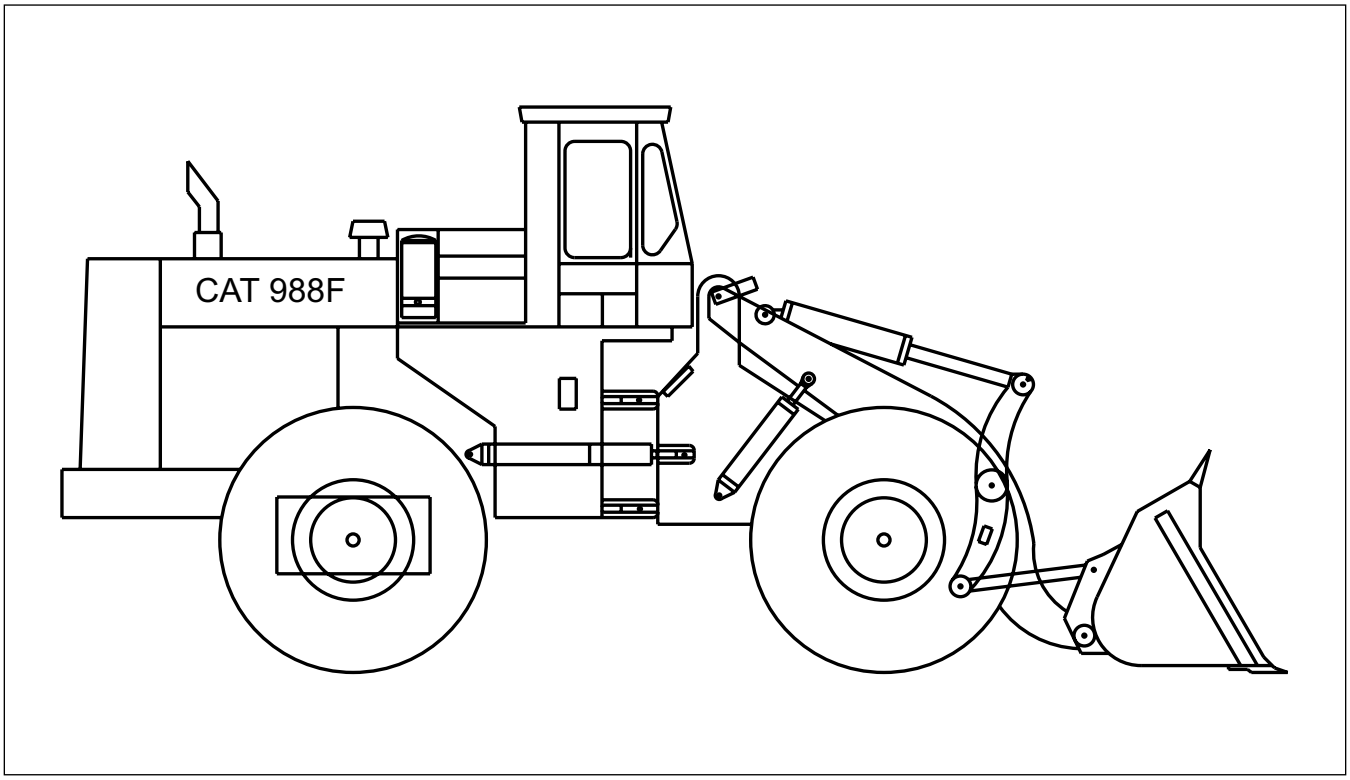
Caterpillar 988F
Installation & Maintenance



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OPERATION AND SERVICE INSTRUCTIONS

SECTION 1 COMPONENTS

1.1 SYSTEM PUMP

Tri-Lube HD 24 VDC Heavy Duty Grease Pump

1.1.1 Description: The Tri-Lube HD electric motor driven Grease Pump Package is designed for series progressive central lubrication systems on heavy duty construction, mining, or other mobile equipment.

The pump body can include from one to three fixed displacement cartridge piston pumps and a choice of reservoir capacities up to 45 lbs. This heavy duty pump is designed to deliver grease with consistencies rated up to NLGI #2 (dependent upon ambient temperature) at pressures up to 3500 psi (241 bar). **See 1.1.4 Specifications "Lubricant" for additional temperature and grease requirements.**

The rugged Tri-Lube HD package is corrosion protected and suitable for permanent outdoor installation where 24 VDC power is available.

1.1.2 Features / Benefits

- Designed for use with Trabon series-progressive divider valve systems. These systems provide positive lubrication and distribute accurately measured amounts of lubricant to each connected point.
- Electric motor driven (24 VDC) – for applications where air or hydraulic power is unavailable or undesirable.
- Modular design based on common pump body, electric motor, pump drive and fixed displacement cartridge piston pump.
- Cartridge pumps are radially mounted (threaded) into circumference of pump body and are externally connected to combine output volumes suppling grease to divider valve assemblies. Cartridges may be replaced or added in the field, without dismounting or disassembling the pump.
- Low reservoir sensing system provides a (sourcing) signal output for use with an **optional** external lamp, bell, or controller input.
- Control includes a DC timer located in a protected cavity in the pump base. Built-in circuitry prevents interference with other electronic apparatus, protects against improper wiring connections, and provides gradual start-up of the electric motor.
- All external surfaces are corrosion protected and all internal cavities are protected with weather-tight seals and condensate drains. A vent/ overflow tube prevents water from entering the reservoir and facilitates refilling.
- A 12 foot supply cable with gasketed strain relief is standard with the pump.
- The cast aluminum pump body incorporates heavy, gusseted mounting lugs. The lower lugs are slotted to simplify installation. Stabilizing lugs integral to the reservoir cover, anchor the pump package for use on rough terrain.

- Convenient fill stud in the pump body simplifies filling the reservoir while keeping the lubricant clean and free of air.
- Fill-stud mating coupler shipped loose to facilitate reservoir refilling.

1.1.3 Operation: The DC motor (rated for maximum 25% duty cycle) is attached to the vertically oriented gear shaft that drives a cam. As the cam rotates, the cartridge piston pump(s) are powered and primed on each rotation.

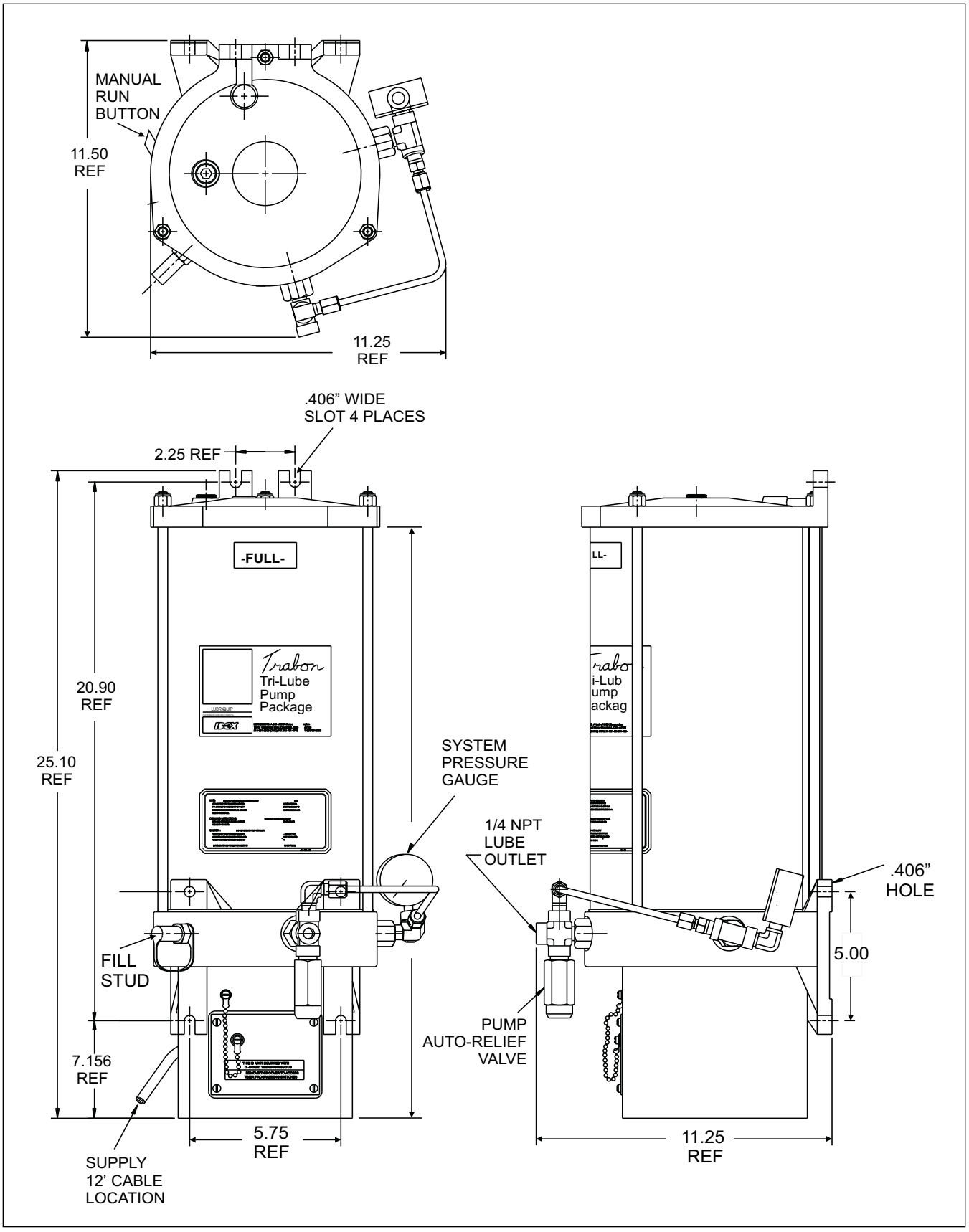
The bottom of the lubricant reservoir is open to the intake port(s) on the cartridge pump(s). A rotating paddle wiper, also attached to the gear shaft, continuously forces lubricant downward, toward the intake port(s).

The pump motor is intermittently activated by a signal from the on-board timer in accordance with the user determined lube cycle. A manual jog switch is provided for system test purposes. A lube cycle will be initiated each time the vehicle's key switch is turned "On".

1.1.4 Specifications

Pumping Cartridge	**Note:** Output may vary with changes in temperature, system pressure, grease viscosity, nominal applied voltage, etc.
Max Output Pressure (Intermittent Duty)	3,500 psi (241 bar)
Output Volume, Fixed (Per Cartridge Element)	0.08 cu.in./minute (1.3 cc)
Lubricants	To accommodate the various temperature conditions encountered with construction equipment, the following lubricant guide can be used:
00 NLGI	-30ºF to 30ºF (-34ºC to -1ºC)
1 NLGI	30ºF (-1ºC) and above
Operating Temperature	-20ºF to 140ºF (-29ºC to 60ºC)
Reservoir (1/4 in. Acrylic)	
Capacity	20 lb (9 kg)
Quick-Connect	Protected fill fitting in pump body
Electrical Requirements	**Note:** Fuses and fuse holders (supplied by user) to be located for maintenance convenience.
Motor Voltage	24 VDC, user must fuse @ 2 amps slow-blow style
On-Board State Timer	**Example:** If pump on-time is set for 10 min, off-time (time between cycles) must be set for 30 min or longer. Total cycle time for this example is now 40 min. 10 = 25% of 40. See page 1-11 for available settings
Electrical	24 VDC (matches motor voltage)
On-Time	Adjustable in steps from 30 sec to 15 min
Off-Time	15 to 450 minutes
Duty Cycle	Not to exceed 25%
Electrical Connection	Strain relieved, gasketed 12 ft (3.7 m) cable
Weight Empty	40 lb (18.2 Kg)

1.1.5 Dimensions Inches (mm)



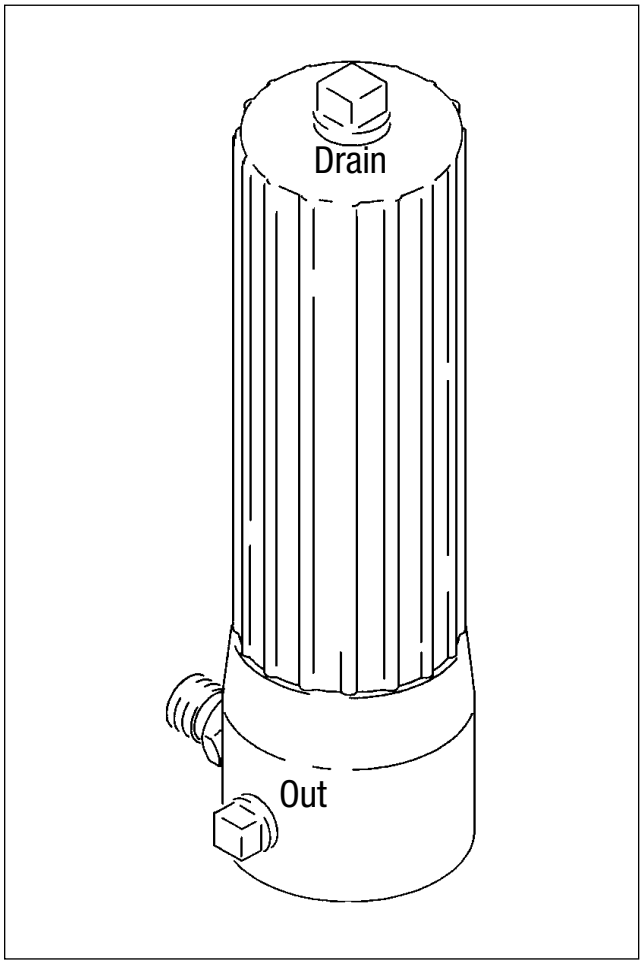
1.1.6 **Mounting:** Pump must be mounted in a vertical position only, with the reservoir above the pump. Use four (4) 3/8 in. diameter mounting bolts for pump body, and two (2) 3/8 in. diameter bolts for upper support.

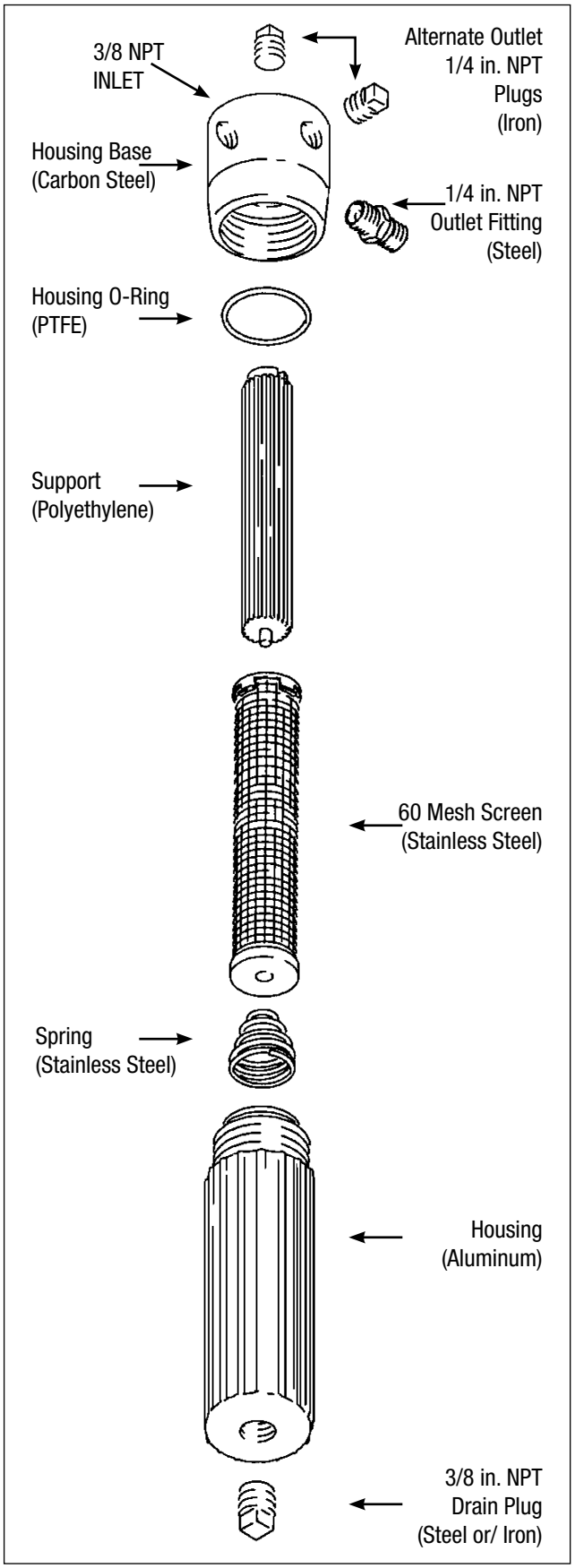
1.1.7 **Wiring:** On-Board Timer Version

Red	+ VDC
Black	– VDC (earth ground)
Green	Not used
White	Low level (when used)
See page 1-10 for wiring schematics	

1.2 SYSTEM STRAINER

High Pressure Strainer 558942 (527-101-257)





* See page 7-4 for replacement elements

1.3 DIVIDER VALVE ASSEMBLIES

MSP modular divider valves

Your key to maximum design flexibility with series progressive reliability.

Match lubricant flow to the exact needs of each point.

- Precise monitoring, positive feedback
- Simple to install and operate
- Modular design for total flexibility

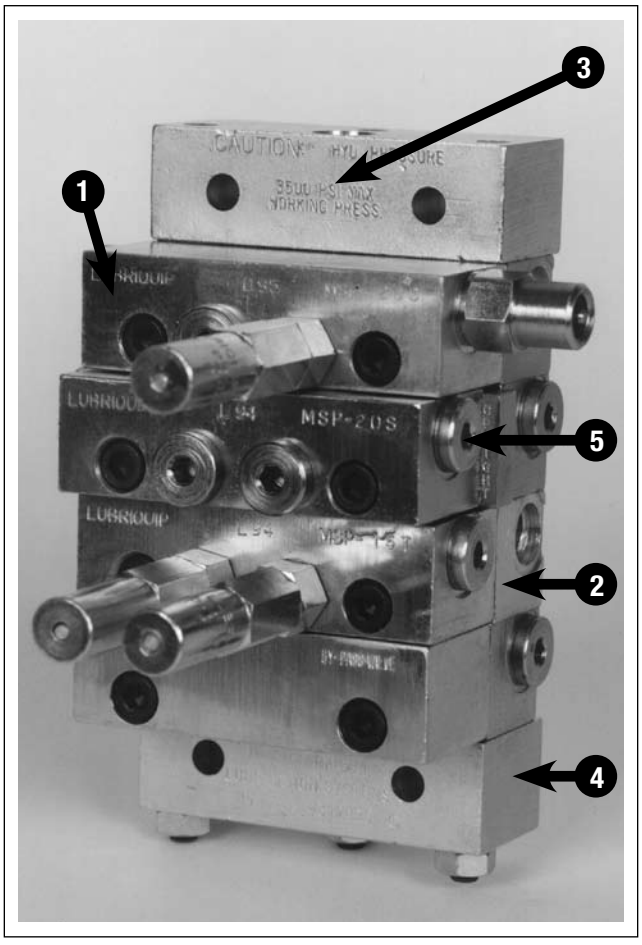
The flexible, modular MSP divider valve

- For grease or oil systems up to 3,500 psi (241 bar)
- Lubricate up to 16 points per valve assembly
- O-Ring sealing prevents leaks, reduces maintenance
- Individual valve outputs vary by a maximum ratio of 16:1
- Built-in check valves prevent lube re-entry and help keep lines full
- Stackable design simplifies installation, adds flexibility
- Available in carbon steel with standard zinc plating, or with nickel plating for improved appearance or in type 316 stainless steel for corrosive applications.

Each assembly includes:

1. **Valve sections** with working piston (3 min)
2. S**ubplates** with outlet ports
3. I**nlet** section
4. E**nd** section.

Twin piston sections are ported to create **separate outputs** for two lube points. **Single** sections **combine** the output from both ends of the piston and send it to a single lube point.



A wide variety of safeguards monitor and verify lube cycles.

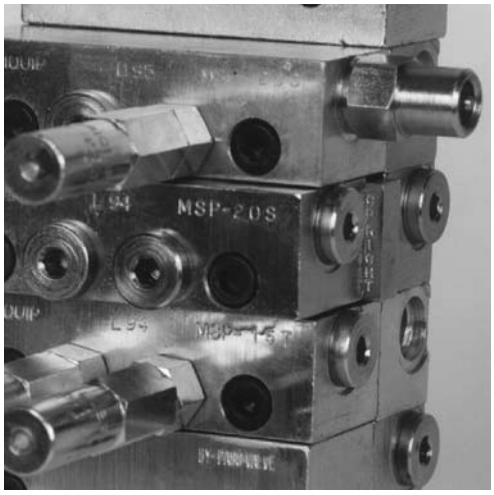
- Track valve-piston action
- Easily interfaced to system controller

Cycle indicators: these mechanical and electrical units sense the divider valve piston's action for accurate control and monitoring of lube cycles.

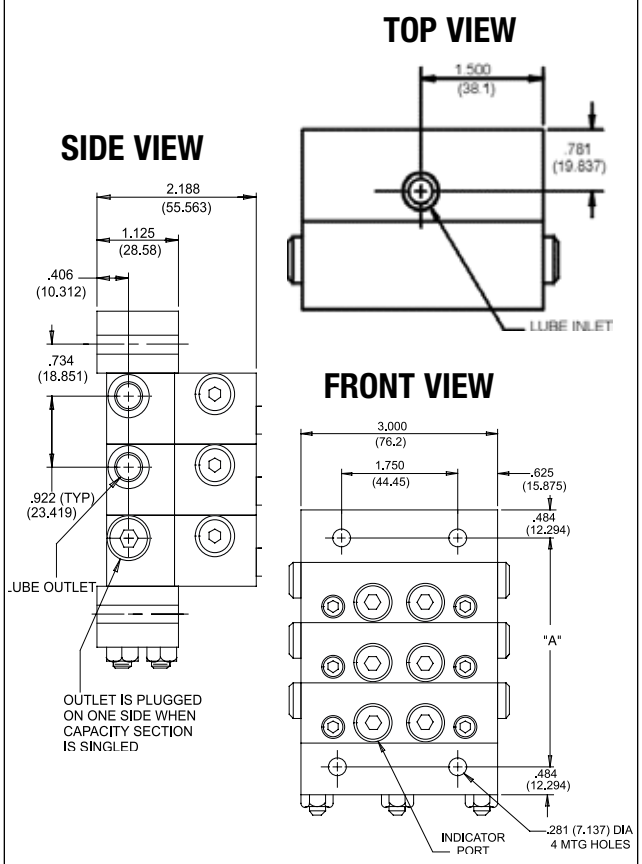
Cycle indicator pin: Valve sections are available with a factory-installed indicator pin which moves in and out as lubricant passes through the valve.

Designed with over 90 years experience in centralized lubrication.

- Engineering certified to iso 9001 standards
- Modular design for maximum flexibility
- Install and maintain without disturbing lube lines

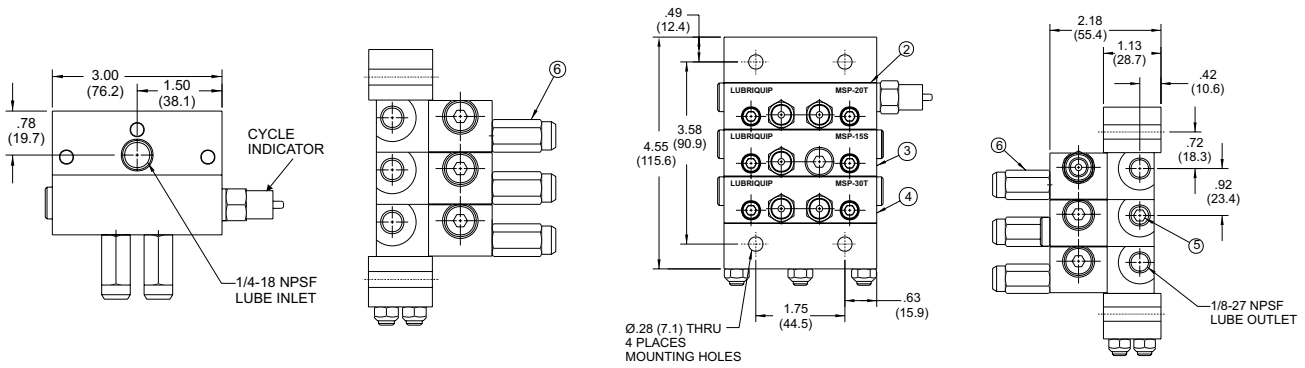


MSP Divider Specifications	
Standard Material	Corrosion protected steel
Optional Material	Nickel plated steel, type 316 stainless steel
O-Ring Seals	Standard, 70 durometer buna-n
Max Cycle Rate	
w/Cycle Pin	60 Cpm
w/out Cycle Pin	200 Cpm
Max Pressure	3,500 Psi (241 bar)
Max Temperature	Buna-n seals, 200ºf (93ºc)
Lubricant	Oil or grease
Divider Valve Assembly Net Weight	
3-Section	5.9 Lb (2.7 Kg)
4-Section	7.3 Lb (3.3 Kg)
5-Section	8.7 Lb (4.0 Kg)
6-Section	10.2 Lb (4.6 Kg)
7-Section	11.6 Lb (5.6 Kg)



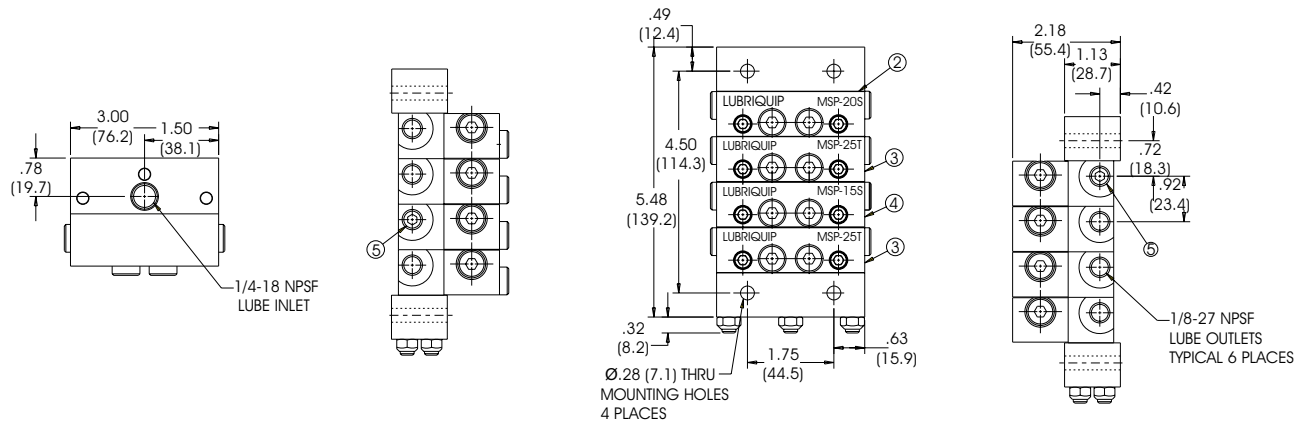
Qty. of Sections	"A"
3	3.578 (90.881)
4	4.500 (114.30)
5	5.422 (137.718)
6	6.344 (161.138)
7	7.266 (184.556)

1.3.1 Master Divider Valve Assembly 562761 (106-109-865)



Item	Qty.	Description	Part No.	Old Part No.
2	1	Valve Block - 20B w/Cycle Pin	562739	106-100-935
3	1	Valve Block - 15S	562713	106-100-035
4	1	Valve Block - 30T	562725	106-100-225
5	1	Plug, 1/8 in. Pipe	557349	503-485-000
6	5	Auto Relief Valve, 2500 psi	563175	508-310-465

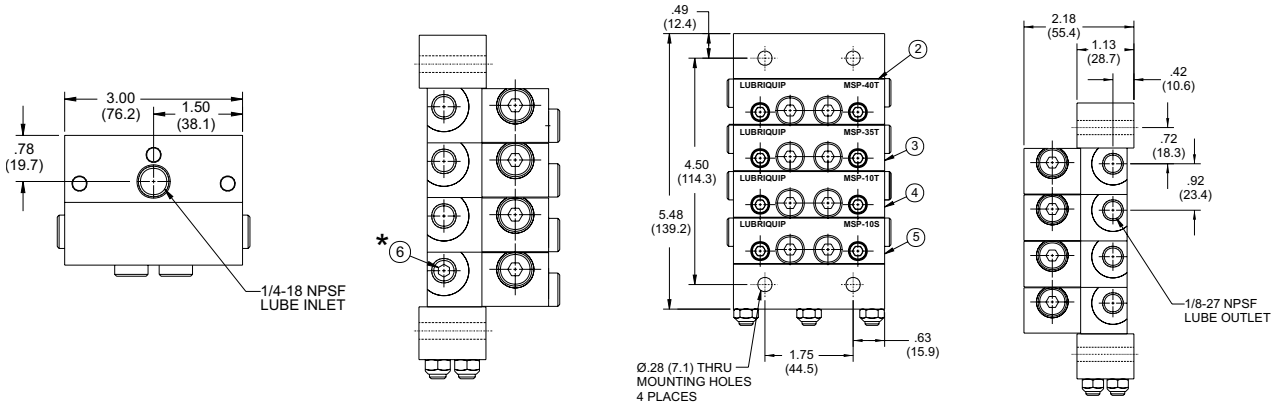
1.3.2 Front, (Right and Left Side) Divider Valve Assembly 562762 (106-109-866)



Item	Qty.	Description	Part No.	Old Part No.
2	1	Valve Block - 35T	562726	106-100-235
3	1	Valve Block - 25S	562715	106-100-055
4	1	Valve Block - 15S	562713	106-100-035
5	2	*Plug 1/8 in. Pipe	557349	503-485-000

*1/8 in. pipe plugs may be on opposite sides for right vs. left side divider assembly based on lube line accessibility. See system schematic on page 2-2.

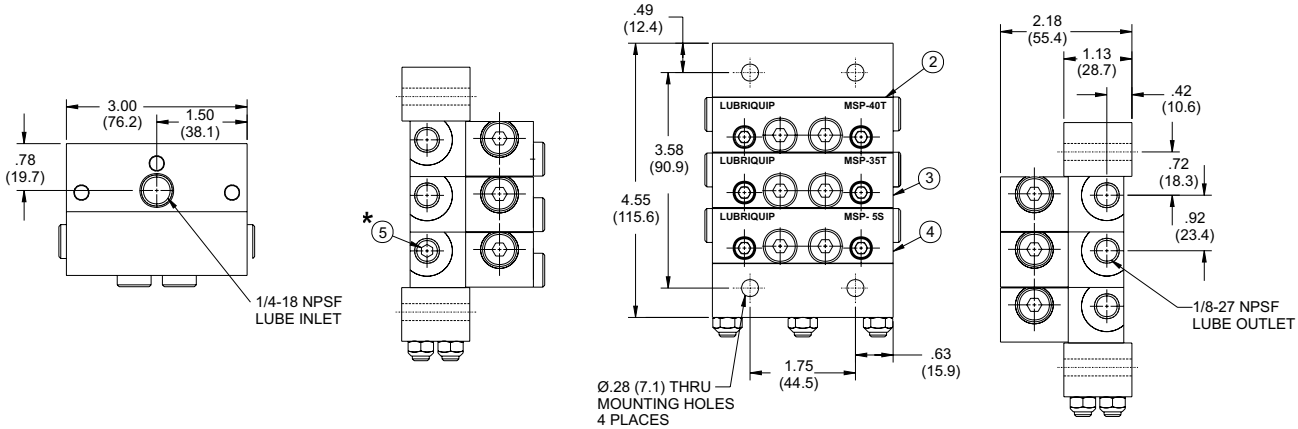
1.3.3 Left Side Divider Valve Assembly 562765 (106-109-869)



Item	Qty.	Description	Part No.	Old Part No.
2	1	Valve Block - 40T	562725	106-100-245
3	1	Valve Block - 35T	562726	106-100-235
4	1	Valve Block - 10T	562721	106-100-185
5	1	Valve Block - 10S	562712	106-100-025
6	1	*Plug, 1/8 in. Pipe	557349	503-485-000

*1/8 in. pipe plugs may be located on opposite side of divider valve assembly to aid in lube line accessibility

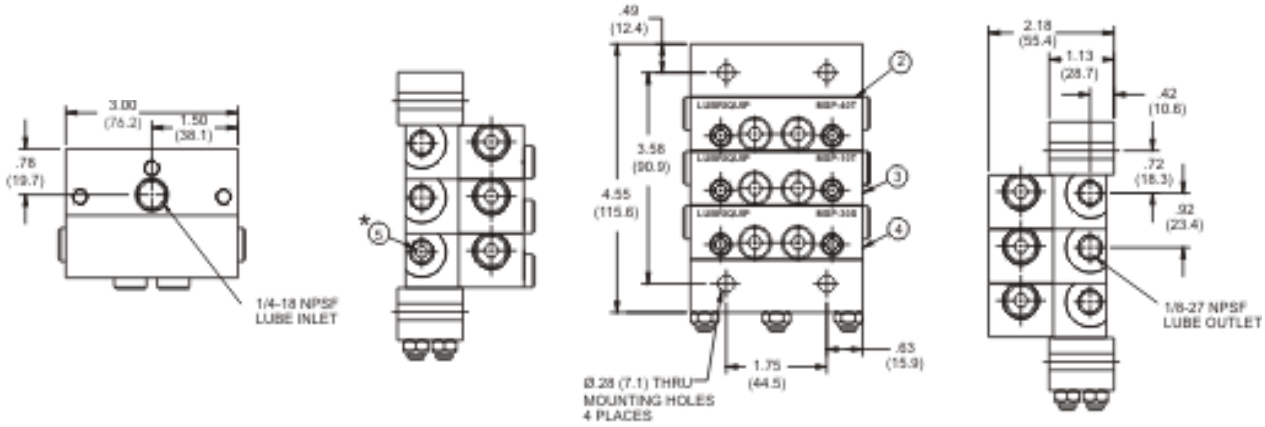
1.3.4 Right Side Divider Valve Assembly 562763 (106-109-867)



Item	Qty.	Description	Part No.	Old Part No.
2	1	Valve Block - 40T	562725	106-100-245
3	1	Valve Block - 35T	562726	106-100-235
4	1	Valve Block - 5S	562711	106-100-015
5	1	*Plug, 1/8 in. Pipe	557349	503-485-000

*1/8 in. pipe plugs may be located on opposite side of divider valve assembly to aid in lube line accessibility

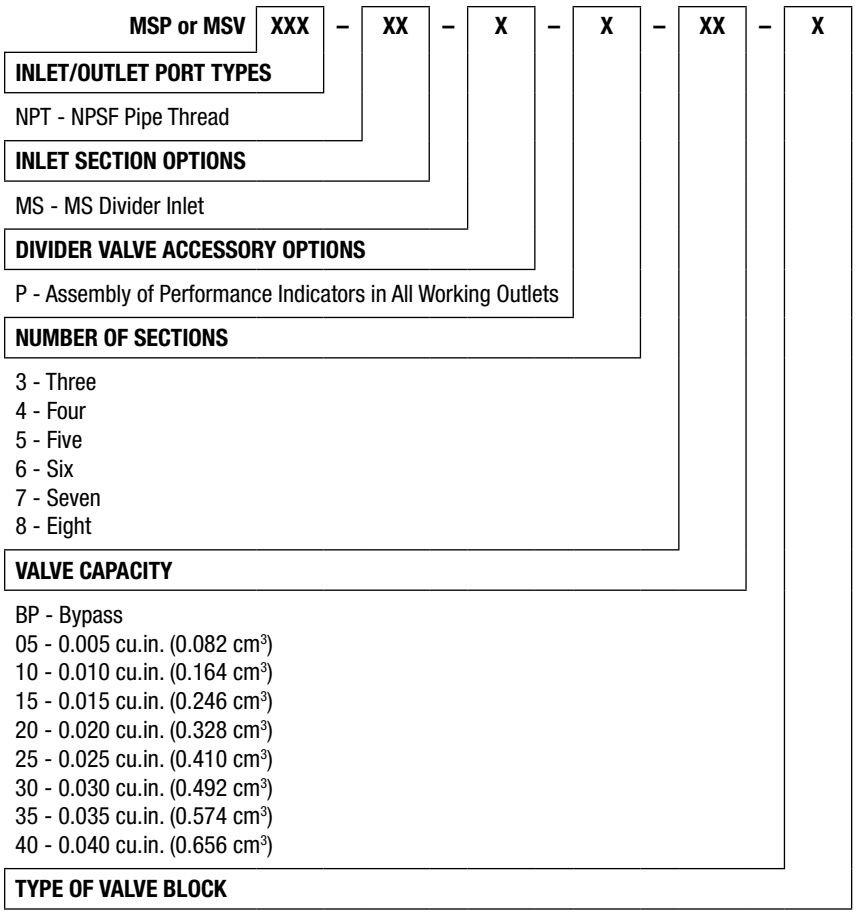
1.3.5 Rear Divider Valve Assembly 562764 (106-109-868)



Item	Qty.	Description	Part No.	Old Part No.
2	1	Valve Block - 40T	562725	106-100-245
4	1	Valve Block - 10T	562721	106-100-185
5	1	Valve Block - 30S	562716	106-100-065
6	1	*Plug, 1/8 in. Pipe	557349	503-485-000

*1/8 in. pipe plugs may be located on opposite side of divider valve assembly to aid in lube line accessibility

1.3.6 HOW TO ORDER



NOTES:

1. Right/Left Hand determined when viewing front of divider valve assembly. (Divider valve assembly placed on flat surface with inlet at top.)
2. Valves are specified starting from inlet section.
3. When valve is a single, only one outlet in its subplate can be used, other outlet must be plugged.
4. Cycle pins are available on MS (20, 25, 30, 35, and 40) valves only.
5. All divider valve assemblies must have a minimum of 3 working valves.
6. Bypass block cannot be supplied or assembled on a divider valve assembly with 3 subplates. A bypass block is not a working valve.
7. Divider systems should be limited to first and second stages only. Third staging is not recommended.

MSP - Standard Industrial to 3,500 psi (241 bar)
MSV - Synthetic Industrial to 3,500 psi (241 bar), Viton Seals

ORDERING EXAMPLE

4-section MSP Divider Valve Assembly, standard seals, NPT ports and performance indicators in each working outlet.

Consisting of:

1 - .030 Twin Valve with Cycle Pin Right Side

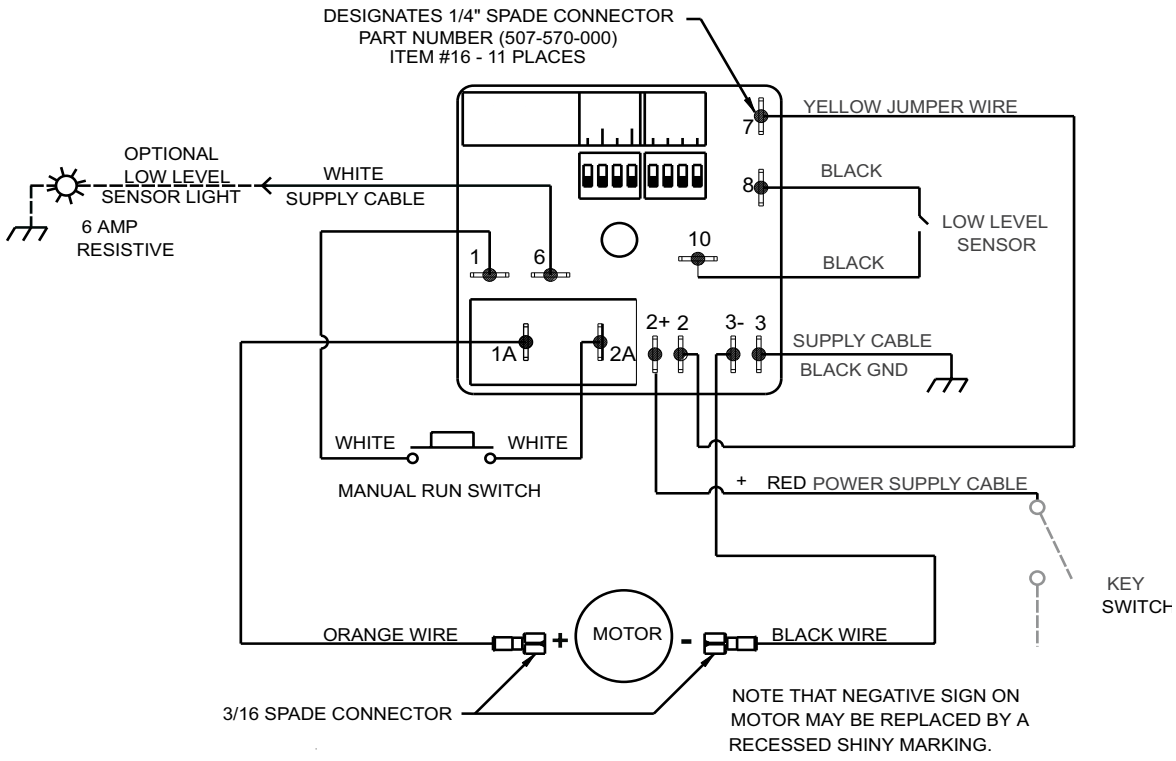
1 - .040 Single Valve - Right Hand Outlet

1 - .040 Single Valve - Right Hand Outlet

1 - .020 Twin Valve

Ordering Code - MSP-NPT-MS-P-4-30B-40S-40S-20T

1.4 On-Board Timer 563549 (529-860-161)



TIMER WIRING DIAGRAM

Operation: Timer starts in the "On" position on power up and initiates a lube cycle.

Low Level Switch: If Low Level Switch closes then the light output will flash at a one second duty cycle until the next "Off" time period expires. The output will reset back to the totally off state until the low level switch transfers again.

Motor Enable: See page 1-14 for "On" and "Off" cycle times.

There are two banks of 4 miniature switches mounted on the timer. These are known in industry as DIP (Dual In-line Package) Switches. One bank controls the amount of time the pump motor runs (ON TIME); the other controls the amount of time that the motor rests (OFF TIME). Pushing a switch UP turns it on and programs the timer to stay ON (or OFF) for the number of minutes printed on the label above the switch.

Note that one, two, three, or all four switches in either bank may be turned on at the same time. It is in this fashion that the switches "add", or combine to provide a range of programmable times to control the pump's operational cycle. In addition, note that the switches may be on in any combination, it is not required that only adjacent switches be on. See timer switch settings below. Each time the main power to the Tri-Lube pump is turned off, the timer cycle will be interrupted; when the power is reconnected, a timer "On" condition will begin a lube cycle. **WHEN SETTING THE TIMER, BE SURE TO HEED THE MAX. 25% MOTOR DUTY CYCLE NOTE.**

TIMER SWITCH SETTINGS - OFF

Batch Number				Off Time
30	60	120	240	
Off	Off	Off	Off	15 Min
On	Off	Off	Off	30 Min
Off	On	Off	Off	60 Min
On	On	Off	Off	50 Min
Off	Off	On	Off	120 Min
On	Off	On	Off	150 Min
Off	On	On	Off	180 Min
On	On	On	Off	210 Min
Off	Off	Off	On	240 Min
On	Off	Off	On	270 Min
Off	On	Off	On	300 Min
On	On	Off	On	330 Min
Off	Off	On	On	350 Min
On	Off	On	On	380 Min
Off	On	On	On	420 Min
On	On	On	On	450 Min

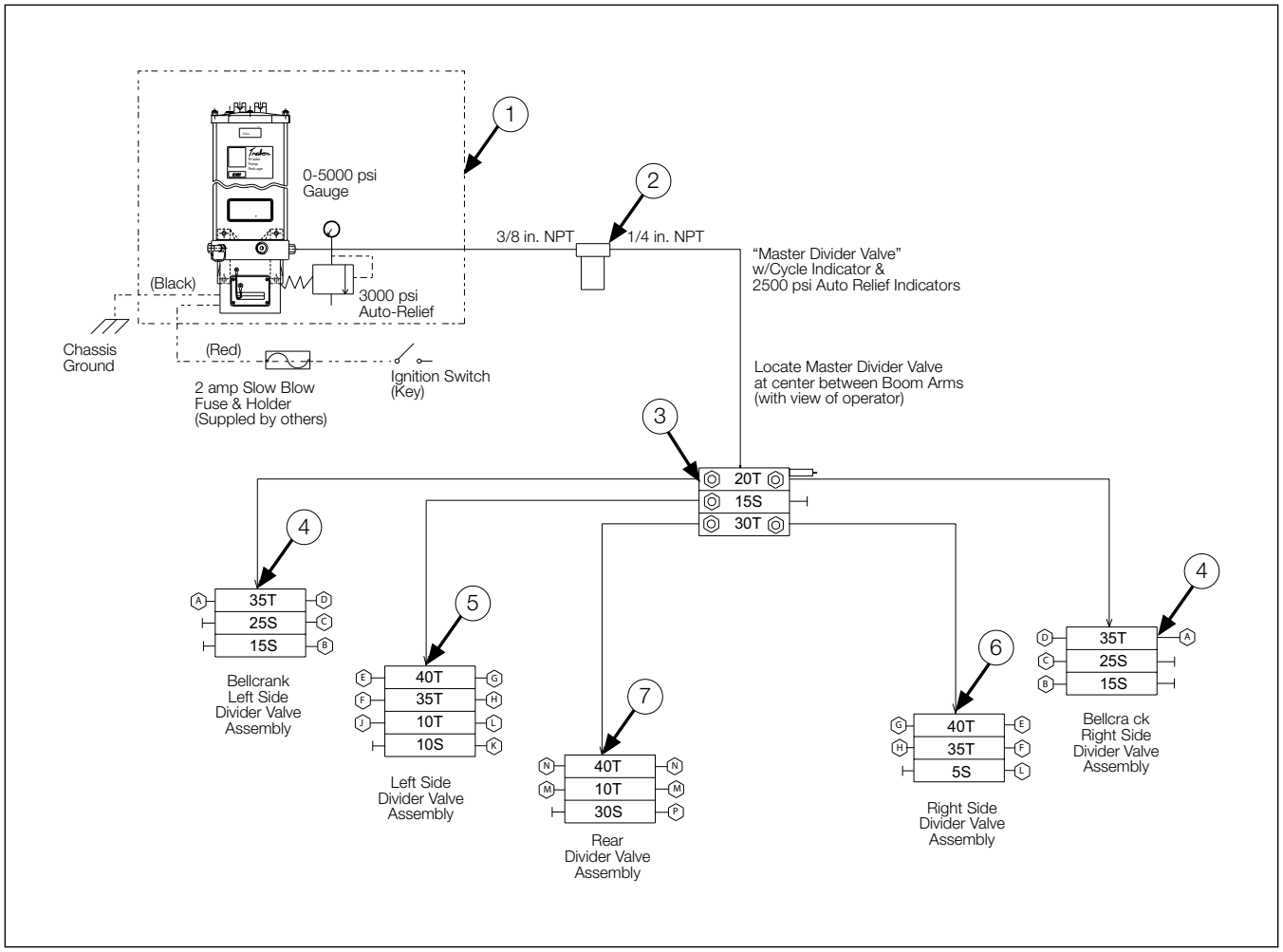
Timer Switch Settings - On

Batch Number				On Timer
1	2	3	8	
Off	Off	Off	Off	30 Sec
On	Off	Off	Off	1 Min
Off	On	Off	Off	2 Min
On	On	Off	Off	3 Min
Off	Off	On	Off	4 Min
On	Off	On	Off	5 Min
Off	On	On	Off	6 Min
On	On	On	Off	7 Min
Off	Off	Off	On	8 Min
On	Off	Off	On	9 Min
Off	On	Off	On	10 Min
On	On	Off	On	11 Min
Off	Off	On	On	12 Min
On	Off	On	On	13 Min
Off	On	On	On	14 Min
On	On	On	On	15 Min

OPERATION AND SERVICE INSTRUCTIONS

SECTION 2
ORIGINAL SYSTEM DESIGN

2.1 SYSTEM SCHEMATIC

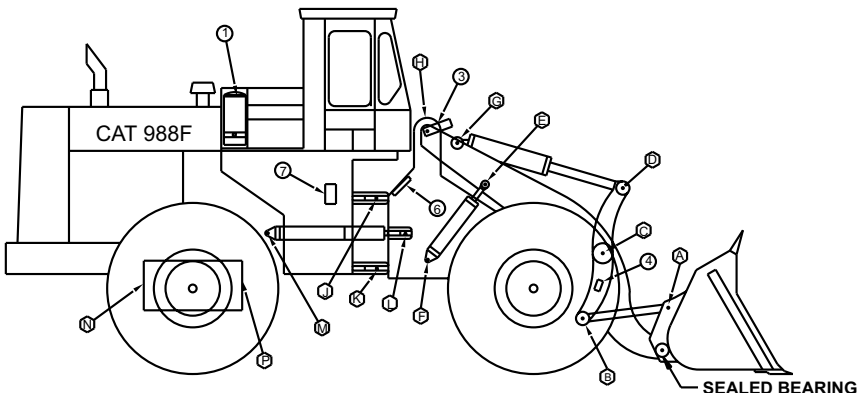


2.2 KIT COMPONENTS

Original Kit Components				
Item	**Qty**	**Description**	**Part No.**	**Old Part No.**
	1	Component Kit	563533	529-801-000
1	1	• Tri-Lube HD, 24 VDC Pump w/20# Reservoir Timer, Low Level Switch, psi Gauge, Manifold	563531	529-800-306
2	1	• 60 Mesh, High Pressure Strainer Assembly	558942	527-101-257
3	1	• Master Divider Valve Assembly: MSP-NPT-MS-P-3-20B-15S-30T w/Cycle Indicator	562761	106-109-865
4	2	• Bellcrank Divider Valve Assemlbies: MSP-NPT-MS-3-35T-25S-15S	562762	106-109-866
5	1	• Left Side Divider Valve Assembly: MSP-NPT-MS-4-40T-35T-10T-10S	562765	106-109-869
6	1	• Right Side Divider Valve Assembly: MSP-NPT-MS-3-40T-35T-5S	562763	106-109-867
7	1	• Rear Divider Valve Assembly: MSP-NPT-MS-3-40T-10T-30S	562764	106-109-868
8	1	• Reservoir Fill-Stud Coupler (shipped loose)	557877	550-050-230
9	12	• Divider Valve Assembly Weld Bars (shipped loose)	560920	527-002-260
10	24	• 1/4-20 in. x 1-3/4 in. Hex Head Cap Screw (for weld bars)	555466	415-010-090
11	24	• Lockwasher, 1/4 in. (for weld bars)	558675	421-010-010
12	24	• Washer (for weld bars)	556525	421-700-894
13	1	• Machine Label (shipped loose, see note #15)	555758	457-002-541
14	1	• Operation Manual	–	600-044-878

See Section 7 for Spare Parts Information

2.3 LUBRICATION POINTS



Lubrication Points List		
Item	**Qty**	**Description**
A	2	Upper Bucket Pin
B	2	Bucket Link
C	2	Bellcrank Pivot
D	2	Bucket Cyl - Rod End
E	2	Left Cyl - Rod End
F	2	Left Cyl - Cap End
G	2	Bucket Cyl - Cap End
H	2	Room Pivot
J	1	Upper Articulating Pivot
K	1	Lower Articulating Pivot
L	2	Steering Cyl - Rod End
M	2	Steering Cyl - Cap End
N	2	Rear Axle Cradle
P	1	Rear Axle Nose Bearing
	25	**Total Lube Points**

2.4 GENERAL NOTES

1. Pumping unit to be mounted in a location where refilling of reservoir and observation of auto relief is convenient and protected.
2. Suggested "initial timer" settings:
   - "On" time at 3 minutes
   - "Off" time at 15 minutes

   (adjust as necessary to suit operating conditions)
3. Refer to operation manual for priming and purging instructions as well as component details and instructions.
4. Assemble MSP divider valves loosely to weld bars, prior to welding to machine.
5. 1/8 in. socket head pipe plugs are supplied loose. Follow flow diagram for proper plug locations.
6. Twin divider valve sections, stamped "T", must have two outlets.
7. Single divider valve sections, stamped "S", must have only one outlet.
8. Pipe nipples and female elbow adapters of various lengths are suggested for recessed bearing or pin inlet.
9. All lines must be adequately supported with clamps and anchored to machine. Any line, connection, or component which is vulnerable to damage must be guarded.
10. Run all lines by the shortest and neatest routes and in protected areas.
11. Lines must be free of particulate contamination before connection to divider valve assembly. If pipe compound is used, ensure no compound gets inside lines.
12. Pre-fill all divider valves, hoses/lines, with contaminant free grease of the same type that will be used during normal operation. Refer to operational manual for additional information.
13. All 1/4 in. OD steel tubing must have a minimum .035 inch wall thickness.
14. All 1/4 in. ID hose must be SAE "100R1" or 100R7" rated at minimum. Reusable or crimp-on fittings per customer preference.
15. Machine label to be affixed to machine in clear view.
16. Grease recommendations: To accommodate the various temperature conditions during construction equipment operation, the following lubricant guide can be used:

Ambient Temperature	Lubricant NLGI No.
-30ºF to 30ºF (-34ºC to -1ºC)	"00"
30ºF (-1ºC) and Above	"1"

17. In the event that changes are made to the system during installation due to machine modifications and/or during operation to accommodate extenuating operating conditions, the schematic must be updated to show as the installed system.
18. In the event that changes are made to the system, never plug a divider valve outlet designed to serve a bearing or another divider valve assembly.

OPERATION AND SERVICE INSTRUCTIONS

SECTION 3 DEFINITIONS

This section contains definitions of various terms within this manual. For additional information, please contact your local distributor or Graco at 800-533-9655 or www.Graco.com

3.1 GLOSSARY OF LUBRICATION TERMS

Auto Relief Valves: A relief valve that mounts in the indicator port of the divider valve working section. This device relieves a downstream high pressure condition in excess of its rating and allows the remainder of the system to receive lubricant. The grease relieved from the Auto relief also provides a visual diagnostic signal that blockage exists in the system downstream of the connected lube outlet.

Cycle Indicator: A pin fixed to and/or extended by the measuring piston in a divider valve, dual-line valve or injector that gives visual indication of piston movement.

Cycle Switch: A switch that is attached to and actuated by the **cycle indicator** and gives electrical indication of piston movement.

Divider Valve: A positive displacement lubricant (oil, or grease) measuring valve that both divides and proportions input flow. The internal pistons (3 minimum) are actuated by flow and sequentially dispense lubricant to the connected points.

Divider Valve Assembly: A specific assembly of various sizes and styles of divider valves selected for specific bearing points as shown on system schematic and lubrication points list.

Feeder Size: A specific divider valve detailing its displacement and choice of either as “S” or “T”. Example = 10T

S: Located on top surface of divider valve next to divider valve displacement. The “S” represents a divider valve section that uses only 1 outlet port. It can be the left or right one but can not be both. Never plug both ports. This will prevent lubrication to all or part of system which can damage pins and/or bearings. **Example = 10S**

T: Located on top surface of divider valve next to divider valve displacement. The “T” represents a divider valve section that must use both outlet ports. Do not plug either outlet port. This will prevent lubrication to all or part of the system which can damage pins and/or bearings. **Example = 10T**

Lube Cycle/Lube Interval/Lube Period: Terms used interchangeably to describe the time period from one lubrication event to the start of the next.

Lube Pump Ratio: The area of the power piston (hydraulic or air) divided by the area of the lube piston. This ratio establishes the maximum lubricant discharge pressure for any given input pressure (hydraulic or air.

NLGI (National Lubricating Grease Institute): An organization of grease manufacturers that works with the ASTM (American Society for Testing Materials) to develop technical standards.

NLGI Grade Number: Numbers assigned by the NLGI to classify greases according to their hardness as measured by a cone penetration test. The numbers range from 000 (very fluid) to #6 (solid). Only the 000 thru #2 grade are considered usable in centralized lubrication systems.

Service Factor: As shown in original divider work sheet. This factor is used in sizing a system and takes into consideration both the loads and environmental working conditions and location on equipment.

OPERATION AND
SERVICE INSTRUCTIONS

SECTION 4
COMPONENTS

4.1 PRE-FILLING OF SYSTEM

Pre-Filling The System with Lubricant

Once the lubrication system installation has been completed, it is necessary to pre-fill all of the lines (tubing/pipes/hoses) and all of the divider valves before operation of the lubrication system can be started. Proper adherence to the following procedures will help to reduce and alleviate machine start-up problems caused by residual air in the lubrication system lines and components during their installation process. Leaving entrapped air in the lube lines could prevent lubricant from gaining access to the lube points during the critical initial start-up period. Proper pre-filling of the lubrication system will insure that lubricant is immediately available to every lube point upon machine start-up, protecting them from any potential damage. In order to simplify pre-filling, it is divided into three separate procedures:

- Filling the lines connecting the secondary divider valves to the lube points (Section 1.0).
- Filling the lines connecting the master divider valve to the secondary divider valves (Section 1.1).
- Filling the master divider valve (Section 1.2).

These three procedures should always be performed as a complete group in the sequence listed in order to ensure that every component in the system is completely filled with lubricant prior to machine start-up.

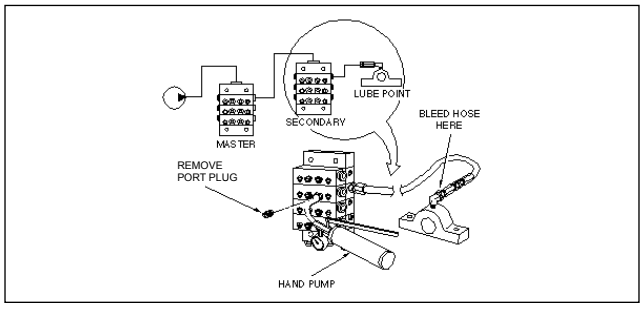
CAUTION: Use only contaminant free grease of the same type that will be used during normal operation.

4.1.1 Filling Secondary-to-Lube Point Lines

Refer to image below when performing this procedure:

1. Remove the port plugs from all of the indicator ports on the front of the secondary divider valves.
2. Connect a hand pump filled with clean, filtered lubricant to the indicator port closest to the first line to be filled that corresponds to the output port that is feeding the line to be filled.
3. In order to verify when the lubricant is flowing and has reached the end of the lube line, loosen the connector at the lube point of the line that is to be filled.
4. Stroke the hand pump until air-free lubricant is observed flowing from the end of the lube line.
5. Tighten the lube line connector at the lube point, but do not replace the port plugs or performance indicators into the ports on the front of the working section.
6. Repeat Steps 1 through 5 for each of the other lube lines connected to the other outlet ports in the secondary divider valve assembly and for any other secondary divider assemblies in the system.

NOTE: Do not replace any of the port plugs removed in Step 1 until the line-filling procedure described in Section 1.1 (Filling Master-to-Secondary Lube Lines) has also been completed.



4.1.2 Filling Master-To-Secondary Lubelines

Refer to image below when performing this procedure:

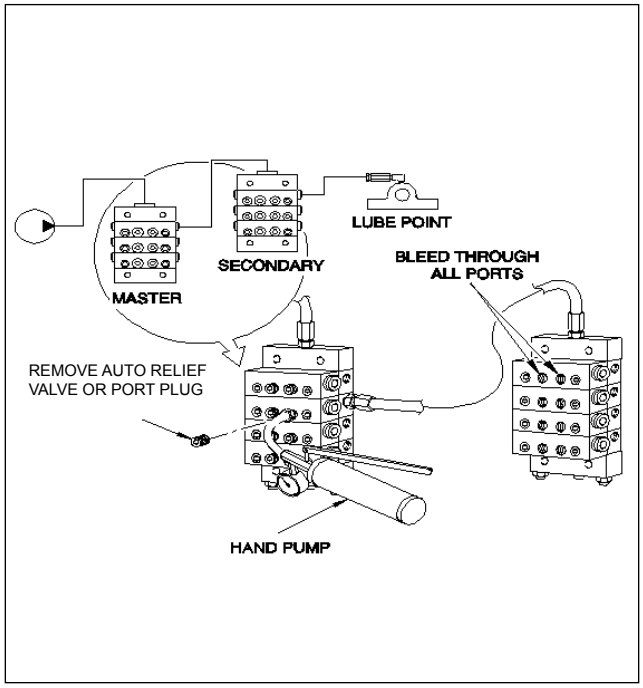
1. Remove the port plugs or auto relief valves from all of the indicator ports on the front of the master divider valve.
2. Connect a hand pump filled with clean, filtered lubricant to the indicator port closest to the lube output port that is feeding the line to the secondary divider valve.
3. Stroke the hand pump to fill the line between the master divider valve and secondary divider valve.
4. Continue to stroke the pump until the lubricant purges all of the air out of the internal passages of the secondary divider valve and lubricant flows freely from all indicator ports with no evidence of included air.
5. Reinstall the port plugs in their respective positions in the secondary divider valve. Do not replace the port plugs in the master divider valve yet.
6. Repeat Steps 1 through 5 for each of the other lube lines between the master divider valve and all other secondary divider valves.
7. Do not replace any of the port plugs or auto relief valves removed in Step 1 from the master divider valve assembly until the air-purging procedure described in Section 1.2 (Filling the Master Divider Valve) has also been completed.

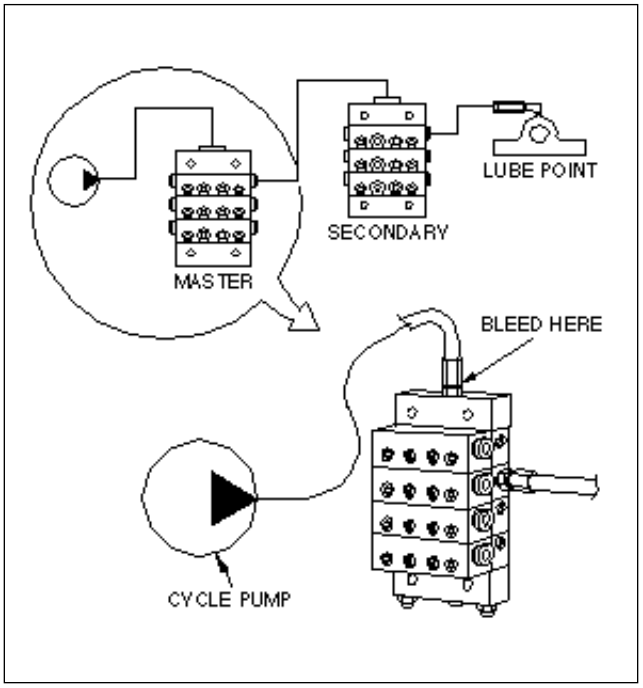
4.1.3 Filling The Master Divider Valve

Refer to image below when performing this procedure:

1. Verify that all port plugs or auto relief valves have been removed from all indicator ports in the master divider valve.
2. Verify that the system pump is properly connected to the inlet port of the master divider valve.
3. Cycle the system pump sufficiently to fill the main feeder line between the pump and the master divider valve, and lubricant is observed being discharged from all of the indicator ports on the front of the master divider valve with no evidence of included air.
4. Reinstall the master divider valve port plugs or auto relief valves into their respective positions.

NOTE: If any maintenance procedures requiring loosening or disconnecting of any connectors or fittings are performed subsequent to completion of the pre-filling procedures described above, but prior to machine start-up, the pre-filling procedures should be repeated to assure that the lubrication system is completely filled with lubricant and is air-free. Since the most critical operating period for a newly installed machine, in terms of potential for being damaged by unremoved/unfiltered lubricant contaminants and lack of adequate lubrication, is the initial start-up and operation, compliance with the recommended pre-filling procedures is crucial for attaining a problem-free start-up of the machine tool and continued reliable long term operating capability.





4.2 COMPONENT INSTALLATION TUBING, PIPE, AND HOSE CLEANING

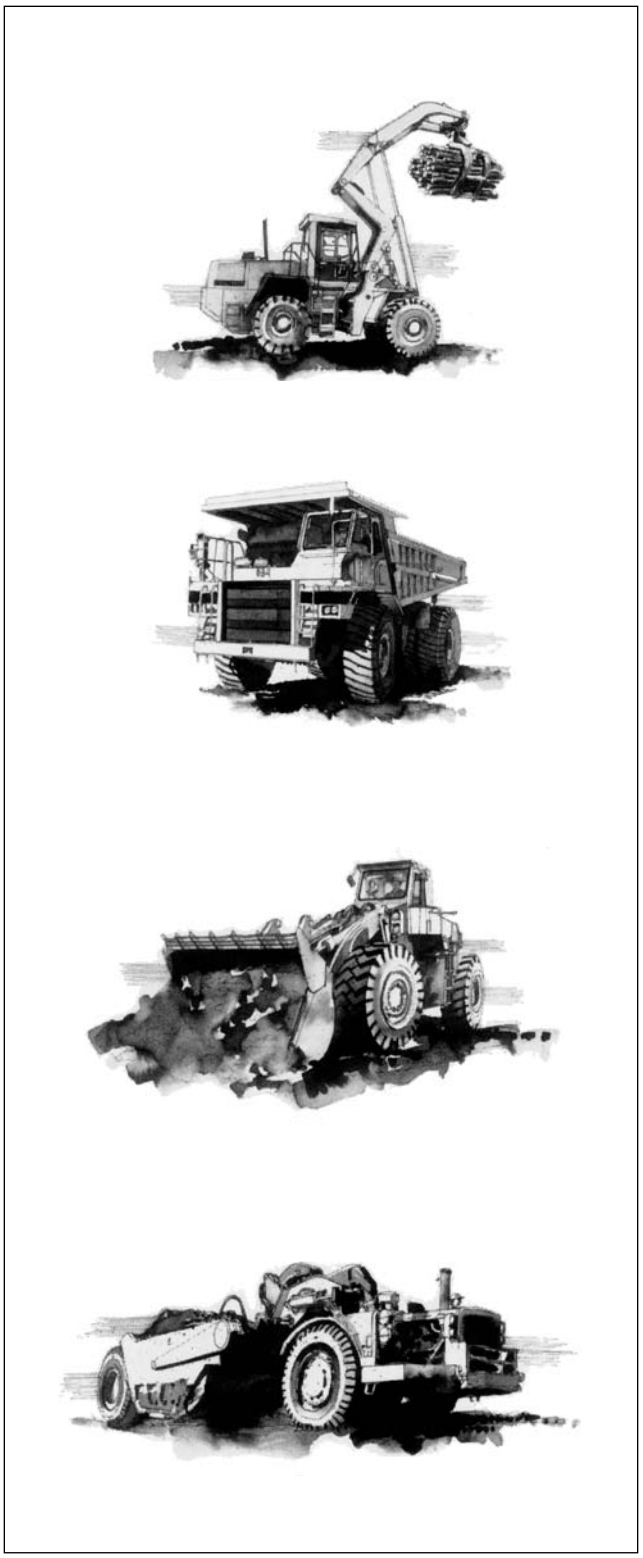
4.2.1 **Introduction:** When installing a Series-Progressive lubrication system, the installer must have a copy of the lubrication schematic diagram that was developed when the system was designed (see section 2.). The schematic diagram illustrates the approximate layout of the components, their relationship to each other, and is the authoritative and guiding document to be followed and referred to during the installation process. This Installation Guide segment addresses lubrication system installations in general terms with recommendations specific to Series-Progressive centralized lubrication systems where applicable.

Depending upon the individual application requirements, some system components are assembled at the factory prior to shipment while others require assembly at the installation site during the installation process. For instance, a series-progressive system divider valve may be shipped fully assembled and ready for assembly whereas some peripheral accessories, such as limit switches, performance indicators, proximity switches, etc., may be packed separately to reduce risk of damage during shipment. Refer to the lubrication schematic to determine the location of each component and accessory. For those components and accessories that are shipped unassembled, refer to the literature that accompanies each of them for specific instructions regarding their assembly and installation.

System installation procedures for specific components utilized in a series-progressive lubrication system are detailed in the following paragraphs in this Installation Guide:

- General Installation Guidelines (para 4.2.2)
- Mounting the Pump (para 4.2.3)
- Mounting Divider Valves (para 4.2.4)
- Installing Tubing, Pipes, and Hoses (para 4.2.5)
- Cleaning Tubing, Pipe, and Hose Assemblies 4.3

Whenever possible, these guidelines and recommendations should be followed during installation of the Series-Progressive lubrication system by the machine manufacturer or any other installer. This will enable the final customer or user to conveniently monitor and maintain the system integrity and trouble-free operation efficiently and economically.



4.2.2 General Installation Guidelines: The positioning and orientation of components relative to each other is essential to ensure the correct function and operation of any centralized lubrication system. Even if the proper components have been selected, improper positioning may make it more difficult to purge air out of the total system when air-bleeding procedures are performed. Any trapped air left in the lines or components of the lubrication system will impede and degrade performance and response time capabilities. The basic rules to be followed for proper component placement are:

1. The pump and reservoir should be mounted in a convenient and protected area.

2. Reservoir fill line should be accessible and a strainer mounted before the fill stud. If required, a pressure gauge can be mounted in the cab for system monitoring. A Timer should be used whenever practical to accurately control lubricant usage. All lubricant lines must be adequately supported with clamps and anchored to the machine. Any line or component which is vulnerable to damage should be guarded.

3. If lubrication points are located on a portion of the equipment that is moving, the divider valves should be located to minimize the number of connecting hoses that are required to be moving and flexing. See Figure 1, page 4-6.

4. Keep the lengths of installed tubing, pipes, and hoses as short as possible in order to minimize the total line volume/capacitance. Large line volumes increase the time necessary to build up to system operating pressure when the pump is activated, resulting in a slower system response time. The system response time delay may cause lube system fault indications when the allotted time to achieve lubrication of all lube points (Monitor Time) is exceeded. Therefore, designing and installing the system overall configuration to minimize the total line lengths and size is very important in optimizing the system performance capabilities and minimizing response time.

See Figure 1 for example and diagram of this general system configuration guideline.

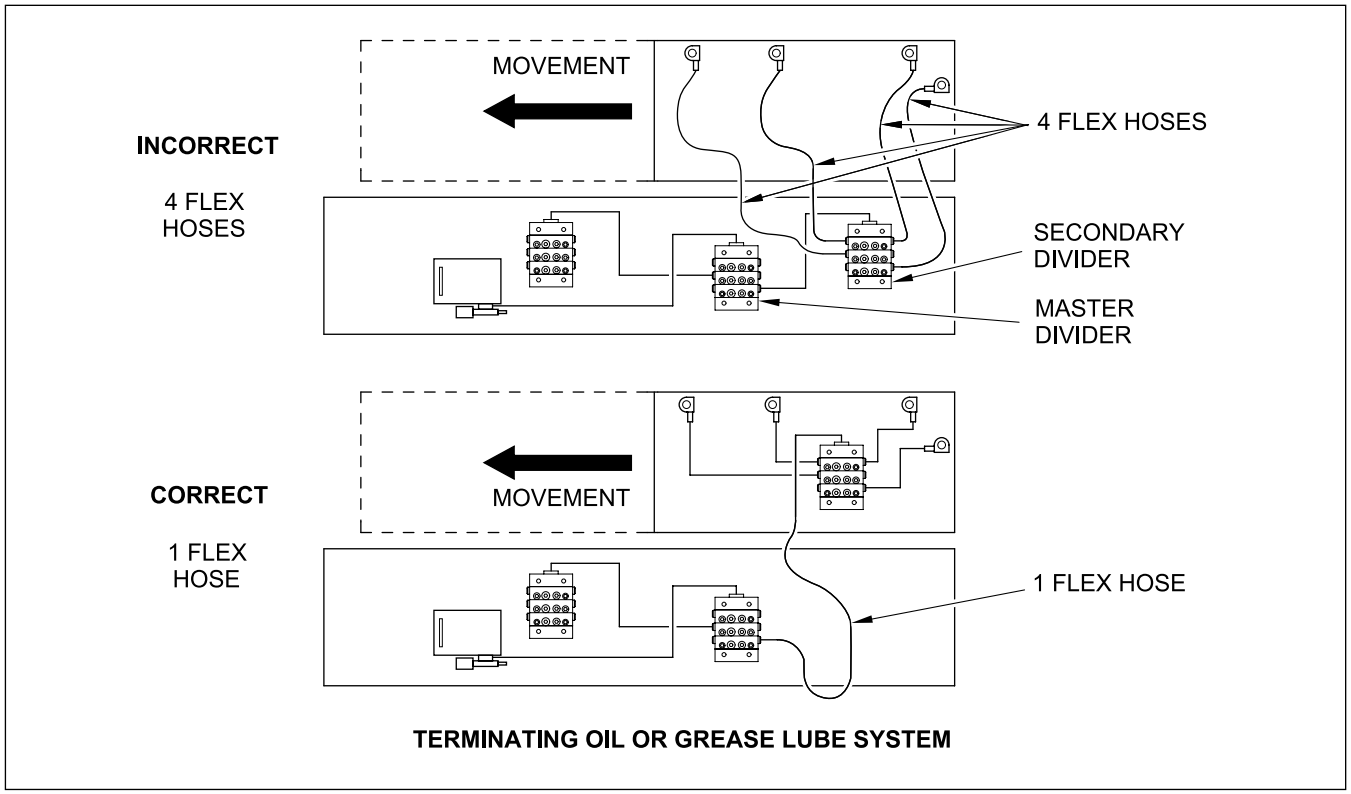


Figure 1

4.2.3 Mounting the Pump: All pump and reservoir package combinations incorporate a method for attaching them to a suitable mounting surface. Considerations for placement of the pump include:

- Mount the pump/reservoir package in a location that allows the reservoir to be easily accessible for observation of its lubricant level and for easy refilling.
- Locate the pump and reservoir in an area that is not subjected to heavy traffic and/or heavy debris or by-products from the machine it is located on.

4.2.4 Mounting Divider Valves: The following recommendations apply when locating and mounting divider valve blocks and should be adhered to as closely as possible to assure that the lubrication system will operate efficiently and accurately:

- The divider valve assembly should be oriented so that the lube inlet port is at the top 12:00 o'clock position in order to make the purging/ bleeding procedures easier and more efficient.
- The divider valve assembly should be oriented so that the spools in the working-valve sections operate parallel to the ground floor. Avoid mounting the divider valves in such a way that they are tilted relative to the ground floor plane or perpendicular to it (see Figure 2).
- Avoid locating the divider valve assembly in locations that restrict access to it. The ports on the front of the divider valves should be accessible for pre-filling and purging procedures (see Figure 3).

The inlet and end sections of each divider valve have two holes each to enable the installer to attach it to an appropriate surface with properly-sized bolts. The valves may be attached directly to one of the machine surfaces if the surface can be drilled and tapped, but the mounting surface should be flat in order to prevent the divider valve from being deformed. Other mounting variations may require the use of a mounting plate interface.

CAUTION: If a weld-in-place mounting plate is being installed, the plate should be welded in place prior to mounting the divider valve assembly in order to prevent damage to the internal O-rings by heat generated during the welding operation.

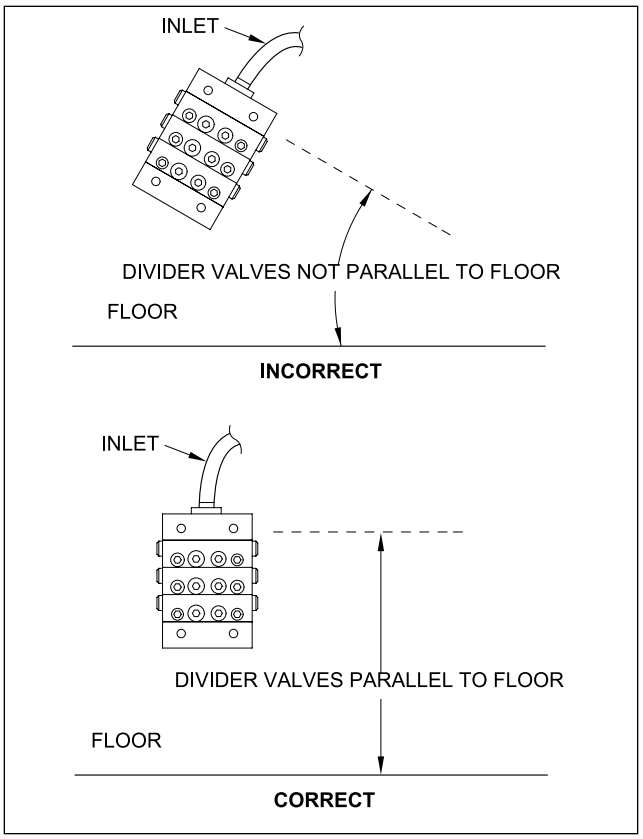


Figure 2

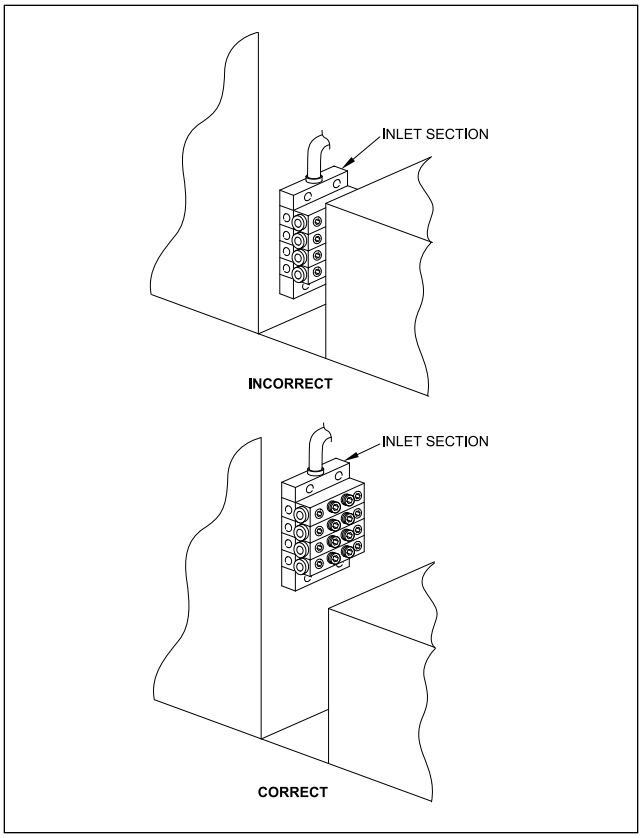


Figure 3

4.2.5 Installing Tubing, Pipes, and Hoses: The basic rule to remember and follow is to keep all lines as short as possible with a minimum number of bends that are consistent with ease of installation and removal. Adhering to this strategy reduces the cumulative pressure drop in any type of system and results in reduced stress upon all of the system components. Some additional related guidelines offered by the manufacturers of the components are:

- Avoid straight short runs of tubing. These require a bend to facilitate removal and to allow it to compensate for the strains generated in a pressurized system. Figures 4, 5, and 6 illustrate some examples of suggested methods of bending tubing to conform to given conditions.
- Keep tubing away from walkways or areas where it could present a safety hazard or be damaged by pedestrian or vehicular traffic (see Figure 7). When installing the tubing, take into consideration how the machine will be operated and serviced.
- Use as many tube clips as necessary to keep tubing securely in place (see Figure 8).
- When installing hose on a moveable component, cycle the component to both extremes of its range of travel. Then use anchor blocks or swivel fittings to ensure that the hose is not crushed or severely bent when the machine is operating (see Figure 9).
- Bend tubing so that it conforms as closely as possible to the contour of the surface or object it is mounted on. Avoid free-standing tubing or hose that might cause interference or be subject to damage due to increased vulnerability (see Figure 10).
- Use a deburring tool to remove all burrs from the bore of all tubing sections that have been cut (see Figure 11).
- Make sure all fittings are properly tightened to recommended torque levels to prevent small leaks or weeping of lubricant.

Several manufacturers of tubing and pipe fittings offer detailed training regarding proper installation practises should additional information be desired or required.

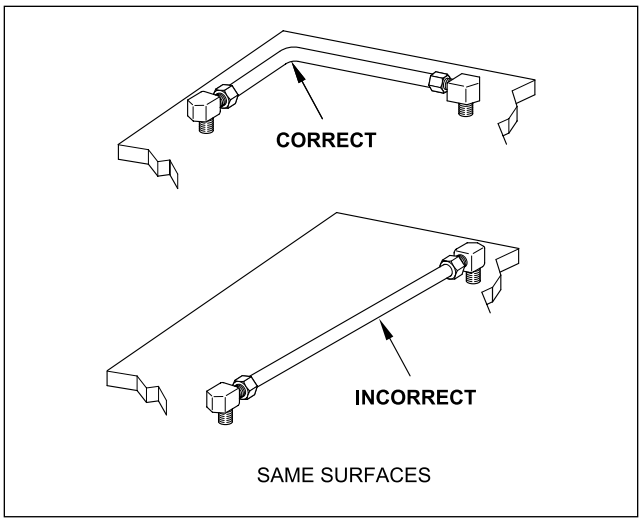


Figure 4

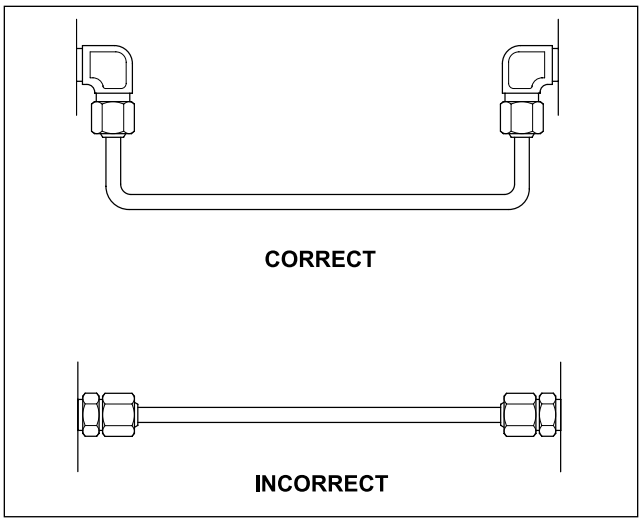


Figure 5

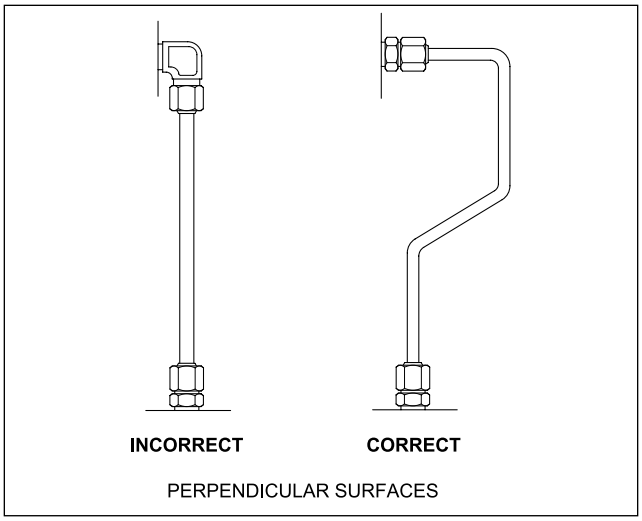


Figure 6

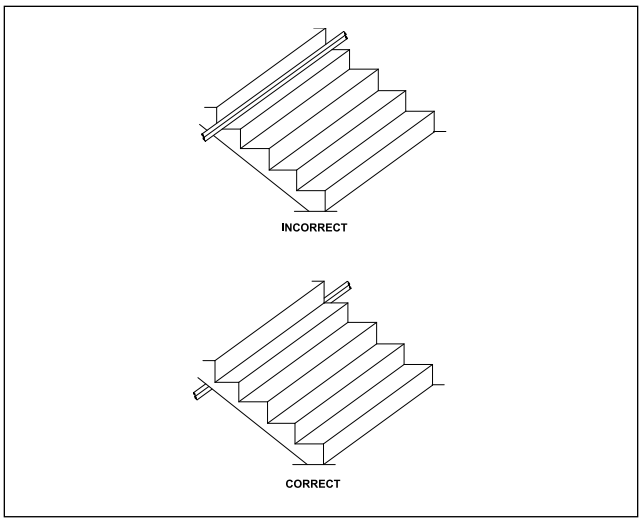


Figure 7

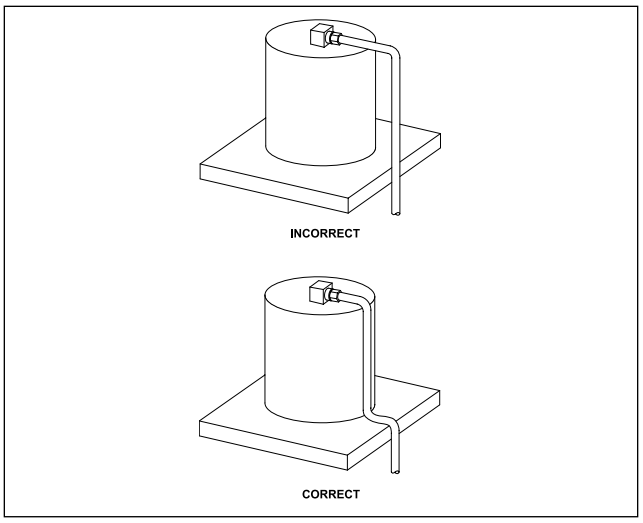


Figure 10

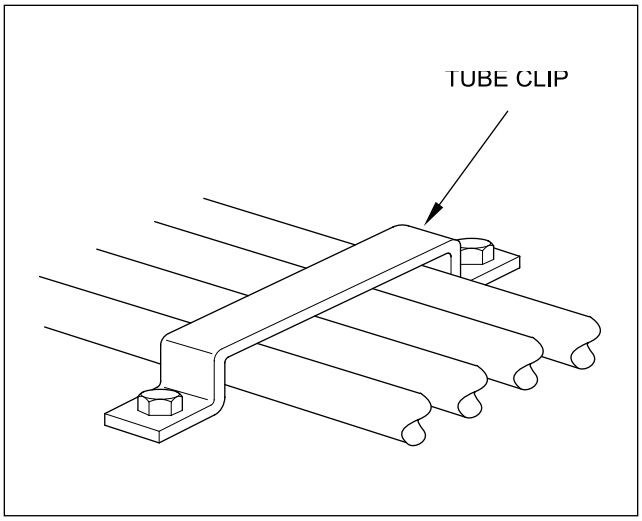


Figure 8

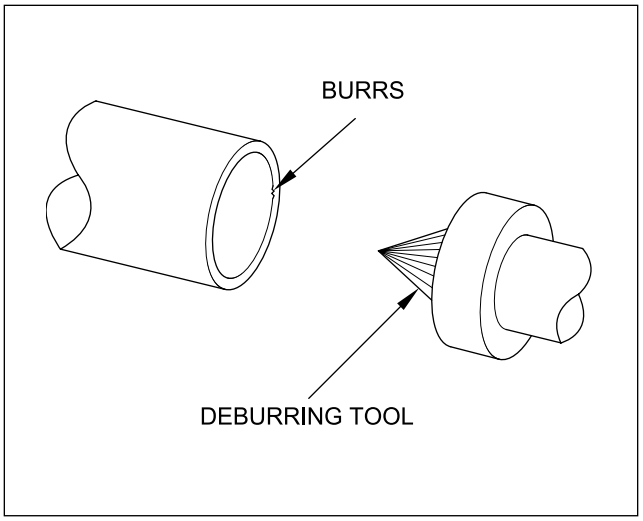


Figure 11

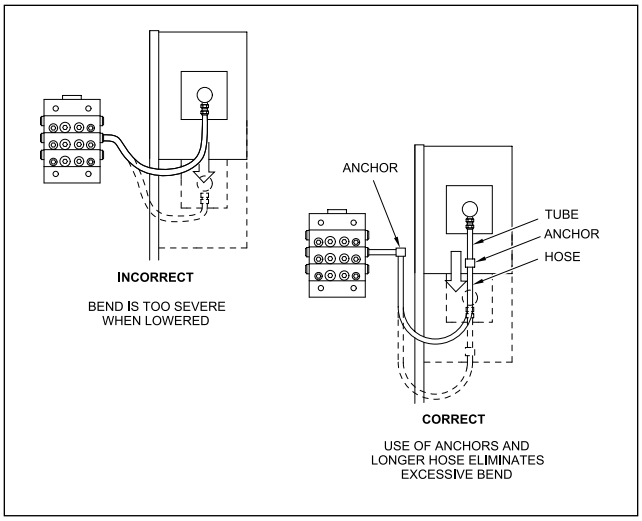


Figure 9

4.3 CLEANING TUBING, PIPE, AND HOSE ASSEMBLIES

When installing any type of fluid system, including lubrication systems, thorough cleaning of tubing and pipes is essential in order to ensure proper functioning and reliable operation. The most critical time in the life of a fluid system is the initial operating period. Any component manufacturing debris or any contaminants added during the installation process that are not cleaned out of the system before the first operating period will be available for transport to other components, bearings, etc. Depending upon the amount and size, the debris that has not been cleaned out of tubing or pipes and any particulate contamination that has not been filtered out of the fluid can potentially cause immediate damage, or else cause future operating problems via cumulative degradation of any components damaged during the first operating period of the system. Therefore, to avoid any partial or complete failure of the equipment when it is placed in operation, conductors and other system components must be thoroughly cleaned and inspected prior to the system installation, assembly, and operation.

There are two recommended procedures for properly cleaning tubing:

- Pickling and Passivating Procedure

This method removes contamination such as corrosion, scale, slag, and weld spatter from pipes or tubing. The pickling process uses an acidic solution that chemically loosens the contaminants. This process should be used after any hot bending, brazing, silver soldering, or welding without anti-slag gas.

NOTE: The pickling process is the preferred method of cleaning pipes and tubing. However, due to the acidic chemicals and detailed procedures required for performing the cleaning operation properly, it is recommended that pickling be performed only by an experienced professional pickling service.

- Component Flushing Procedure

The flushing method is designed for cleaning tubing before its assembly into a system. This procedure is especially recommended for use after brazing tube fittings onto a piece of tubing. The process mechanically loosens contaminants from the inside of the tubing. High-pressure fluid is then applied to flush out the loosened contaminants. This process is described in greater detail in Paragraph 4.3.1

4.3.1 Flushing Procedure for Tubing: This procedure is designed to flush each piece of tubing free of contaminants before it is installed into the system. The procedure consists of the following seven steps:

1. Use a properly-sized stiff stainless steel wire brush to loosen existing contaminants from the tube inside diameter, extending as far as possible into any bends in the tubing (see Figure 12).

2. After loosening the contaminants by brushing from both ends of the tubing, blow out the loose debris with a compressed air gun using clean, filtered air (see Figure 13).

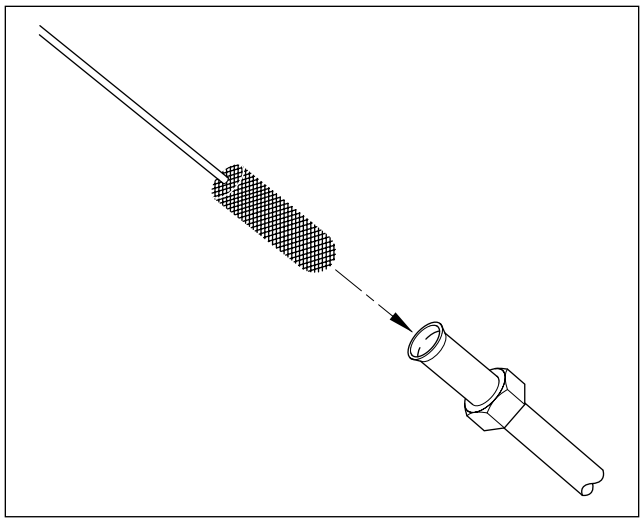


Figure 12

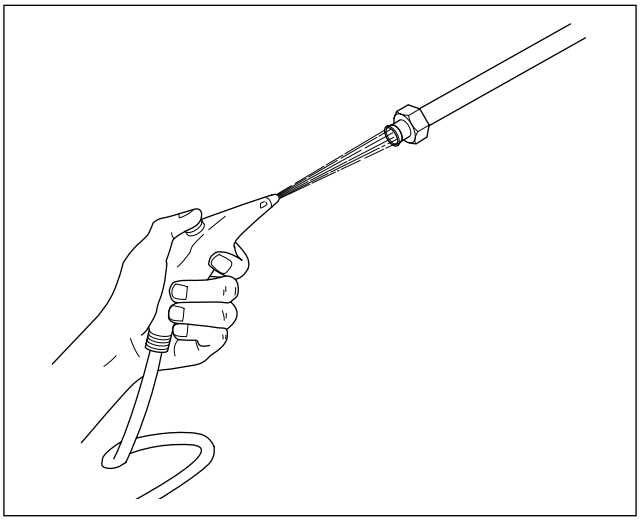


Figure 13

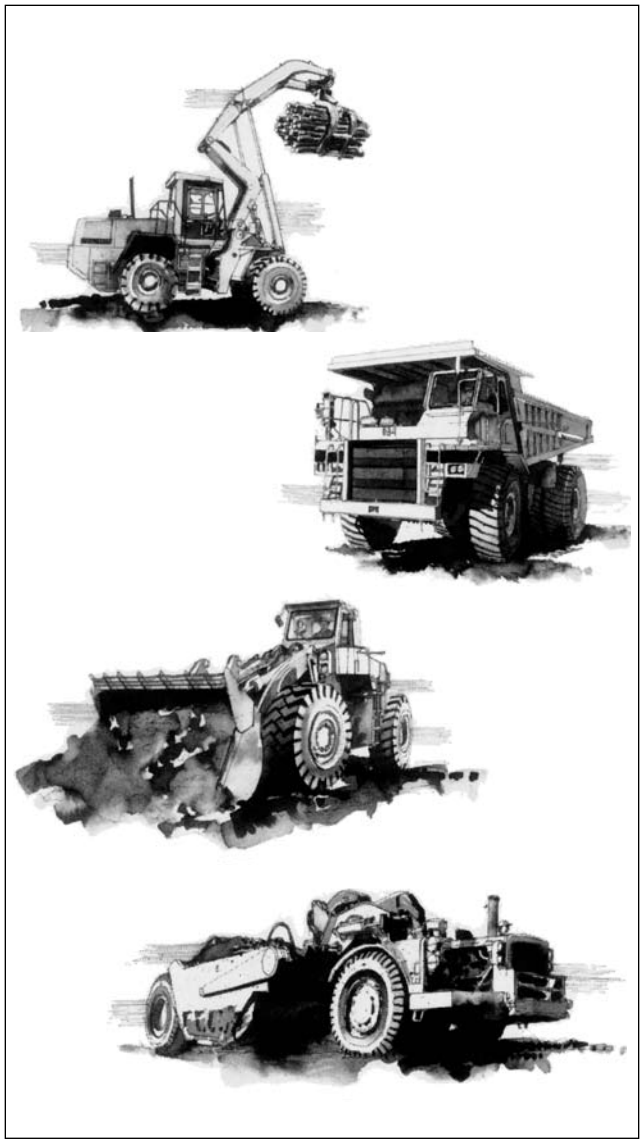
OPERATION AND SERVICE INSTRUCTIONS

SECTION 5
SYSTEM OPERATION

5.1 SYSTEM FUNCTION

5.1.1 Operation of System: Each time the pump is actuated, lubricant is delivered to the system. The Master divider valve or first divider valve in the system divides the lubricant into the amounts required by the secondary divider valve assemblies which in turn serves any number of lubrication points. **The pump develops only the pressure required to lubricate the bearing points.**

Since the system works on a progressive piston displacement basis, every piston must complete its stroke before the next piston can cycle. If any one pistons in the system fails to complete its cycle, pressure will build up and warn the operator of the system malfunction. When high pressure occurs, blockage can be traced by checking the relief to atmosphere indicators located on the master divider valve assembly. A sign of grease exiting the auto relief indicator located on the Master divider valve assembly indicates a malfunction in the outgoing line to the secondary divider or bearing point common with the indicator position.



5.1.2 Tri-Lube HD Pump Operating Instructions

Product Description: The Tri-Lube HD (Heavy Duty) electric motor driven grease pump package is designed to be used in a series progressive lubrication system on construction, mining, or other mobile equipment. The grease supply goes to Master divider valve assembly. Depended on ambient temperature, lubricants up to NLGI grade #1 may be pumped. Pump cartridges may be replaced by the user in the field without removing the Tri-Lube HD unit from its mounting. The Tri-Lube comes equipped with low reservoir level sensing system. On-board electronic circuit controls the ON/OFF cycle time of the pump motor

Installation: The Tri-Lube components are corrosion protected and gasketed where necessary and can withstand exposure to the elements and to periodic equipment wash-down procedures. Do not, however, mount the Tri-Lube HD in a location where it faces the possibility of being submerged in water. The Tri-Lube must be mounted in a vertical orientation against a bulkhead or framework supporting structure. Use (6) 3/8 in. diameter bolts or studs and appropriate washers, nuts, etc. to mount the pump. Assure that the reservoir is supported properly without misalignment or strain to the tie rods. Shims may be required for use on the upper two mounting bolts to achieve this requirement.

Fusing Information: Regardless of the control circuitry employed, the power supplied to the Tri-Lube HD from the main battery supply of the machine being lubricated must come in through a fused circuit. User to supply 2 Ampere AGC style fusing hardware for 24 VDC applications.

Wiring: The Red (+) and Black (-, or ground) wires must be connected to the main battery supply of the machine through a fused circuit as described above. The white wire supplies a signal generated by the Low Level Sensing Circuit. The green wire is unused. Refer to page 1-12 for schematic.

Plumbing: To satisfy large grease supply requirements, two pump cartridge outputs are manifolded together and then routed to the rest of the lubrication system. This approach will shorten pump-running time during each cycle and contribute to extended system life. The addition of a gage to monitor system pressure and system circuit protection for each master assembly output leg in the form of relief valves is standard on this system.

Low Reservoir Level Sensing: A sensor will supply a pulsed low level warning signal through the red wire when the grease level in the reservoir tube drops below the minimum level. This pulsed signal may be connected to an optional external lamp, buzzer, or other signaling device supplied by the end user. Normal pump operation will continue after the low level signal begins. However, if the warning is ignored for too long, the pump will eventually run out of grease entirely and begin pumping air into the system. The low level circuit will automatically reset when the reservoir is filled above the trip point. The signal present at the red wire is a pulsed sourcing type signal equal to the system voltage (24 VDC). Connect the red wire to one side of the signaling device (lamp), and ground the other side of the signaling device.

A. Setting the Timer Module (On Board DIP Switch Controlled Style)

Part No. 563549 (529-860-161) - 24 Volt

There are two banks of 4 miniature switches mounted on the timer. These are known in industry as DIP (Dual In-line Package) Switches. One bank controls the amount of time the pump motor runs (ON TIME); the other controls the amount of time that the motor rests (OFF TIME). Pushing a switch UP turns it on and programs the timer to stay ON (or OFF) for the number of minutes printed on the label above the switch.

Note that one, two, three, or all four switches in either bank may be turned on at the same time. It is in this fashion that the switches “add”, or combine to provide a range of programmable times to control the pump’s operational cycle. In addition, note that the switches may be on in any combination, it is not required that only adjacent switches be on. See page 1-13 for available timer settings. Each time the main power to the Tri-Lube HD pump is turned off, the timer cycle will be interrupted; when the power is reconnected, a timer “On” condition will begin a lube cycle. **WHEN SETTING THE TIMER, BE SURE TO HEED THE MAX. 25% MOTOR DUTY CYCLE NOTE.**

***For the caterpillar 988F, the settings are 15 minutes “Off” and 3 minutes “On”.**

Manual Run Switch: For convenience, a manual run switch is provided on units with on-board timers to assist in system testing and/or purging operations. The pump motor will run whenever the switch is held in either the up or down position. The switch has a spring return to the center off position. Use of this switch allows “jogging” of the pump without removal of the gasketed timer cover.

Filling the Reservoir: Fill reservoir with contaminant free grease through the supplied fitting at the base of the reservoir. Do not attempt to fill from the top. To avoid plugging the vent tube that runs down the back of the reservoir parallel to the tie rods, do not overfill. Maintain at least an inch or more of air space at the top of the reservoir. Upon initial fill, and during subsequent fills if the reservoir is allowed to run totally dry, the entrapment of a slug of air around the pump cartridge(s) can adversely affect the time it takes to prime the pump(s). To avoid this, during these situations, if an air operated “barrel pump” is used to supply grease for refills, slow the delivery rate by backing air pressure to 35 psi max. (turned down from the normal 80 - 85 psi found in most situations).

OPERATION AND
SERVICE INSTRUCTIONS

SECTION 6
TROUBLESHOOTING AND MAINTENANCE

6.1 HOW TO REMOVE AIR FROM SYSTEM

6.1.1 Purging Air From the System: All lubrication Systems attain optimum operational efficiency when any ingested air has been purged from all of the lines and components. Manual air-bleeding procedures are necessary in the event any system components are loosened, disconnected, or removed after their initial installation. Although most lubricating systems are eventually self-purging, the relatively small volume of lubricant dispensed by the metering devices results in a slower rate of lubricant flow, compared to the amounts available from a manual hand pump, and delays the completion of the total system air-purging process. Therefore, manual system air purging becomes a necessity on repaired equipment before machine operation is resumed. The procedures in sections 1, 2 and 3 should be followed in sequences in order to ensure that any air ingested into the lube system during a maintenance procedure is entirely removed.

There are several air purging procedures available for selection and use, the choice of which depends upon the particular maintenance or repair procedure that has preceded it:

- Air purging after replacing a line between a secondary divider valve and a lube point - see Section 1.
- Air purging after replacing a line between the master divider valve and a secondary divider valve - see Section 2.
- Air purging after replacing a line between the pump and a master divider valve - see Section 3.

CAUTION: Use only contaminant free grease of the same type that will be used during normal operation.

- Air purging after adding or replacing any component module in a master divider valve assembly - see Section 4.
- Air purging after adding or replacing any component module in a secondary divider valve assembly - see Section 5.

Section 1

Purging Air From Secondary Divider Valve-to-Lube Point Lines

Refer to Figure 1 when performing this procedure:

Step 1 - Install the line from the secondary divider valve to the lube point, but do not completely tighten the connection at the lube point.

Step 2 - Remove the port plug or the piston enclosure plug in the working valve section on the secondary divider valve assembly corresponding to the outlet port and line connected to the lube point.

Step 3 - Attach a hand pump filled with clean, filtered lubricant to the port on the secondary divider valve that was opened in Step 2.

Step 4 - Operate the hand pump until air-free lubricant is observed flowing from the line at the lubrication point.

Step 5 - Tighten the fitting at the lubrication point while lubricant is still flowing.

Step 6 - Remove the hand pump and reinstall the port plug or piston enclosure plug removed in Step 2 into the secondary divider valve's open port.

The system is now ready for operation.

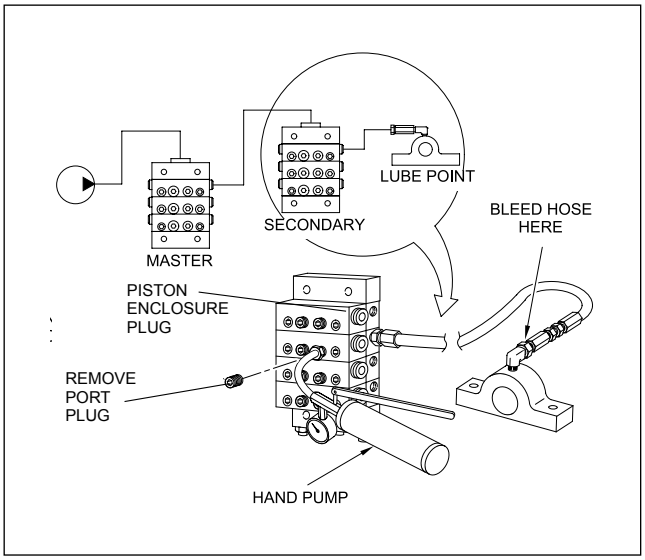


Figure 1

Section 2

Purging Air From Master-to-Secondary Divider Valve Lube Lines

Refer to Figure 2 when performing this procedure:

Step 1 -Install the line from the master divider valve to the secondary divider valve, but do not completely tighten the connection at the secondary divider valve's inlet.

Step 2 - Remove the auto relief valves, port plug or the piston enclosure plug from the working valve section on the master divider valve assembly corresponding to the outlet port and line connected to the secondary valve.

Step 3 - Attach a hand pump to the port on the master divider valve that was opened in Step 2.

Step 4 - Operate the hand pump until air-free lubricant is observed flowing freely from the secondary valve's lube inlet connector.

Step 5 - Tighten the fitting at the secondary valve's inlet while lubricant is still flowing

Step 6 - Remove all of the indicator port plugs from the secondary divider valve's working sections.

Step 7 - Operate the hand pump again until air-free lubricant is observed flowing out all of the secondary divider valve's indicator ports.

Step 8 - Reinstall all of the port plugs in the secondary divider valve while lubricant is still flowing from the ports.

Step 9 -Remove the hand pump and reinstall the auto relief valve or piston enclosure plug removed in Step 2 into the master divider working valve's open port.

The system is now ready for operation.

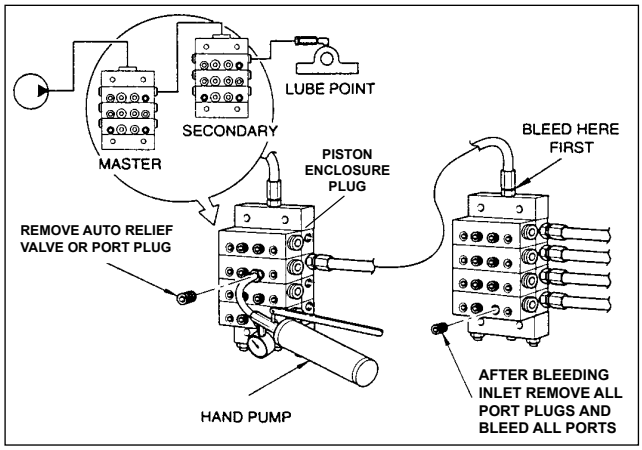


Figure 2

Section 3

Purging Air From Pump-to-Master Divider Valve Lines

Refer to Figure 3 when performing this procedure:

Step 1 - Install the line from the system pump to the master divider valve, but do not completely tighten the connection at the master valve's lube inlet.

Step 2 - Cycle the system pump until air-free lubricant is observed flowing from the line at the master divider valve's lube inlet.

Step 3 - Tighten the fitting at the lube inlet port while lubricant is still flowing.

The system is now ready for operation.

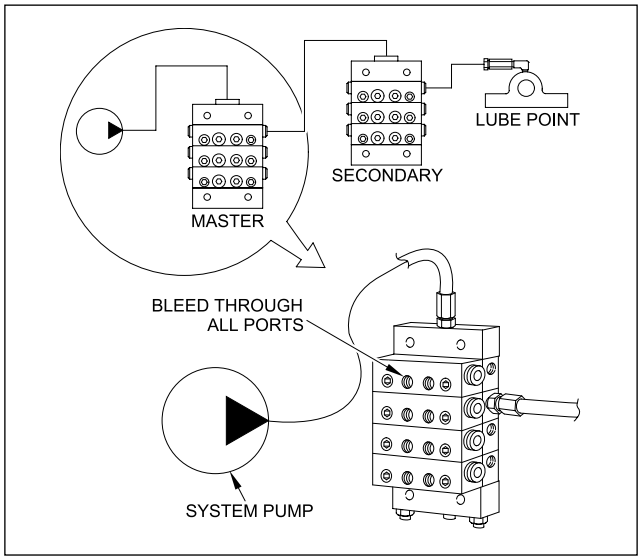


Figure 3

Section 4

Purging Air After Adding or Replacing a Master Divider Valve Module

This procedure should be followed whenever any of the individual modules in a master divider valve assembly are added or replaced or when any of its auto relief valves or port enclosure plugs have been loosened or removed. Refer to Figure 4 when performing this procedure:

Step 1 - Install the new or replacement module into the master divider valve assembly; also connect the tubing or hoses to the appropriate secondary divider valve(s) or lubrication point(s) if the new/replacement module is a base section. However, do not completely tighten the connection(s) at the secondary divider valve's inlet or at the lubrication point(s).

Step 2 - Disconnect and remove the line from the pump at the inlet of the master divider valve.

Step 3 - Attach a hand pump filled with clean, filtered lubricant to the pump inlet port on the master divider valve.

Step 4 - Operate the hand pump until air-free lubricant is observed flowing from each secondary valve's lube inlet connector and/or each lubrication point's connector.

Step 5 - Tighten the fitting at the secondary valve inlet or at the lubrication point while lubricant is still flowing.

Step 6 - Remove the hand pump and reconnect the system pump to the inlet of the master divider valve.

The system is now ready for operation.

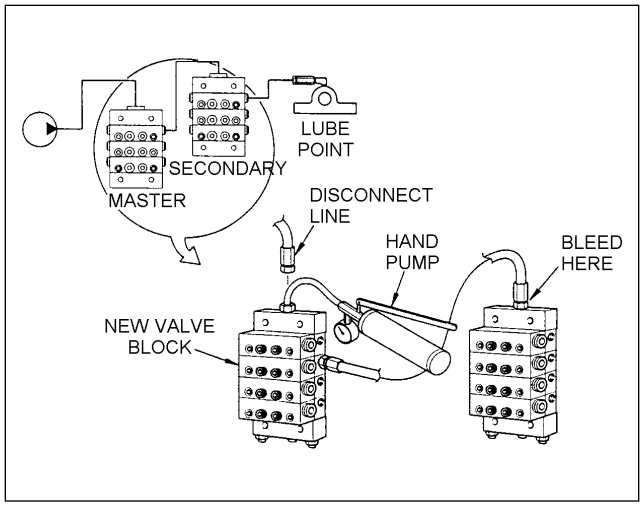


Figure 4

Section 5

Purging Air After Adding rr Replacing a Secondary Divider Valve Module

This procedure should be followed whenever any of the individual modules in a secondary divider valve assembly are added or replaced or when any of its port enclosure plugs have been loosened or removed~ Refer to Figure 5 when performing this procedure:

Step 1 - Install the new or replacement module into the secondary divider valve assembly; also, connect the tubing or hoses to the appropriate lubrication point if the new/replacement module is a base section. However, do not completely tighten the connection at the lubrication point.

Step 2 - Remove the auto relief valve, port plug or piston enclosure plug from the working valve section on the secondary divider valve assembly corresponding to the outlet port and line connected to a particular lube point~

Step 3 - Attach a hand pump filled with clean, filtered lubricant to the port on the secondary divider valve that was opened in Step 2.

Step 4 - Operate the hand pump until air-free lubricant is observed flowing from the loosened connector at the lube point.

Step 5 - Tighten the fitting at the lube point while lubricant is still flowing.

Step 6 - Repeat Steps 2, 3, 4, and 5 for any additional lubrication points connected to the new module.

Step 7 - Remove the hand pump and reinstall the auto relief valve or port plug removed in Step 2 into the secondary divider valve's open port.

The system is now ready for operation.

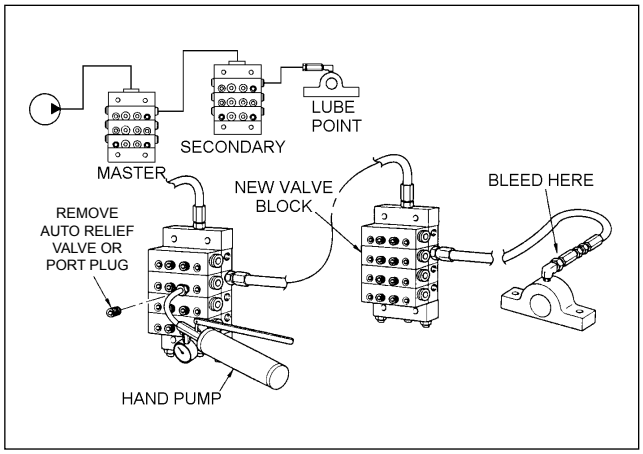


Figure 5

6.2 HOW TO LOCATE BLOCKAGE

6.2.1 **Description:** In a Trabon Series-Flo System®, free flow of lubricant from the pump through the transmission system and the bearings is necessary. If any portion of this transmission system (a divider valve, line fitting or any bearing) does not freely accept and pass its portion of the lubricant a blockage has occurred. This blockage will cause a higher than normal pumping pressure to be developed by the pump. Depending on the application or system design, this blockage with its resultant high pump pressure will usually cause a complete loss of lubricant flow into the total system and no bearing will be receiving lubricant.

The loss of flow due to a blockage is first indicated with the higher than normal system pressure that is developed by the pump as it attempts to overcome this blockage. This abnormally higher pressure that is a result of a blockage is limited, isolated, and signalled through the use of auto relief to atmosphere valves incorporated into the "master" divider valve assembly.

Divider Valve - A Series-Flo® type divider valve is a manifolded proportioning device consisting of an inlet and end section plus a minimum of three intermediate sections. The divider valve is manifolded together with tie rods and nuts. A master divider valve is the first divider valve downstream from the lube pump. A secondary divider valve is any divider valve receiving lubricant from the master divider valve.

Intermediate Sections - Intermediate sections (three or more required per manifold) contain a piston specially fitted to that section, built in outlet check valves and various passageways that, working with the piston, meters and valves the flow of lubricant. See Figure B. Intermediate sections may be manufactured to require one (1) or two (2) lube outlets. Stamping located on the face of each section will indicate (1) the style of divider valve section (MSP), (2) the discharge per piston stroke expressed in thousandths of cubic inches (35 = .035 in^3) and (3) the number of lube outlets required (S = single, one outlet only; T = twin, two lube outlets required). See Figure A.

WARNING: Never block a lube outlet that is designed to discharge lubricant.

Automatic Relief Valve - These pinpoint lube line blockage but allow the lube system to continue to supply lubrication to points that are not blocked. (They can be used in secondary divider valves.) The excessive pressure created by line blockage moves a piston, enabling the lubricant to escape through a vent. When the pressure is relieved, the spring resets the piston. Because these devices permit the lube system to keep operating when a lube point is blocked, an optional separate pressure switch connected to an audible or visual alarm could be used to warn of high pressure.

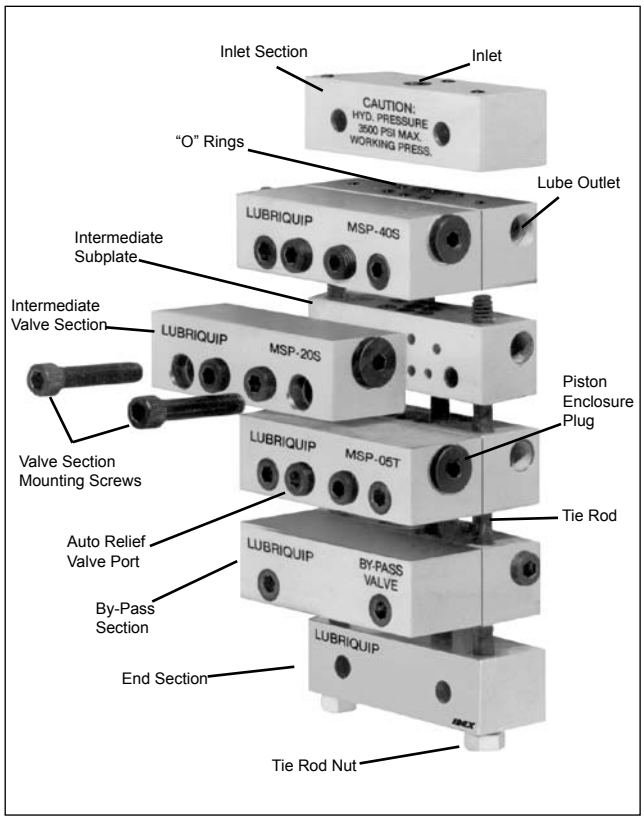


Figure A. Components of the MSP Divider Valve

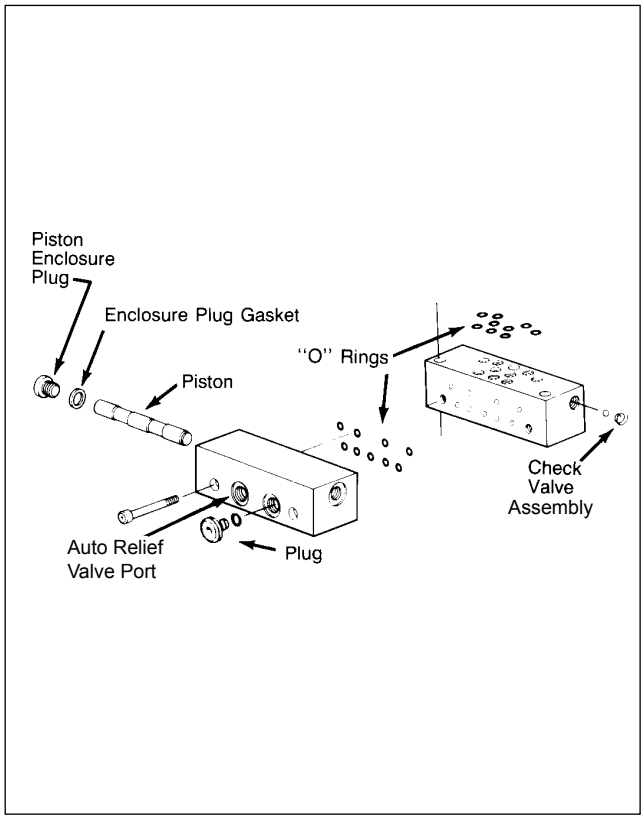


Figure B. Intermediate Valve and Subplate Section

6.2.2 Locating Blockage

If a blockage exists it is caused by one of the following reasons:

1. Crushed transmission line in the System.
2. Blocked bearing in the system.
3. Improperly drilled fitting in the system.
4. Blocked divider valve in the system.

All servicing and disassembling should be carried out under the cleanness conditions possible. A blockage will be centrally signalled by a pressure gauge, optional pressure switch, or by the pump relief to atmosphere valve, exhausting lubricant. Before proceeding as outlined, make a visual inspection of the system and check for crushed lines or improper divider valve installation. Verify that each divider valve outlet required to discharge lubricant can do so and that no pipe plugs have been installed in an outlet designed to serve a bearing or another divider valve.

Use only contaminant free grease of the same type that will be used during normal operation.

NOTE: Dirt and foreign material are the worst enemies of any lubricating system.

Procedure -

Step 1 - Use a manual pump with a gauge as shown in figure C. Fill the pump with clean, filtered lubricant common to the system. Connect the manual pump into the inlet of the master divider valve and slowly operate pump. If system will not cycle freely below 1,500 PSI at 70^0F, see Step 2.

Step 2 - 2-1. Master Divider Valve Equipped With Auto Relief to Atmosphere Valves: With manual pump connected to the master divider valve as outlined in Step 1, raise pressure to 2,600 PSI, the auto relief valves will signal the location of the blockage. Grease exiting auto relief indicates pressure is in that outgoing line and signals the blockage is in the area being served from this outlet, as shown in figure D. See Step 3.

If no grease exits the auto relief, the blockage is in the master divider valve.

Step 3 - Testing accomplished in Step 2 has indicated the blockage is downstream of the master divider valve. Install the manual pump in the indicator Port of the master divider valve that is common to this blocked area. See Figure D. Proceed to downstream secondary divider valve and remove all indicator port plugs.

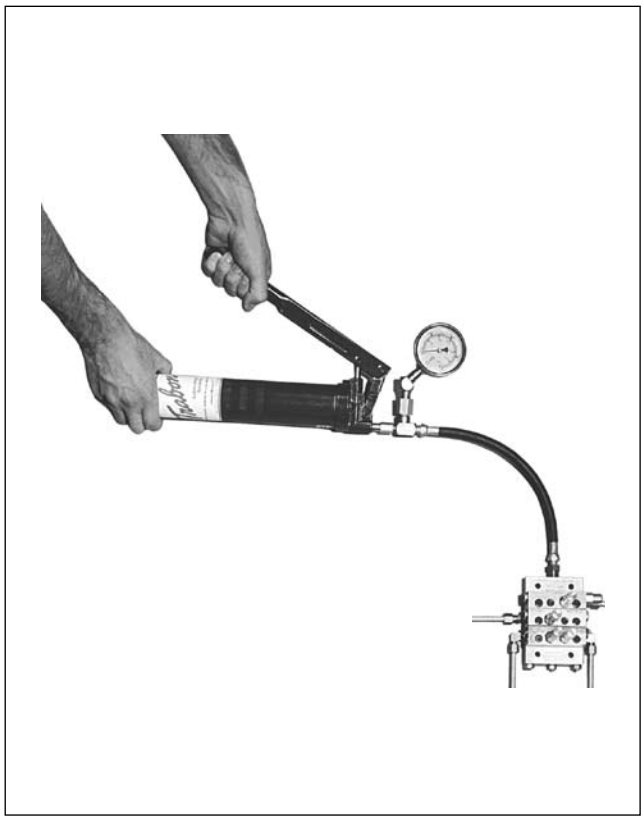


Figure C

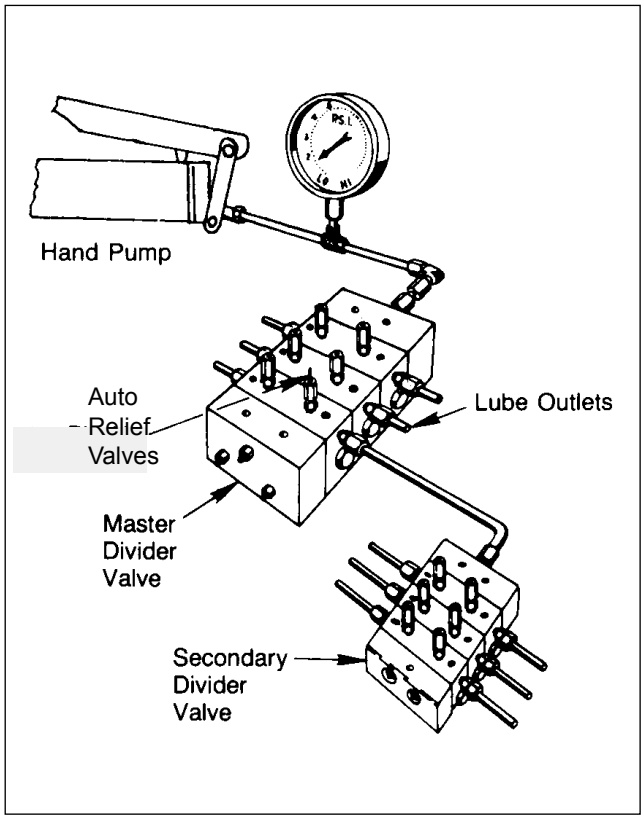


Figure D

Slowly operate manual pump. If lubricant can be discharged freely through each of the indicator ports of this divider valve the blockage is not in the supply line or the divider valve, see Step 4. If lubricant is not freely discharged through the open indicator ports of the secondary divider valve the blockage is in this divider valve or its supply line. Disconnect supply line at secondary inlet fitting and slowly operate manual pump to verify location. If blockage is in divider valve see Step 5.

Step 4 - Install manual pump into each indicator port of secondary divider valve in turn, and slowly operate pump. See Figure E. If high pressure exists blockage has been located. Look for crushed line, tight bearing, improperly drilled fittings and/or lube inlet port. Correct as necessary.

Step 5 - When testing indicates a blockage has occurred in any divider valve, that divider valve must be disassembled and cleaned.

NOTE: Dirt and foreign material are the worst enemies of any lubricating equipment. All servicing and disassembling should be carried out under the cleanness possible conditions.

Before disassembling any divider valve make a sketch and note as to the arrangement of the intermediate sections. For example: INLET 10T-20S-10T-30S END. See Figure F. Also remove end plugs only and try to move each piston back and forth without removing the piston from the intermediate section.

CAUTION: Do not insert hard metal objects into piston bore (i.e., punches, screwdrivers, etc.) use a brass rod and hand pressure only.

If all pistons are movable and there is no indication of a more serious problem, replace end plugs and using a new o-ring apply the correct torque, see Torque Table. Retest this divider valve using the manual pump. If a piston is jammed, or a hard wax-like substance, or dirt is noted at the end of the piston chamber, proceed with disassembly. The divider valve can be dismantled by removing the tie rod nuts. With the individual sections on the bench remove the end plug from both ends of the section. Taking one section at a time remove the piston, if it appears to be jammed, try removing it from the other direction. With badly jammed pistons it may be necessary to use a brass rod and lightly tap piston out.

Clean sections and pistons in a suitable clean solvent until all lubricant has been removed. Use compressed air to dry and blow out all ports thoroughly. A small wire probe should be used to make sure all passages are clean and open. Inspect the cylinder bore and

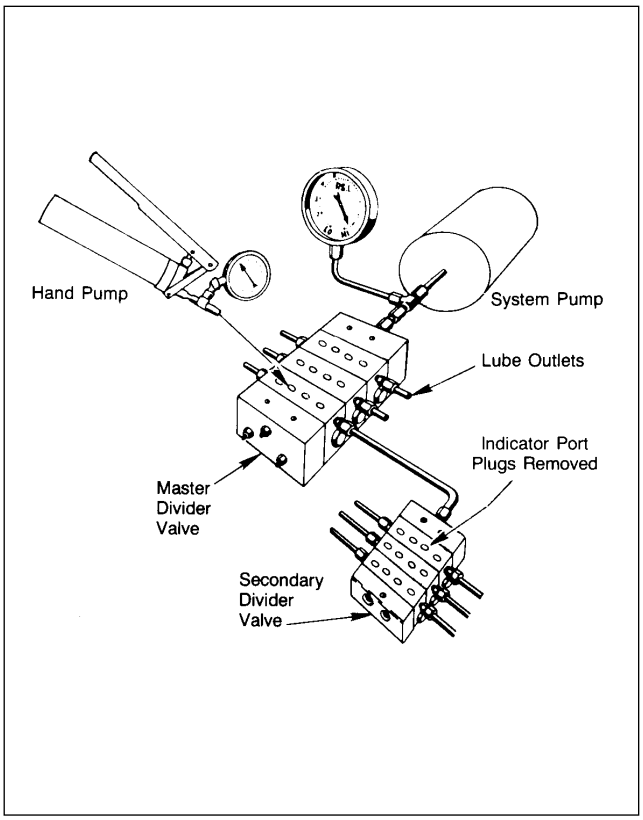


Figure E

piston carefully for scratches, score marks or other damage.

NOTE: If either piston or cylinder bore is damaged a new section must be installed. All pistons are selectively fitted to the bore for proper clearance. Care must be taken to install piston only into the intermediate section from which it was removed.

If divider valve section and piston both appear in good condition, reassemble section making certain that piston slides smoothly but snugly in cylinder bore. Repeat cleaning and inspection of each section. After all sections have been cleaned, blown out, inspected and found to be in good condition, reassemble divider valve as indicated by the notes and sketches.

CAUTION: Use all new o-ring, and correct torque ratings listed below. Test operation of divider valve using manual pump.

ASSEMBLY TORQUE (FT LBS)	
	MSP
Tie Rod Nuts	5-8
Indicator Plugs	8-9
End Plugs	12-15
Valve Section Mounting Screw	8-9
Pipe Plugs	8-9

6.2.3 **Contamination Blockage:** If dirt, foreign material or any other form of contamination is found in a divider valve, cleaning that divider valve will only temporarily solve contamination blockage problems. The source of the contamination must be eliminated for satisfactory service. The system filtering method must be investigated, filter elements should be inspected or changed as required. The reservoir must be inspected and cleaned if necessary. The reservoir filling method should be reviewed to eliminate any chance of foreign material entering the reservoir during filling. All lubricating systems require filtered lubricant.

6.2.4 **Separation Blockage:** If a hard wax or soap like material is found in the intermediate section grease separation is occurring. This means that the oil is being squeezed from the grease at normal system operating pressure and the grease thickener is being deposited in the divider valve. Cleaning the divider valve will usually result in only temporarily solving the problem. Consult your lubricant supplier for recommendations on alternate lubricants and your local Trabon Distributor to verify compatibility with centralized lubricating Systems.

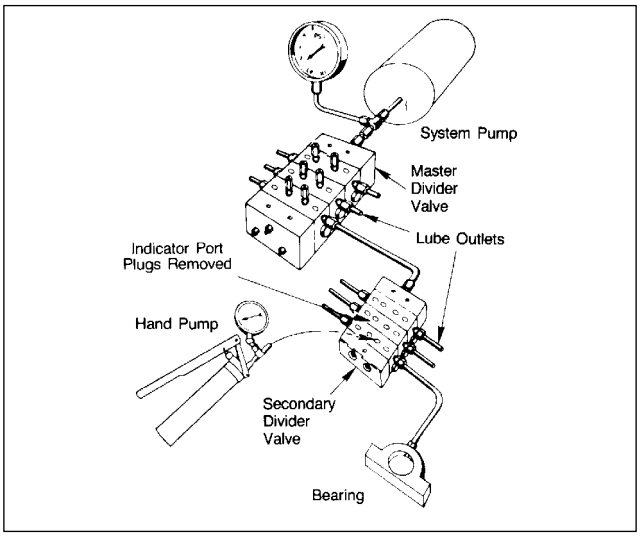


Figure F

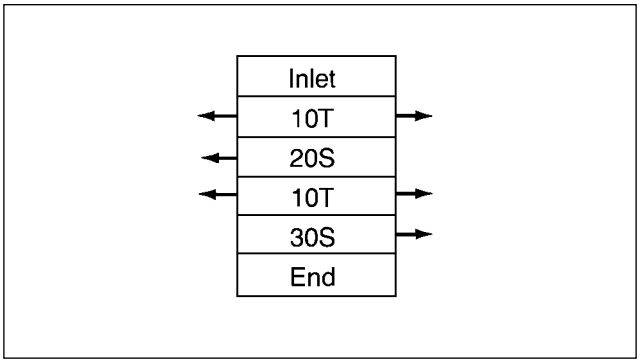


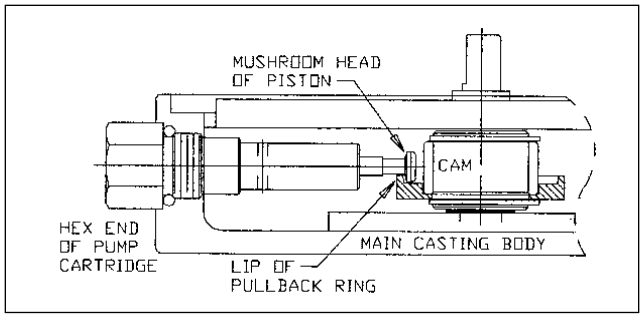
Figure G

6.3 HOW TO REPLACE A PUMP CARTRIDGE

6.3.1 Replacing Pump Cartridges: Replacing piston pump cartridge units is an easy, straight forward task that can be performed in the field without disturbing the mounting of the main unit. However, due to an internal design feature that assures proper piston actuation, there is definitely a right and wrong way to perform this task. Read and understand the process before beginning.

To avoid severe internal damage to the driveline or to the new cartridge, these procedures must be followed carefully.

The drawings will help clarify the procedure. Shown below is the relationship of the components in their normal position. Note that the lip of the pullback ring captures the head of the piston.



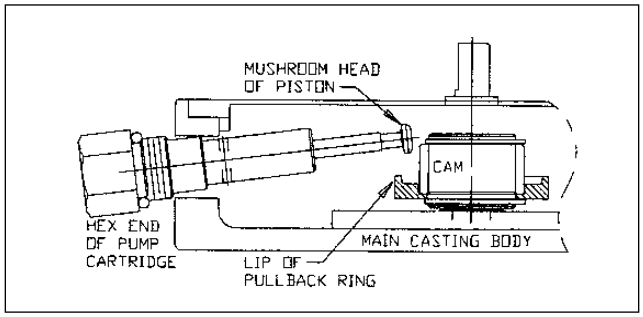
6.3.2 Cartridge Removal

1. Remove external plumbing, gages, tees, tubing, etc. from the cartridge in question.

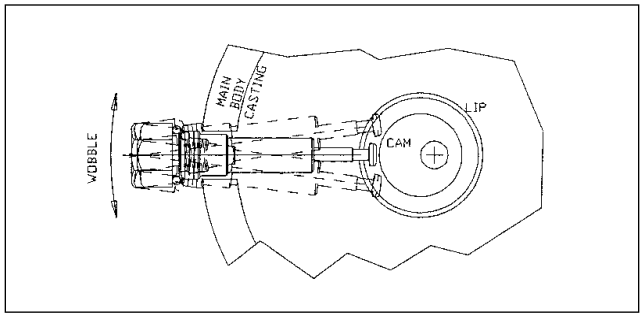
2. Unscrew the cartridge hex end from the pump body just until the threads disengage. After initially "breaking" the joint with a wrench, unscrewing with finger pressure is the best way to find the point of thread disengagement.

3. Pull the cartridge straight out about 1/8 in. to 3/8 in. The piston will be extending but will still be captured.

4. Push the hex end of the cartridge down about 15º as shown. This will disengage the "mushroom button end" on the end of the piston from the lip on the pullback ring mechanism.



5. This step will allow the cartridge and the piston to be removed as one unit and is most important. If not performed the piston will stick in the grease when the cartridge is removed and create a problem. Wobble the hex end of the cartridge back and forth from side to side and up and down a number of times. The reason for this is to free the grease that was packed next to the sides of the cartridge and to create a channel in the grease inside the body chamber through which the piston can freely pass.



6. Remove the cartridge by pulling it back free of the main body casing. Check to see that the piston is sticking out from the end of the cartridge. No piston? Retrieve the piston from the main body casting by using a flashlight, magnet, pencil, tweezers, or whatever it takes. **Do not leave a "lost" piston loose inside the main body casting. Severe damage may result the next time the motor is started.**

6.3.3 Cartridge Insertion: The design of the drive cam mechanism of the Tri-Lube provides positive piston actuation and a mechanical timing function required to assure proper filling of the pump cartridge under widely varying conditions. Due to the nature of this design,

Damage to the unit is certain if the cartridge is inserted "straight in" without following the procedure. The mushroom button end of the piston must be in the proper position with respect to the lip on the pullback ring.

1. If adding a second or third cartridge to an existing unit, remove the threaded plug with a hex allen wrench.

2. Using a screwdriver or a pencil or other implement, reach through the threaded hole in the main casting body and remove an amount of grease approximately equal in size to a couple of golf balls. The idea is to create a clear channel that reaches through the grease up to the surface of the cam. Ideally, this clear area should extend from the lip area of the pullback ring upward above the cam. When the cartridge is inserted, this clear area will allow the piston to stay in the

position described below. If possible, look into the hole with the aid of a flashlight to check for a reasonably clear path.

3. Partially or completely remove the piston from the cartridge and coat it with grease. This coating will provide some friction and prevent the piston from slipping out of the position set in the next step.

4. Re-insert the piston and let the end extend approximately 1-5/8 in. from the end of the cartridge.

5. Insert the cartridge assembly into the pump body at a slight upward angel (approx. 15 degrees) until the threads on the cartridge meet up with the threads on the main body casting. Depending on the position of the cam, you should feel some very slight resistance when (if) the tip of the piston mushroom touches the cam. As you continue to push the cartridge in, the piston will slide further back into the bore of the cartridge. The distance through which this sliding action occurs will vary with the position of cam.

6. Tip the piston end of the cartridge assembly down (rock the hex end up with your fingers) until it is level. The centerline axis of the cartridge should now be aligned with the axis of the threads in the main casting body. The mushroom button end of the piston should now be up over (captured by) the lip of the pullback ring.

7. To verify proper positioning, (the “capture”), pull the cartridge straight back out from the casting body slowly about 1/4 in. to 3/8 in.. You should feel some slight resistance as the mushroom head catches on the lip and begins to pull the piston out of the cartridge bore. Do no tip the cartridge during this step. If you are not sure that you feel this resistance, remove the cartridge and go back to step 4.

8. Push the cartridge back in and engage the threads; screw the cartridge in all the way and tighten snugly with wrench. (approx 5-10 ft.lb)

6.4 HIGH PRESSURE STRAINER REPLACEMENT

Strainer Change-Out Procedure

1. Turn keyswitch to off position

2. Remove the drain plug (7) from housing (6) to relieve any trapped pressure.

3. Unscrew housing (6) from housing bowl (1).

4. Pull the 60 mesh screen (4) straight out of the housing bowl.

5. Remove the screen support (3) pushing in on it’s locating stud.

6. Clean all parts with a compatible solvent.

7. Insert screen support (3) into 60 mesh screen (4) so the locating stud fits through the small opening in screen.

8. Carefully install the screen (4) and support (3) into housing bowl (1).

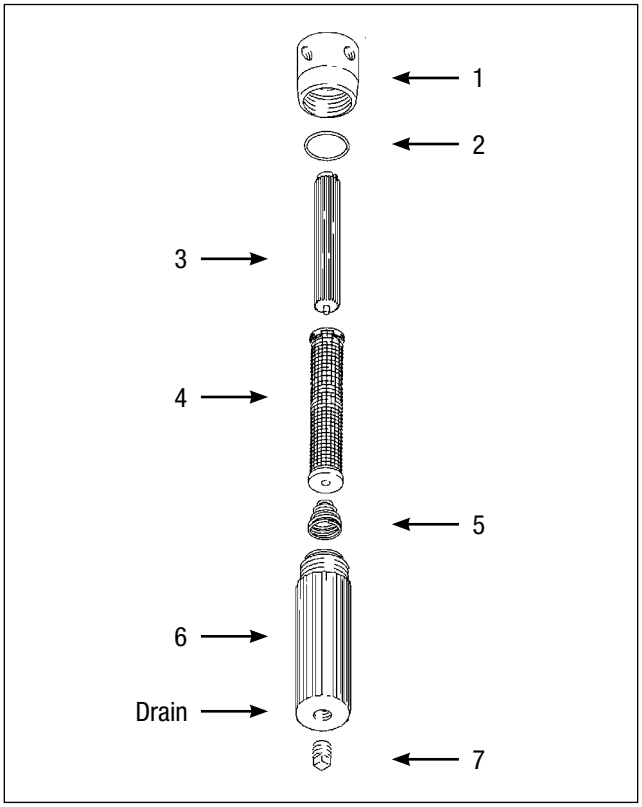
9. Lubricate o-ring (2) with contaminant free grease. Squeeze on 2 sides of the o-ring as it is pushed into o-ring groove.

10. Lubricate housing (6) threads and screw it into housing.

11. Clean, then apply PTFE tape to drain plug (7) threads. Screw drain plug into housing (6).

CAUTION: Never use 1,1,1-trichloroethane, methylene chloride, other halogenated hydrocarbon solvents or materials containing such solvents. Such use could result in a serious chemical reaction, with the possibility of explosion, which could cause death, serious bodily injury and/or substantial property damage.

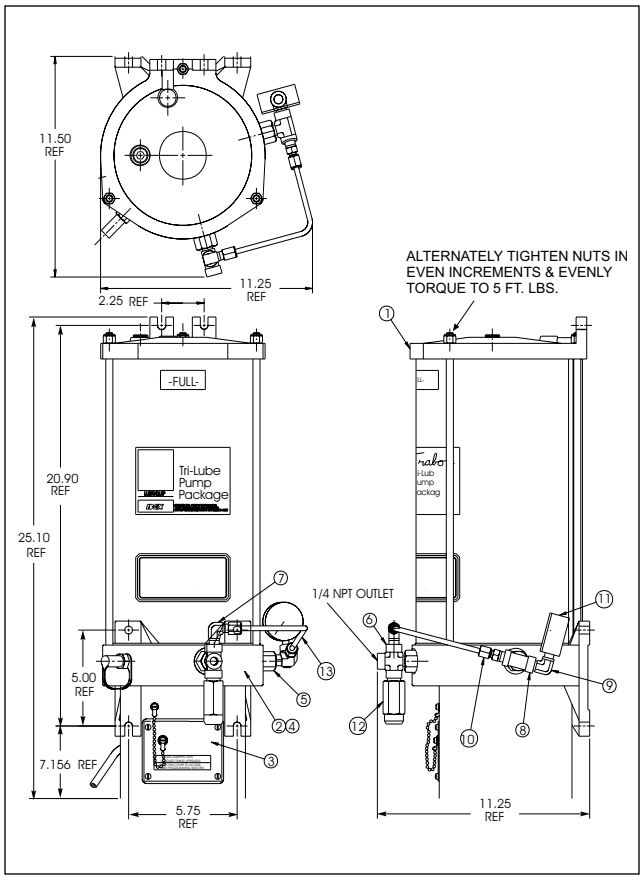
Consult **your** material suppliers to ensure that the materials being used are compatible with aluminum and zinc parts.



OPERATION AND SERVICE INSTRUCTIONS

SECTION 7
SPARE PARTS

7.1 SYSTEM PUMP
563531 (529-800-306)



ORDERING INFORMATION				
Item	**Qty**	**Description**	**Part No.**	**Old Part No.**
1	1	Reservoir Assembly 20#	–	529-840-001
2	1	Pump Drive Motor Assembly, 24 VDC	563536	529-820-060
3	1	Timer Kit, 24 VDC	557794	529-865-000
4	1	Low-Level Scraper Kit	–	529-860-121
5	2	Pump Cartridge Assembly	563537	529-825-010
6	1	Cross Male Branch 1/4 in. Pipe	556421	412-390-020
7	1	Elbow, 1/4T x 1/4PM	556631	435-130-050
8	1	Tee Male Branch 1/4in. Pipe	556407	412-180-020
9	1	Elbow, Street, 1/4PM	556412	412-270-030
10	1	Connector, 1/4T x 1/4PM	556628	435-090-050
11	1	Gauge, 1/4 in. Pipe, 0-5,000 psi	557352	503-557-001
12	1	Press Relief Valve, 3,000 psi	563161	508-210-300
13	2	Tubing, 1/4 in. OD x 0.035 W SS 304	556272	400-125-000

7.2 SYSTEM PARTS

7.2.1 PUMPS

Description	Part No.	Old Part No.
Pump Cartridges	563538	529-825-026
0-5,000 psi Gauge	557352	503-557-001
Reservoir Gasket Seal	556719	439-060-185
Relief-to-Atmosphere Valve	563161	508-210-300
24 VDC Timer	557794	529-865-000

7.2.2 HIGH PRESSURE STRAINER

Description	Part No.	Old Part No.
60 Mesh Strainers, 3 Pack	–	527-101-258
Housing O-Ring	–	527-101-259
Strainer Support	–	527-101-260
Strainer Spring	–	527-101-261

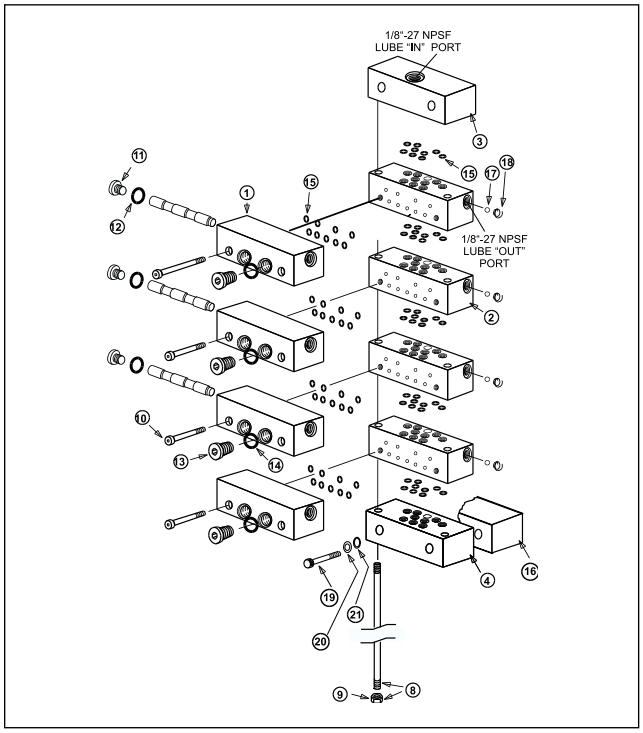
7.2.3 DIVIDER VALVE ACCESSORIES

Description	Part No.	Old Part No.
Relief-to-Atmosphere Valve	563175	508-310-465
1/8 in. NPT Pipe Plugs	557349	503-485-000

7.3 DIVIDER VALVE COMPONENT DETAILS

SPECIFYING GUIDE - MSP DIVIDER VALVE

Component Identification and Ordering Information
Zinc plated carbon steel



List Key	Size	Description	Buna-N Seal Part No.	Buna-N Seal Old Part No.
1		Valve Sections		
	5T	.005 Twin Outlet	562720	106-100-175
	5S	.005 Single Outlet	562711	106-100-015
	10T	.010 Twin Outlet	562721	106-100-185
	10S	.010 Single Outlet	562712	106-100-025
	15T	.015 Twin Outlet	562722	106-100-195
	15S	.015 Single Outlet	562713	106-100-035
	20T	.020 Twin Outlet	562723	106-100-205
	20S	.020 Single Outlet	562714	106-100-045
	25T	.025 Twin Outlet	562724	106-100-215
	25S	.025 Single Outlet	562715	106-100-055
	30T	.030 Twin Outlet	562725	106-100-225
	30S	.030 Single Outlet	562716	106-100-065
	35T	.035 Twin Outlet	562726	106-100-235
	35S	.035 Single Outlet	562717	106-100-075
	40T	.040 Twin Outlet	562727	106-100-245
	40S	.040 Single Outlet	562718	106-100-085

List Key	Description	Part No.	Old Part No.
2	Subplate, 1/8-27 NPSF	563419	527-000-311
3	Inlet, 1/4-18 NPSF	560919	527-001-800
4	End Section	563428	527-001-900
8	Tie Rod and Nut Assembly		
	• 3 Section	557731	527-001-930
	• 4 Section	557732	527-001-940
	• 5 Section	557733	527-001-950
	• 6 Section	557734	527-001-960
	• 7 Section	557735	527-001-970
	• 8 Section	557736	527-001-980
9	Tie Rod Nut Only	556371	410-440-010
10	Valve Block Mounting Screws	556513	419-140-070
11	Piston Enclosure Plug	557716	527-000-232
12	Piston Enclosure O-Ring	556568	422-210-040
13	Indicator Port Plug	557776	527-300-840
14	Indicator Port Plug O-Ring	556567	422-210-030
15	MSP Buna-N O-Ring	556540	422-010-060
16	Assembly Mounting Block	560920	527-002-260
17	Outlet Check Ball	556327	401-030-020
18	Outlet Check Spring	557737	527-001-910
19	Assembly Mounting Bolt	–	415-001-090
20	Lock Washer	558675	421-010-010
21	Flat Washer	556525	421-700-894

7.4 SPARE PARTS

Qty	Description	Part No.	Old Part No.
1	Pump Cartridge	563538	529-825-026
2	Reservoir Gasket Seals	556719	439-060-185
1	Relief-to-Atmosphere Valve (Pump Relief)	553161	508-210-300
1	60 Mesh Strainer Elements, 3 Pack	–	527-101-258
1	Housing O-Ring	–	527-101-259
2	Relief-to-Atmosphere Valve (Master Relief)	563175	508-310-465
1	5S Single Outlet	562711	106-100-015
1	10T Twin Outlet	562721	106-100-185
1	10S Single Outlet	562712	106-100-025
1	15S Single Outlet	562713	106-100-035
1	20B Twin Outlet w/Indicator	562739	106-100-935
1	25S Single Outlet	562715	106-100-055
1	30T Twin Outlet	562725	106-100-225
1	30S Single Outlet	562716	106-100-065
1	35T Twin Outlet	562726	106-100-235
1	40T Twin Outlet	562727	106-100-245
1	Inlet Block	560919	527-001-800
1	Subplate Block	563419	527-000-311
5	1/8 in. NPT Pipe Plugs	557349	503-485-000

OPERATION AND SERVICE INSTRUCTIONS

SECTION 8
OPTIONAL EQUIPMENT

8.1 AUTOMATIC RELIEF-TO-ATMOSPHERE VALVE

Installed in indicator ports on the working piston sections, they quickly identify the affected lines.

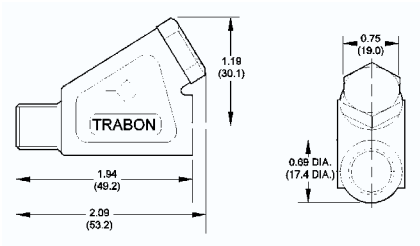
The spring-loaded piston unseats when blockage occurs, venting lubricant to atmosphere each time piston cycles. This allows system to lubricate unaffected points. When the blockage is cleared, the valve reseats automatically.

Description	Part No.	Old Part No.
Relief Pressure, 2,500 psi (172 bar)	563175	508-310-465

8.2 RESERVOIR FILL STRAINER

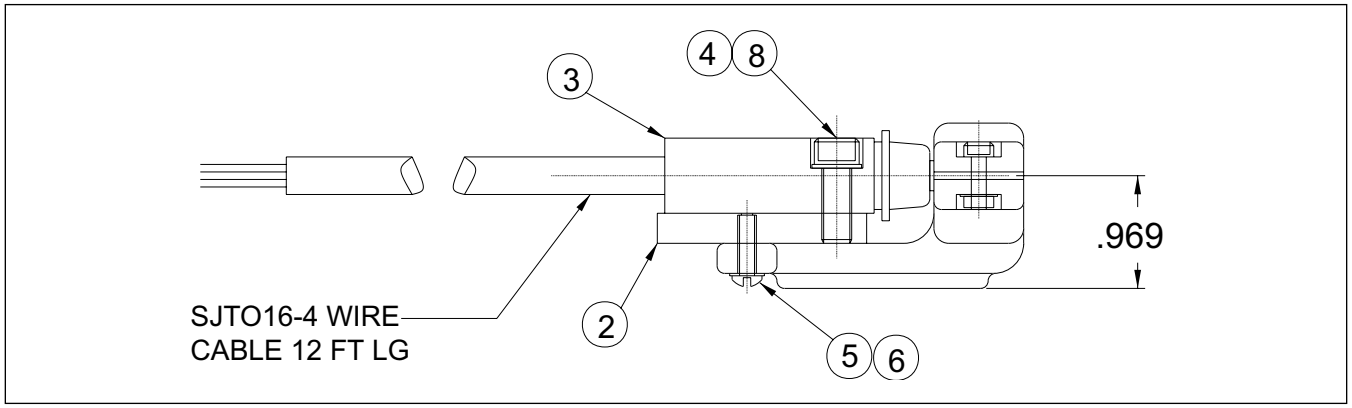
FILL POINT STRAINER W/REMOVABLE ELEMENT	
Rated Pressure	3,000 psi (207 bar)
Thread Size	1/4 in. NPT
Approx. Net Weight	2 oz. (0.06 kg)

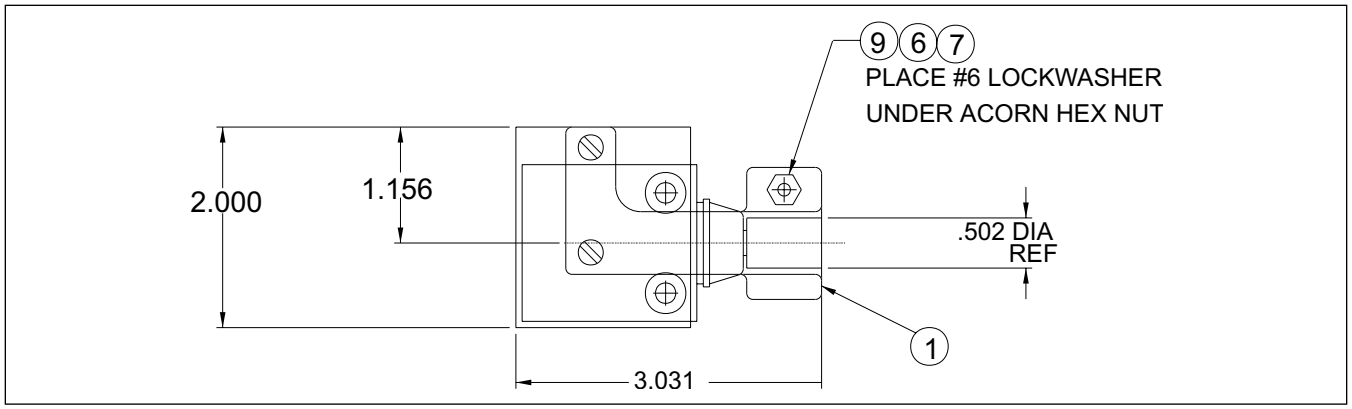
Description	Part No.	Old Part No.
Grease Strainer w/100 Mesh Screen	563102	473-020-468
Replacement Screen	557153	473-020-465



8.3 CYCLE INDICATOR SWITCH WITH 12 FT CABLE, 510-599-300

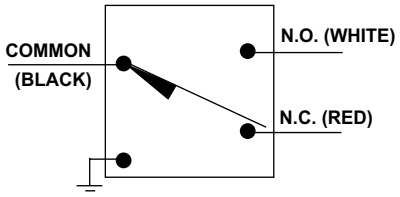
Used in conjunction with cycle indicator pin at cycle rates not exceeding 60 cpm, it provides electrical signal to the system.





Item	Qty	Description	Part No.	Old Part No.
1	1	Bracket	557546	511-968-002
2	1	P-6 Mounting Bracket	560703	511-968-100
3	1	6-P Switch, SPDT	–	529-790-000
4	2	Screw #10-32 x 5/8	555582	419-120-030
5	2	Scr #6-32 x 1/2 RD HD	–	416-702-027
6	3	#6 Lockwasher	555633	421-070-050
7	1	Nut, Acorn #6-32	558634	410-702-025
8	2	#10 Lockwasher	555635	421-070-070
9	1	Scr #6-32 x 1/2 Soc HD	558667	419-070-030

ELECTRIC SCHEMATIC



ELECTRICAL RATING:

28 VDC, Res., 3A, Make/Break
28 VDC, Ind., 3A, Make/Break
SPDT NEMA 6P Rating Meets IEC IP 67 Rating
Switch Completely Enclosed with
Boot-Sealed Plunger.

8.4 TROUBLESHOOTING GREASE GUN WITH 0 - 3000 PSI PRESSURE GAUGE 142-000-450

Efficient, economical & easy-to-use manual pump

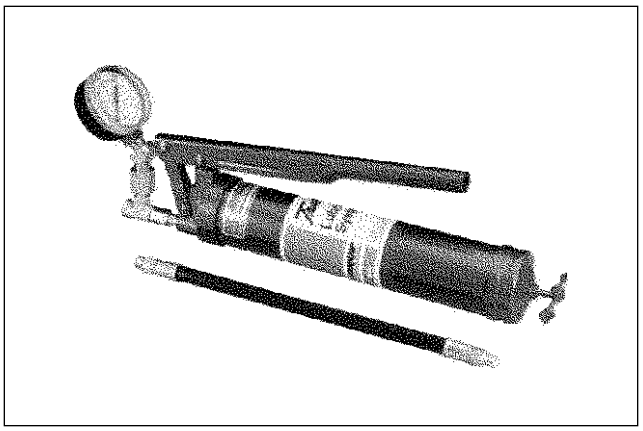
8.4.1 Description: Trabon Manual Pumps provide a simple, cost-effective way to purge grease systems and/or to test the performance of divider valves.

Model 142-000-450 is for grease, and has a metal reservoir. Its pump handle has a follower that indicates how much grease remains in the reservoir. The manual pump is very compact, measuring just 18 in. (457 mm) in length. It delivers lubricant at full pressure at minimum stroke, making it especially effective when working in tight quarters. To simplify and speed lubrication of hard-to-get-at fittings, the pump is provided with a 12 in. (305 mm) flexible hose that connects to the pump outlet and swings through a full 360°. This hose, with its 1/8 in. male ends, is directly adaptable to any indicator port on Trabon MSP divider valves for purging.

The pump is provided with a 0 to 3,000 psi pressure gauge that mounts on the pump.

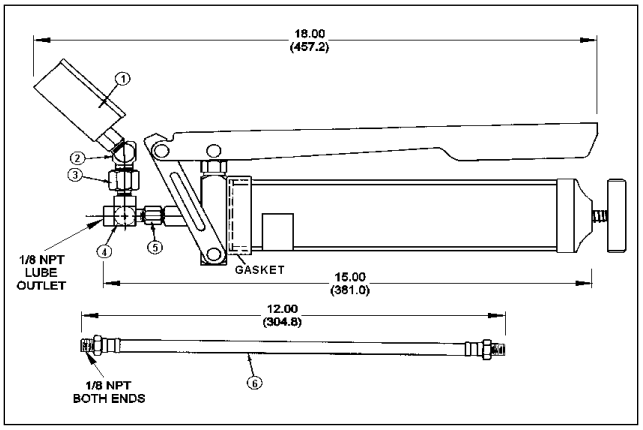
8.4.2 Features

- Steel pump body protects components against the hard knocks common to use of portable manual pumps.
- Excellent pump balance, compactness, and natural grip handle combine to make these pumps easy and less fatiguing to handle and use.
- Built-in automatic handle stop protects the pump's mechanical linkage, extends pump life.
- Extra-large piston assures full 3,000 psi (207 bar) pressure, making these pumps compatible with an exceptionally wide range of systems.
- Reservoir capacity is one lb. (0.453 kg) of grease. This means fewer stops to refill.



8.4.3 SPECIFICATIONS	
Lubricant	Grease
Rated Pressure	3,000 psi (207 bar)
Pump Output	0.100 in^3 (1.6 cm^3) per full handle stroke
Reservoir Capacity	1 lb (0.453 kg)
Reservoir Material	Metal
Pump Body Material	Steel
Approx. Net Weight	4.5 lb (2.04 kg)

8.4.4 Dimensions Inches (mm)



8.4.5 Manual Pump Parts List

List Key	Description	Part No.	Old Part No.
	Gasket (not shown)	–	543-149-000
1	Pressure Gauge, 0-3,000 psi	–	542-870-000
2	45º Street Elbow	560532	509-114-000
3	Bushing	556416	412-330-200
4	Service Tee	556419	412-380-010
5	Extension Nipple	557393	509-028-000
	Hose Assembly	Dis	511-291-000

8.5 PORTABLE FILLER-PAK, 142-000-270

8.5.1 Description: The Trabon Portable Filler-Pak is designed to provide a fast, clean method for filling grease reservoirs.

The Portable Filler-Pak consists of a cover and pump assembly which is securely held to the lubricant container. A build-in foot step is provided for stability while pumping. Also included is a 5 foot length of flexible oil resistant hose with Snap-Tite coupling.

8.5.2 Features

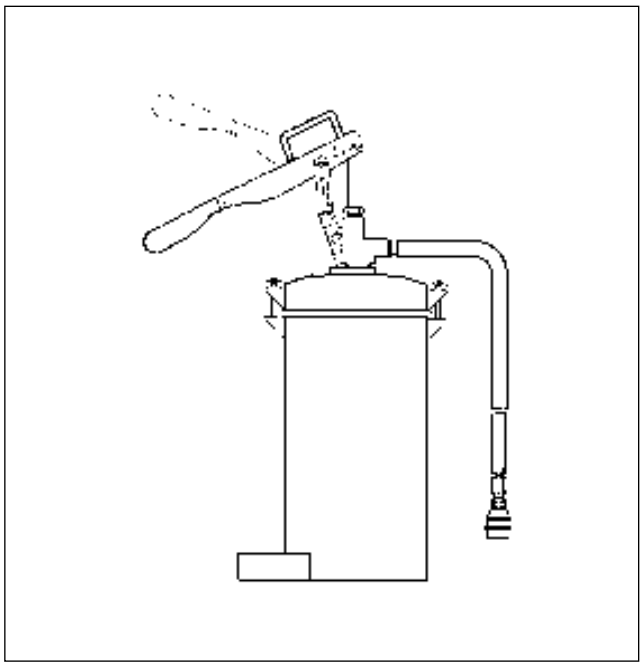
Pump and handle ruggedly constructed

- Pump handle doubles as a carrying handle
- Large reservoir capacity
- Compact, lightweight and easy to carry

8.5.3 Operation: The Portable Filler-Pak is placed on the floor adjacent to the pump reservoir which is to be filled. The hose from the pak is attached by means of a Snap-Tite coupling to fill stud located at the base of the pump reservoir. The pump handle on the top of the Filler-Pak is then operated, forcing lubricant through the hose to the pump reservoir.

The Filler-Pak is filled by removing the combination cover and pump assembly and filling the container with lubricant. The cover and pump assembly are securely held in position on the container. A foot rest at the base of the container is conveniently located so that the Filler-Pak may be anchored to the floor with foot pressure while the lubricant is being pumped.

8.5.4 SPECIFICATIONS	
Rated Pressure	700 psi (48 bar)
Lubricant	Grease
Pump Output	
2:1	11.8 cu.in. (193 cc)
4:1	6.5 cu.in. (106 cc)
7:1	3.0 cu.in. (49 cc)
Reservoir Capacity	30 lb (13.6 kg)
Approx. Net Weight	18 lb (8.2 kg)



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