

# NOTICE

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## MAINTAIN OPERATOR PRESENCE SYSTEM

This machine is equipped with an operator presence system. This system is intended for your safety and must be maintained in good, functional condition.

## AVOID MOVING PARTS



Keep hands, feet and clothing away from power-driven parts.

Keep shields in place and properly secured.

## AVOID ENTANGLEMENT - STAY AWAY



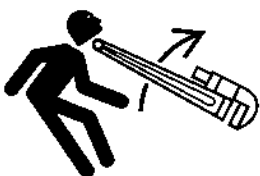
Entanglement in the rotating drill rod and cutting tool can cause death or serious injury.

Stay away from rotating drill rod and cutting tool.

Do not wear loose clothing that could catch on rotating equipment.

Boring and thrust control levers must self-center to NEUTRAL and stop rod motion.

## ROTATING WRENCH CONTACT



Serious injury or death could result if struck by a wrench on the drill rod if rotation is started. Never use hand wrenches to break rod joints. Break rod joints only with the power vises on the machine.

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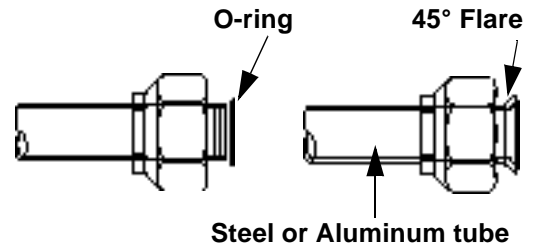
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# AIR CONDITIONING FITTINGS

Some fittings employ an O-ring seal, others use a 45° flare for a metal-to-metal seal.

The 45° flare fittings may be used on steel tubing or aluminum tubing. There are different torque settings for O-ring vs. 45° flare and steel vs. aluminum tubing.



O-Ring Fittings									
Threads		Dynamic Torque						Static Torque	
inch	per inch	Min		Target		Max		ft-lb	Nm
		ft-lb	Nm	ft-lb	Nm	ft-lb	Nm		
5/8	18	8	10	10	14	13	18	8	10
3/4	16	17	23	20	27	22	31	15	26
7/8	14	27	36	29	40	32	44	23	31
1	14	27	36	29	40	32	44	23	31
1-1/16	14	30	40	33	45	36	44	27	31

45° Flare Fittings in Steel Tubes									
Threads		Dynamic Torque						Static Torque	
inch	per inch	Min		Target		Max		ft-lb	Nm
		ft-lb	Nm	ft-lb	Nm	ft-lb	Nm		
5/8	18	20	27	22	30	24	33	18	24
3/4	16	35	47	38	52	42	57	31	42
7/8	14	39	53	44	60	49	67	37	49
1	14	39	53	44	60	49	67	37	49
1-1/16	14	50	67	55	75	61	83	43	60

45° Flare Fittings in Aluminum Tubes									
Threads		Dynamic Torque						Static Torque	
inch	per inch	Min		Target		Max		ft-lb	Nm
		ft-lb	Nm	ft-lb	Nm	ft-lb	Nm		
5/8	18	15	20	17	23	19	26	14	18
3/4	16	22	29	24	33	27	37	20	26
7/8	14	25	34	28	38	30	42	23	30
1	14	25	34	28	38	30	42	23	30
1-1/16	14	34	45	37	50	40	55	30	40

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**2. Is there a mechanical problem?** Mechanical components that are broken, worn, misadjusted, or otherwise out of tolerance will cause faulty operation.

Possible Problem	Possible Effect	What to do
<b><i>Hydraulic pump or engine mechanical problem</i></b>	An unlikely, but possible condition is a “locked pump” or engine mechanical condition that prevents the engine from turning.	After verifying all other systems and components are OK, <b>check for any mechanical condition</b> that will prevent the engine from turning over such as a locked hydraulic pump, damaged crankshaft, etc.

## SYMPTOM: ENGINE TURNS OVER BUT WILL NOT START

**1. Are the related systems operating correctly?** Fuel supply or battery and charging system problems can prevent the engine from starting.

Possible Problem	Possible Effect	What to do
<b><i>Fuel problem</i></b>	If the machine is out of fuel, the fuel filter is plugged, or there is water or other contamination in the fuel, the engine may not start or may run poorly or lack power.	<b>Check fuel supply.</b>
<b><i>Defective battery or not charged</i></b>	If low battery state-of-charge or other conditions prevent the engine from turning over fast enough, the engine will not start.	<b>Check cranking speed</b> with a reliable tachometer; rectify any condition causing cranking speed below 125 rpm (at 10°F (-12° C or above).

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## Checking Out Controls

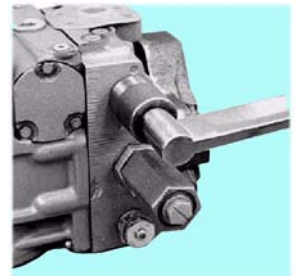
Unless the problem is obvious, the successful troubleshooter will investigate these fundamental electrical-related questions:

1. ***Is the power source (battery, drill/transport, rack angle/stakedown or, ignition circuit breakers, or DSR) OK?*** Electrical actuators such as relays and coils may operate correctly down to as low as 10.8V, but any system voltage measuring below 12.5V can be suspect, especially if grounds are faulty.
2. ***Are the grounds OK?*** The circuit must be complete to ground, and the voltage drop in the ground circuit must be no higher than 0.5V.
3. ***Is the current path complete?*** Many problems can be traced to a broken wire or faulty pin connection in a plug.
4. ***Are all the switches OK?*** The ignition switch and hydraulic enable switch control the hydraulic enable solenoid.
5. ***Are both splitter modules OK?*** Any implement function requires a current path through a diode to the 5-second delay and to the load sense solenoid.
6. ***Are all relays and solenoid coils OK?*** make sure relays and solenoid coils are within tolerance, both cold and hot.
7. ***Are the valves and relay contacts OK?*** Even if all electrical functions are OK, a valve may leak or fail to move, or relay contacts may stick or not conduct current.

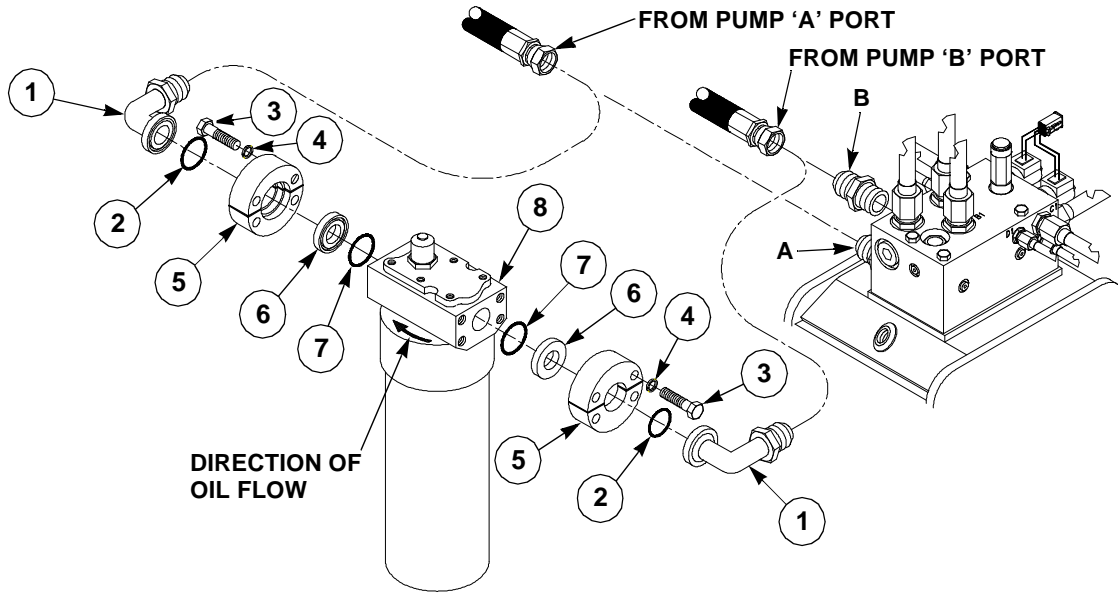
4. Remove pressure limiter lock nut and bypass actuator.
5. Unscrew the pressure limiter adjustment screw from the bypass actuator.
6. Clean and inspect all disassembled parts.

**IMPORTANT:** Assemble with new, lightly lubricated O-rings by reversing the above procedure. Place the cartridge in a vise and press on lower assembly. **The pressure settings must be readjusted after disassembling the pressure limiter housing of the multi-function valve cartridge.**

7. Install cartridge in multi-function valve cavity and torque to 66 ft-lb (89 Nm). Do not overtorque the multi-function valve cartridge.



# FILTER KIT PARTS



Filter Kit for Rotation and Thrust/Pullback Systems			
Number	Part Number	Description	Quantity
(1)	82923-001	Fitting-16M JIC x 16/62 90° SH Ref	2
(2)	72895-001	O-ring-Sq. #16 Flange	2
(3)	235718-001	Bolt-1/2"-13" x 2" GR8 Hex Zinc PLT	8
(4)	485-025	Washer-1/2" Flat Hardened Zinc	8
(5)	75351-001	Split Flange	2
(6)	75350-001	Spacer	2
(7)	72896-001	O-ring-Sq. #20 Flange	2
(8)	71927-001	Filter Assembly	1
	71928-001	Element-Filter	1
	75353-001	Seal Kit	1
	71927-005	Indicator-Visual	1
	71927-007	Glass-Visual Indicator	1

Continued on next page...

## SOLENOID COILS

Three types of solenoid coils are used on the D33x44. The following chart lists features and torques for most of the types used on the D33x44. For correct operation of solenoid valves it is very important to torque the coils correctly.

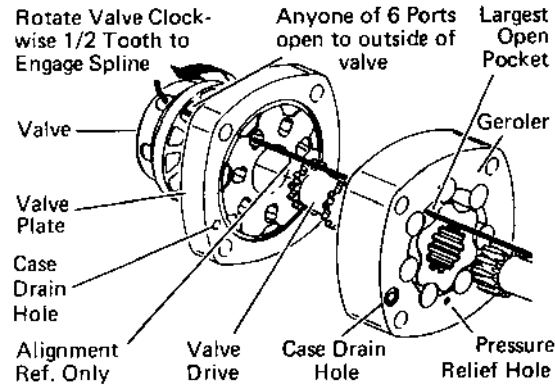
### Coil Specifications

**NOTE:** Ohms and Watts are at 70°F (20°C). The drop-out voltage for '08' and '10' size coils is 10.2V. Coils are rated to operate continuously at up to 212°F (100°C). For accurate testing, be sure to check voltage, resistance, and current at normal coil operating temperatures. **Regardless of voltage and temperature conditions, pull-in current must be at least 0.840 A for size '08' coils and 1.18 A for size '10' coils.**

Coil Type	Vermeer P/N	Amps	Ohms	Watts	Installation Torque
'08'	251117-009	1.2	9.8	14.7	5–7 ft-lb (6.75–9.5 Nm)
'10'	251112-005	1.67	7.2	20	7–10 ft-lb (9.5–13.5 Nm)
EHPR proportional	251108-003	1.2 (max)	5.4	NA	7–10 ft-lb (9.5–13.5 Nm)

The solenoid coils installed on the D33x44 use external O-rings to seal the coils against moisture. Ensure that, whenever a coil is replaced, the appropriate O-ring seals are correctly positioned to prevent the coils from being damaged by water. Consult the following chart and compare with the specification number in the component section to determine the correct positioning of waterproofing O-rings and seals.

## Timing



**NOTE:** There are three steps involved in timing the motor. Timing determines the shaft rotation direction. Timing parts include Geroler, valve drive, valve plate and valve.

**11. Timing step #1:**

- Locate largest open pocket in Geroler, and mark it on outside edge.
- Align case drain hole and pressure relief hole in Geroler with case drain and pressure relief hole in bearing housing; install Geroler on bearing housing; and retain rollers in outer Geroler ring if loose.
- Install valve drive in Geroler.
- Apply petroleum jelly to 3-1/2" seal and install in valve plate.
- Align case drain hole in valve plate with case drain hole in Geroler; and install valve plate (seal side toward Geroler).

**12. Timing step #2:**

- Locate slot opening in valve plate which is in line with largest open pocket of Geroler.

**13. Timing step #3:**

- Locate any one of the side openings of the valve that goes through to the face of the valve.
- Align selected side opening with open slot of valve plate that is in line with largest open pocket of the Geroler.
- Install valve by rotating clockwise 1/2 spline tooth until spline teeth engage, providing correct rotation.

Continued on next page...

## Checking out Controls

Unless the problem is obvious, the successful troubleshooter will investigate these fundamental electrical-related questions:

1. **Is the power source (battery, 15A ignition circuit breaker and 40A power circuit breaker) OK?** Electrical actuators such as relays and coils may operate correctly down to as low as 10.8V, but any system voltage measuring below 12.5V can be suspect, especially if grounds are faulty.
2. **Are the grounds OK?** The circuit must be complete to ground, and the voltage drop in the ground circuit must be no higher than 0.5V.
3. **Is the current path complete?** Many problems can be traced to a broken wire or faulty pin connection in a plug.
4. **Is the ignition switch OK?** The ignition switch provides power directly to the strike alert and to the power relay coil.
5. **Is the power relay OK?** Power to the circuit breakers and the DSR travels through the power relay contacts when the ignition switch energizes the relay coil. Make sure the coil is not open and that the contacts operate and make good electrical contact.

## Checking out Mechanical Systems

Always check for mechanical malfunctions—such as defective bearings, binding linkages, and loose fasteners.

## SYMPTOM: NO POWER TO STRIKE ALERT

**1. Is the ignition circuit live?** Strike alert power is provided from the 15A ignition circuit breaker through the ignition switch.

Possible Problem	Possible Effect	What to do
<i>Ignition circuit breaker tripped or defective, or ignition switch defective</i>	Strike alert power is provided from the 15A ignition circuit breaker through the ignition switch.	<b>Check the ignition circuit breaker. Check that power is available from the ignition switch 'A' terminal to the strike alert module.</b>

## MAINTENANCE

Make sure the voltage stake cable connectors are clean and connectors are not damaged. The voltage stake cable must be securely attached to the strike alert box.

It is important for the voltage stake to be inserted in ground that conducts electrical current. If the voltage stake is in extremely dry soil or asphalt, the Strike Alert may not function. Soaking the soil around a stake with water may improve the soil conductivity to enable the Strike Alert to function. Be sure to fully insert the stake into ground.

### Possible Causes for Failure

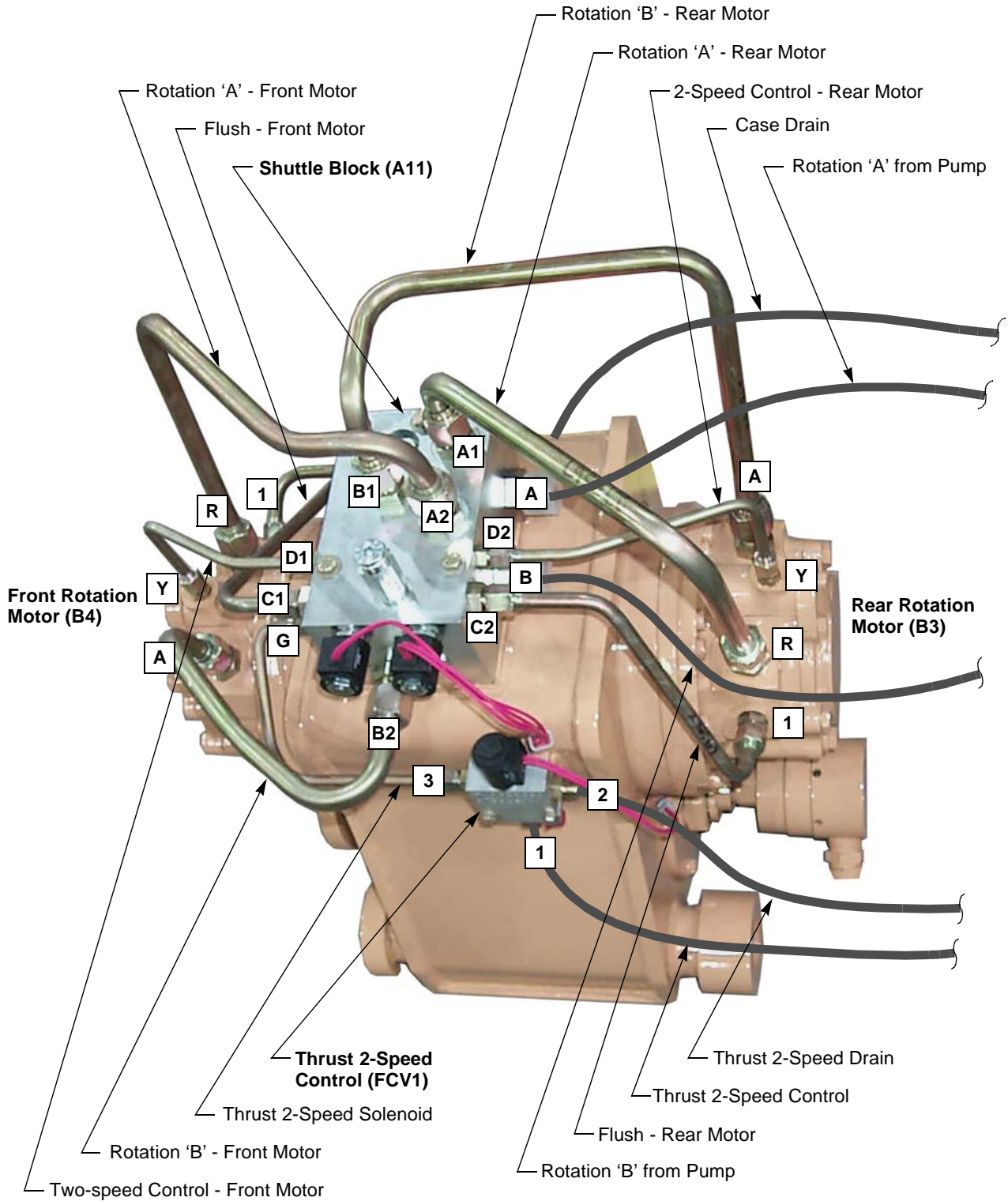
There are several conditions that could possibly cause a failure of the Strike Alert Box. These include:

- R1 or R2 is shorted to ground
- The horn has a direct short across its terminals
- A- shorts directly to +12V for several seconds (might not show up until unit is tested)
- TO shorted directly to +12V for several seconds.
- Direct ground on T1 or T2 (should also heat up the wires to 12+ and the voltage test switch)

Grounding or applying +12V to SG or PO should not cause damage.

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# HOSE ROUTING - ROTATION MOTORS



**A** Component Port Designator

70  
Rotation System

**4. Are the controls or EDC stroking the pump?** Power must travel from the *power relay* through the #401 orange 8 gauge *main power wire*, through the *DSR-Drill/Transport circuit breaker*, through the *DSR*, through the *seat switch* and to the *joystick control*. The *joystick control* then sends a varying current signal (milliamp or mA) to the *EDC AB coil*. The EDC uses the milliamp signal from the controls to direct oil to either of the PCP control ports. The control oil from the PCP is applied to one of the servo pistons to stroke the pump. Approximately 65 mA is required to fully stroke the pump in either direction. If the control is not powered, or if it does not send a correct signal to the EDC, or if the EDC receives a good signal but is defective, an incorrect pressure signal will be sent to the servo pistons, and the pump will not go on stroke correctly.

Possible Problem	Possible Effect	What to do
<b>No power to controls</b>	If any of the following occur, the controls will not be powered correctly -- <i>circuit breaker</i> is tripped -- <i>wiring</i> is damaged -- <i>DSR</i> defective -- <i>seat switch</i> defective or operator not seated .	Check that power is available to pin 4 on the rotation joystick connector. Refer to wiring schematic and the <i>Rotation Controls</i> , page <b>70-4-1</b> .
<b>Control circuit malfunction</b>	There must be a complete current path for current to start from the joystick, travel to the EDC, and return to the joystick.	First check wiring, connectors and pins in all control harnesses. Check for milliamp (mA) signal to EDC. Full stroke current should be 65 mA.
<b>EDC malfunction</b>	If the EDC is receiving the correct signal but does not stroke the pump, it may be damaged internally or the flow of oil to the PCP may be blocked. If the internal screens in the PCP are blocked, EDC control will be limited or will not function.	Substitute a known good EDC and/or perform other steps found in <i>Hydrostatic Service</i> , page <b>40-5-7</b> , including checking the PCP screen condition.

Continued on next page...

# CHECK SHUTTLE FLOW

## Test Objective

To determine if shuttle flow is outside of acceptable limits, indicating a possible flow control valve or shuttle relief valve defect.

## Special Tools and Materials:

- a **copy** of the *Machine Performance Checks* worksheet
- 0.5 gpm 1.9 L/min) 3500 psi (240 bar) flow meter with hose
- tubing wrenches

**NOTE:** Do not attempt to check flow into a container—the results will not account for back pressure in the line.

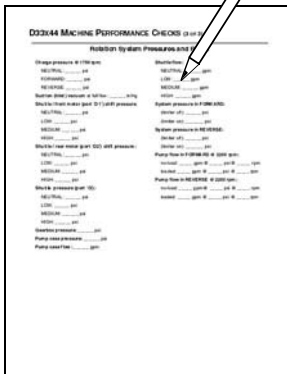
## Conditions



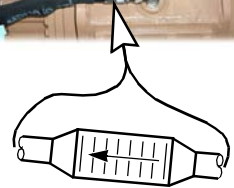
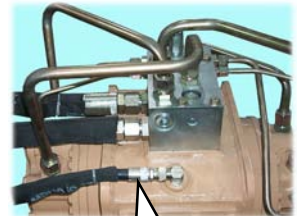
**WARNING:** Entanglement in rotating drill chuck and drill rod can cause death or serious injury. Stay away from rotating equipment. Do not wear loose clothing that could catch on rotating equipment.

Warm up machine so the hydraulic oil in the tank is at least 100°F (40°C). Verify oil temperature with a non-contact thermometer.

## Procedure



1. Connect an in-line flow meter from the case drain port of the gearbox into the case drain line.
2. Run the engine at 2200 rpm and record the flow in NEUTRAL, then operate the rotation system in all three speed ranges and record shuttle flow.
3. **Shuttle flow is not adjustable—if the flow is incorrect, either the shuttle relief setting may be too high (so that shuttle pressure is above charge pressure), or the flow control may be defective.**



# PUMP CASE PRESSURE TEST

## Test Objective

To determine if the pump case pressure exceeds specifications, indicating either a restriction in the case drain line or some condition causing excess flow to the pump case.

## Special Tools and Materials

- a **copy** of the *Machine Performance Checks* checksheet
- 1000 psi (70 bar) pressure gauge
- diagnostic fitting with 1-1/16"-12 thread to install in pump case pressure port

## Conditions

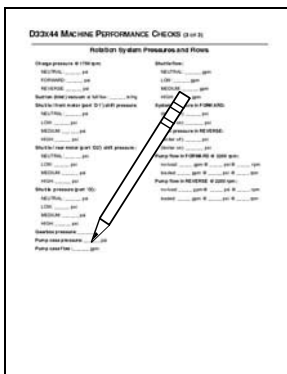
Testing may be done initially with cold oil but must conclude with oil tank temperature at normal working temperature, (at least 100°F (40°C)). Verify oil temperature with a non-contact thermometer.

**IMPORTANT:** This procedure requires specialized training. Do not perform this test if you are not trained in the use of flow meters on high pressure systems.

**IMPORTANT:** Never test case pressure by removing the drain line and plugging the case with a pressure gauge. This can lead to pump case failure and does not provide an accurate test.

Continued on next page...

## Procedure



1. Remove the plug from the case drain port (port 'L2') in the underside of the pump.
2. Install the diagnostic fitting and connect the pressure gauge.
3. Operate the machine at full throttle with the rotation pump in neutral; observe and record pressure.
4. ***If pressure exceeds the specification for a cold or warm machine***, either there is a restriction in the case drain circuit or there is a condition causing excessive flow to the pump case. Check case drain circuit for restriction, then check case drain flow (see page 70-3-17).



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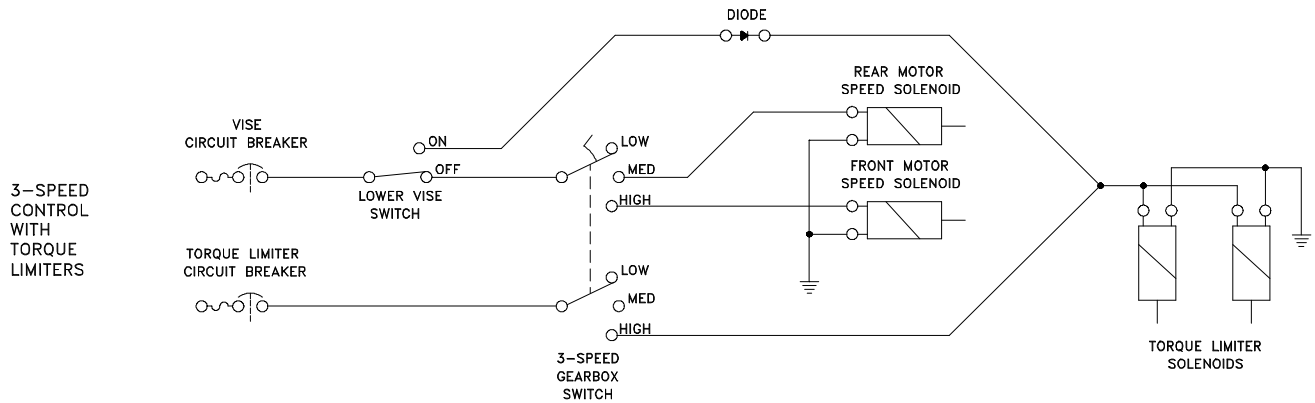


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## TORQUE LIMITERS

### Operation Overview



The forward and the reverse torque limiters limit the loop pressure of the 'B' and 'A' sides of the pump by sending oil to the pump servo circuit whenever the pressure exceeds the torque limiter relief setting. The forward torque limiter is designed to limit pressure whenever the lower vise is ON or the 3-speed switch is in HIGH. The reverse torque limiter limits pressure whenever the lower vise is OFF and the 3-speed is in LOW or MED.

Both solenoid valves are energized at the same time, either by the lower vise switch ON or by the 3-speed switch in HIGH. The forward torque limiter valve **allows** oil to flow (opens) only if the solenoid is energized. The reverse torque limiter valve **shuts off** oil to the pressure limiter (closes) if the solenoid is energized.

## TORQUE LIMITER SOLENOID VALVE BENCH TEST

### Test Objective

- To determine if the torque limiter solenoid valve is holding pressure (not leaking) until energized (forward) or de-energized (reverse). If it is leaking, the maximum pressure that the pump can reach may be limited by the pressure relief setting at all times. Leakage should be **less than 5 drops/min (0.25 cc/min)**.

**NOTE:** The forward torque limiter solenoid is identical to the thrust limiter on/off solenoid. They may be interchanged for diagnostic purposes.

### Special Tools and Materials

- handpowered test pump capable of 3000 psi (210 bar)

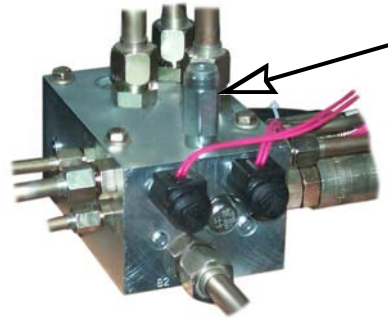
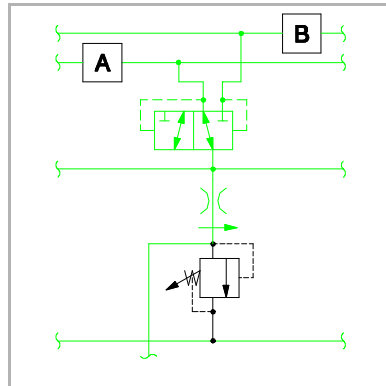
### Conditions



**WARNING:** Pressurized fluid can penetrate body tissue and result in serious injury or death. Leaks can be invisible. Relieve pressure before working on system. When searching for a leak, use an object like cardboard - not your hand. Fluid injected under the skin must be removed immediately by a surgeon familiar with this type of injury.

**IMPORTANT:** For accurate testing, the test pump and components must be 70°F (20°C) or warmer.

## SHUTTLE RELIEF



### Operation

**Removing hot oil:** The shuttle relief allows pressurized oil to flow from the low side of the loop. This removes a portion of the heated oil from the loop so that it can be replaced with cooler oil from the tank. (Without this cooling function, oil in the loop can become too hot, causing heat-related problems and oil viscosity breakdown.)

**Cooling the rotation motors and gearbox:** Oil from the shuttle valve that passes over the relief flows through the rotation motors and gearbox to lubricate and cool the motors and gearbox.

**Providing Oil to Motor Speed Solenoids:** The drive motors require approximately 95 psi (6.5 bar) oil to shift their displacement from high to low. The relief ensures that adequate pressure is provided to the motor shift solenoids to be applied to the motor shift ports.

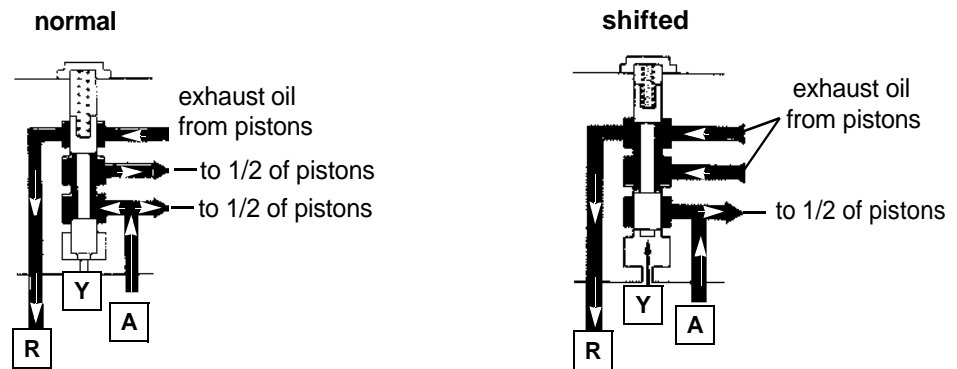
### Action

The shuttle relief should be set to relieve approximately 50–100 psi (3.5–7.0 bar) below the charge pump relief setting. When the shuttle valve is shifted to either loop port, low side loop pressure is applied to the relief. Oil flows across the relief based on the difference between the relief setting and the back pressure found in the case drain/return circuit.

**Displacement shift:** During normal operation, out of *ten* pistons in each motor, *four* are receiving pressurized oil from the 'A' port and applying torque to the drive shaft, *four* are exhausting to the 'R' port, and *two* are in transition between exhaust and pressure.

Applying shuttle oil pressure to the 'Y' port of either motor shifts a spool valve. This exhausts half of the motor pistons directly to the 'R' port, which prevents them from applying torque to the drive shaft. Now only two out of the ten pistons are receiving pressurized oil and the rest are either connected to exhaust oil at the 'R' port or are in transition between pressure and exhaust. This reduces motor displacement by 1/2 and increases motor speed.

The motor is shifted back to normal by removing shuttle oil pressure through the case drain circuit, which allows the spool valve to return to normal and allows use of all the motor pistons.



### Dual Motor Operation

**Shift Operation:** Although the motors shift displacement independently so that both can be in low speed, both in high speed or one in low speed and one in high speed, they act together by splitting oil flow and applying torque according to their displacement. Since they turn on a common shaft, their rotation speed will always be the same. Their contribution to overall torque and power will depend on their displacement.

**Rotation Direction:** Front and rear motors are identical except that the internal distribution block is indexed for clockwise or counterclockwise rotation when oil is applied to the 'A' port which is intended to be the primary inlet or feed port. If necessary, motors can be changed for opposite rotation (refer to page [70-6-11](#)).

## MOTOR REMOVAL / INSTALLATION

### Special Tools and Materials

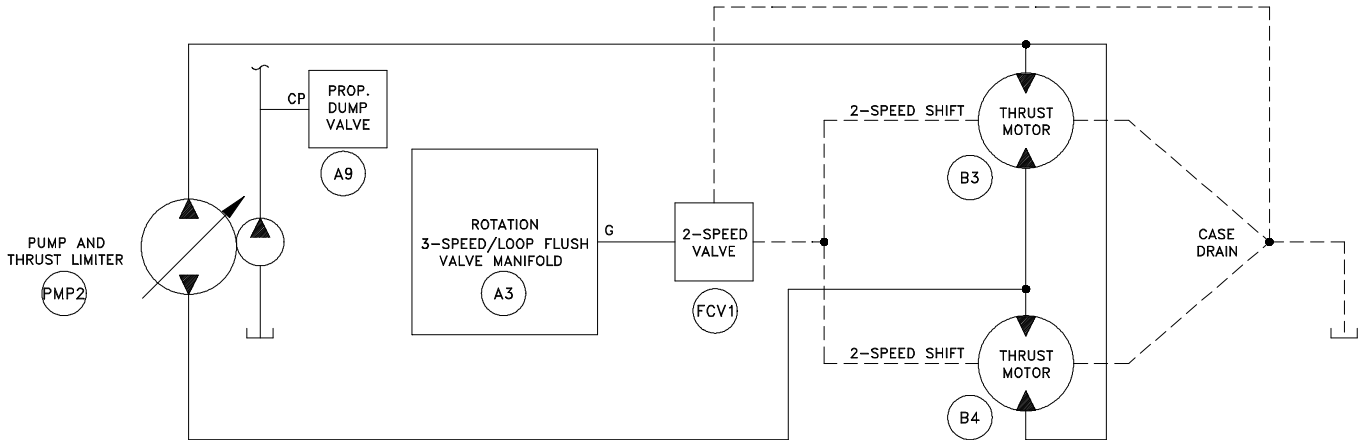
- torque wrenches capable of producing 30 ft-lb (40 Nm) and 90 ft-lb (122 Nm)
- tubing wrenches
- two fabricated guide pins:
  - overall length: 5" (127 mm)
  - thread length: 1-1/4" (32 mm)
  - thread specifications: M12x1.75
- petroleum jelly

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## HOSE ROUTING - THRUST/PULLBACK MOTORS

**NOTE:** A detailed hose routing diagram was unavailable at time of publication.



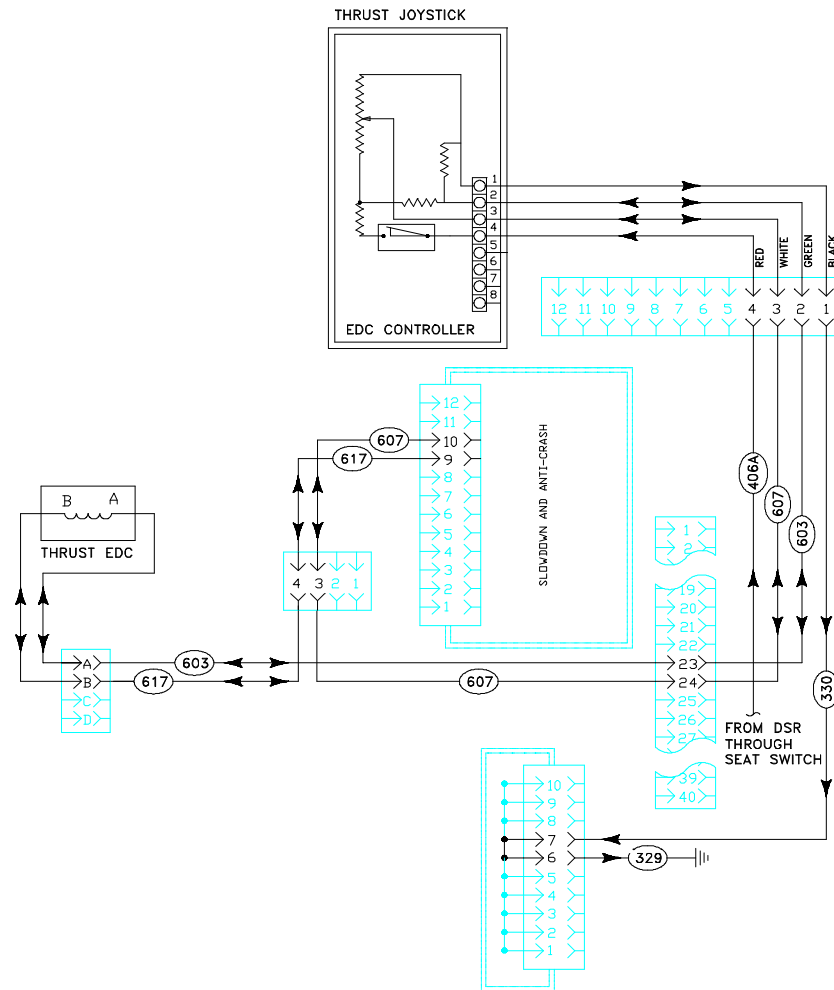
## SYMPTOM: LOW THRUST OR PULLBACK FORCE OR PRESSURE

**1. Is the thrust limiter applied or misadjusted?** The *thrust limiter* sends oil to the *pump servo* to destroke the *pump*. Faulty operation, or operation when it is not desired, will limit *pump* pressure.

Possible Problem	Possible Effect	What to do
<b><i>Rockfire switch malfunction</i></b>	If an electrical signal is sent to the thrust limiter causing the thrust limiter to be applied, thrust pressure will be limited.	<b>Check for unintended thrust limiter “ON” signal</b> from the rockfire switch and replace switch if necessary (refer to page <b>80-4-1</b> ).
<b><i>thrust limiter solenoid valve is defective or dirty</i></b>	If the solenoid valve leaks loop oil to the pressure relief, pump pressure will be limited to the pressure relief setting.	<b>Check solenoid valve for leaking.</b> Either cap off the thrust limiter and pump ports to see if the pump will operate normally without the limiter OR check the thrust limiter using a “pressure leak test” (refer to page <b>80-5-4</b> ).
<b><i>thrust limiter pressure relief valve defective or dirty</i></b>	If the pressure relief setting is incorrect or the relief or an O-ring is leaking, pump pressure will be lower than desired whenever the torque limiter solenoid valve is energized.	<b>Check pressure relief for leaking:</b> O-rings, valve torque, valve cavity condition (refer to page <b>80-5-8</b> ).

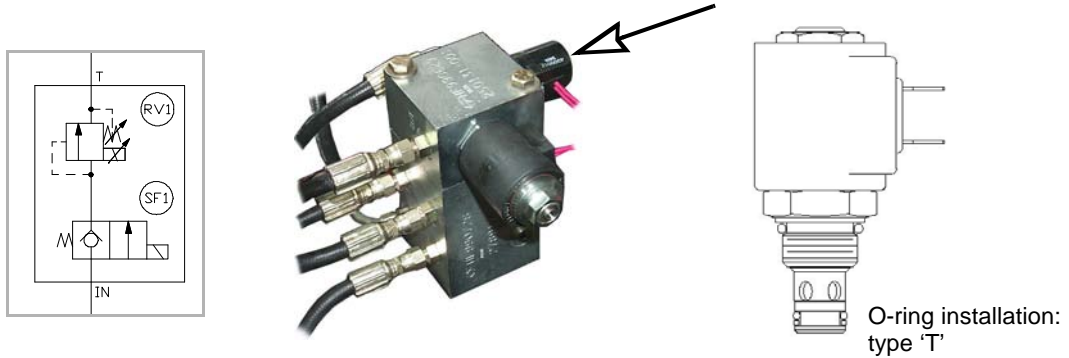
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## EDC Control Circuit



The EDC circuit controls uses the right (thrust/pullback) joystick to control oil flow and direction from the pump. Current from the DSR is sent through the seat switch to pin '4' of the right joystick connector then to pin '4' of the EDC controller in the joystick. The EDC controller sends a current signal on wires '603' and '607' through pins '2' and '3' of the joystick connector, through pins '23' and '24' of the 40 pin connector, and through pins '9' and '10' of the slowdown/anti-crash module, to the 'AB' coil of rotation pump EDC. This causes the pump to stroke in forward or reverse.

## THRUST LIMITER - ON / OFF SOLENOID VALVE



### Operation

The thrust limiter limits thrust pressure whenever the drill mode switch is in ROCKFIRE or TRIHAWK mode and the loop pressure has reached the pressure relief setting.

### Action

The thrust limiter applies loop oil to the pressure relief when the on/off solenoid is energized by the ROCKFIRE or TRIHAWK setting of the drill mode switch. If the loop oil is at a higher pressure than the thrust limiter pressure relief setting, the oil that passes over the relief is used to destroke the pump, limiting thrust applied to the drill rod.

## 2-SPEED SOLENOID VALVE BENCH TEST

### Test Objective

To determine if the motor speed solenoid valve is holding pressure (not leaking) until energized. If it is leaking, the motors may shift erratically or may be shifted into high speed/low torque at all times. Leakage should be less than 3 fl-oz/min (82 cc/min) at 3000 psi (207 bar).

### Special Tools and Materials

- handpowered test pump capable of 500 psi (35 bar)

### Conditions



**WARNING:** Pressurized fluid can penetrate body tissue and result in serious injury or death. Leaks can be invisible, Relieve pressure before working on system. When searching for a leak, use an object like cardboard—not your hand. Fluid injected under the skin must be removed by a surgeon familiar with this type of injury.



**WARNING:** Before performing any maintenance on the machine, follow the Shutdown Procedure unless instructed differently by the manual.

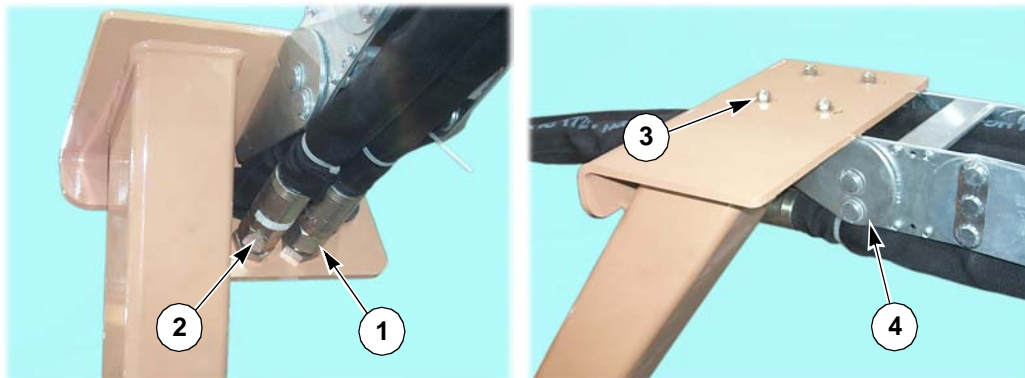
**IMPORTANT:** For accurate testing, the test pump and components must be 70°F (20°C) or warmer.

## CARRIAGE REMOVAL / INSTALLATION

### Special Tools and Materials

- torque wrenches capable of producing range of 30 ft-lb (40 Nm) and 300 ft-lb (407 Nm)
- four 1/2" x 10" NC bolts

### Remove Carriage



1. Remove the thrust/pullback motors. Refer to *Motor Removal/Installation*, page [80-6-1](#)
2. Remove the rotation gearbox. Refer to *Carriage Removal/Installation*, page [80-6-6](#)
3. Remove hoses (1) and (2). Remove four nuts (3), washers and bolts, releasing hose carrier (4).

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## OPERATION OVERVIEW

<b>PFC Pump</b>	The PFC pump supplies hydraulic flow at pressure according to demand.
<b>Load Sense Solenoid Valve</b>	The load sense solenoid valve is energized any time a hydraulic function is operated with an electric switch. This opens the valve to allow oil flow to the load sense line. There are no load sensing lines connected with the rod loader and vise valves; all load sense oil to the PFC pump is supplied by the load sense solenoid, the proportional valve, or the transport valve.
<b>Rod Loader Electromagnets</b>	The rod loader electromagnets are triggered by the magnet switch when the rod loader arms begin to extend toward the rack. The magnet switch also provides the “magnets on” signal to the slow-down/anti-crash module.
<b>Rod Loader Motors</b>	Two motors operate rack and pinion gearing to move the rods. The motors are connected in series with pressure reliefs.
<b>Vise Manifold</b>	The vise manifold (MFL6) uses four solenoid valves to control vise operation. There is no load sense line from the vise manifold to the PFC pump. Instead, the load sense function is triggered electrically.
<b>Rod Loader Manifold</b>	The rod loader manifold (MFL5) uses two bi-directional solenoid valves to control all rod loader operation.
<b>Operation</b>	Correct operation of the system requires that the load sensing system is functioning correctly and the barrier switches are closed.

## SYSTEM SPECIFICATIONS

The following specifications are for the rotation system in general. For individual component specifications, refer to the appropriate section in this manual.

Specification	Value
<b>General</b>	
governed engine RPM	2200 rpm
<b>Rod Loader Motors</b>	
motor make/ Model	Eaton 2000
displacement per revolution	9.6 cid (157 cc)

## SYMPTOM: ROD LOADER WILL NOT RETRACT ARMS

**1. Are the barriers in position and the barrier switches operating correctly?** The rod loader arm barriers must be in the DOWN position to close the front and rear barrier switches. The rod loader arms will not retract if the barrier switches are not closed.

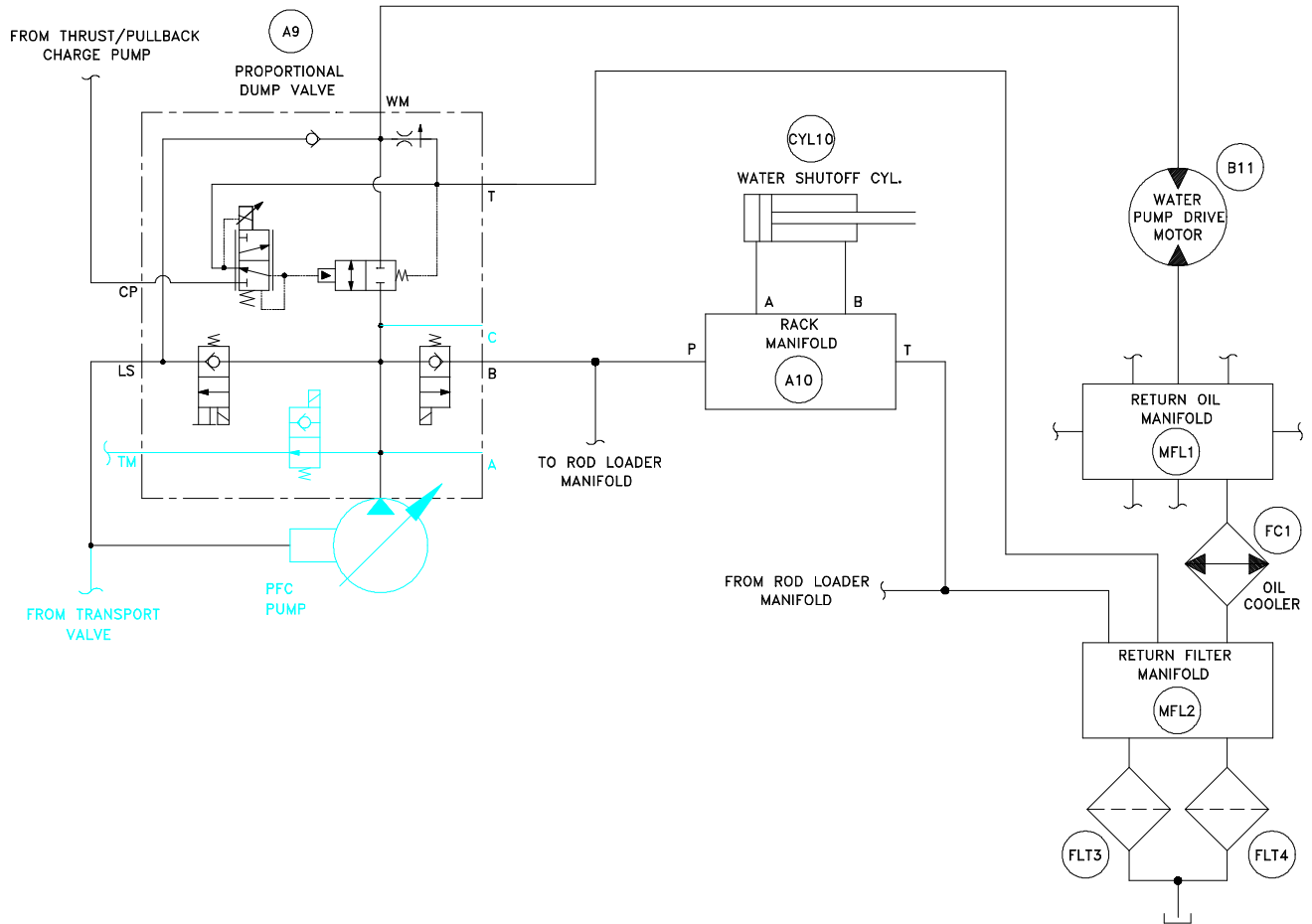
Possible Problem	Possible Effect	What to do
<i>barriers not DOWN or barrier switches are misadjusted or defective</i>	The rod loader arm barriers must be in the DOWN position to close the front and rear barrier switches. The rod loader arms will not retract if the barrier switches are not closed.	<b>Check the barrier position and switch adjustment and operation.</b>

## SYMPTOM: MAGNETS ARE NOT ENERGIZED

**1. Is the magnet switch working?** The magnet switch should close when the loader arms move towards the drill head, away from the first rod column.

Possible Problem	Possible Effect	What to do
<i>magnet switch misadjusted</i>	The magnet switch should close when the loader arms move towards the drill head, away from the first rod column. This energizes both magnets.	<b>Check magnet switch adjustment (refer to page 90-6-1).</b>

# HYDRAULIC DIAGRAM



**3. Does the pump run rough and/or knock?** Rough running or knocking can indicate either cavitation or air entrainment, or a mechanical failure.

Possible Problem	Possible Effect	What to do
<i>pump cavitating</i>	Cavitation is caused by inlet restriction and other conditions that cause very low pressure in the pumping chamber. Also, if the hydraulic hoses to the water pump drive motor are reversed, similar symptoms may result.	<b>Verify that mud mixture not too heavy and mixed properly;</b> verify that inlet line correct length and diameter; verify that any inlet strainer not plugged with debris. <b>Verify that the hydraulic motor is hosed correctly.</b>
<i>excessive amount of air entrained in fluid</i>	The charge pump may be delivering a certain volume of fluid that contains a high volume of air. When the fluid is pressurized, the air is compressed causing a loss of available flow. Leaky inlet fittings can also cause air entrainment.	<b>Check water/mud quality.</b>
<i>valve problem or piston problem</i>		<b>Repair pump.</b>

**4. Does the pump leak mud during operation?** Leakage should be very limited during operation so significant mud leakage indicates a wear problem or mechanical failure. Pump should be serviced as soon as possible.

Possible Problem	What to do
<i>piston cups are wearing and about to fail</i>	<b>Rebuild pump.</b>
<i>fluid cylinder bolts are not properly tightened</i>	<b>Check bolt torque.</b>
<i>fluid O-rings or gaskets damaged</i>	<b>Repair pump</b>
<i>piston holder O-ring failed</i>	<b>Repair pump.</b>

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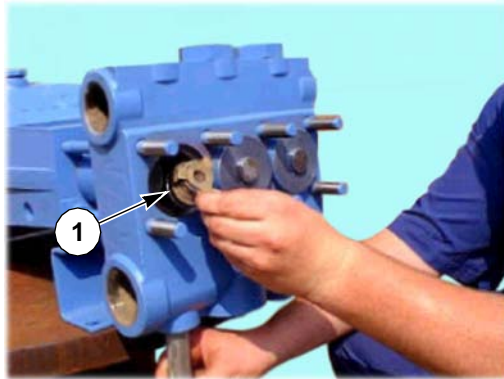
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## Install Valves

1. Thoroughly flush the inside of the fluid cylinder to remove all debris. Then, clean the six valve seat tapers inside the fluid cylinder by wiping them with a clean, lint-free towel. Also, clean the surface around all cylinder cover ports, suction drain plug holes and discharge drain plug holes.

**IMPORTANT:** New valve assemblies are secured using a self-locking taper and must make metal-to-metal contact to be effective. If debris between the valve assemblies and mating valve seat tapers inside the fluid cylinder fails to allow the valve assemblies to seat properly, damage to the new valve assemblies and fluid cylinder will result. Carefully inspect each valve assembly seat and valve seat taper inside the fluid cylinder for visible damage.

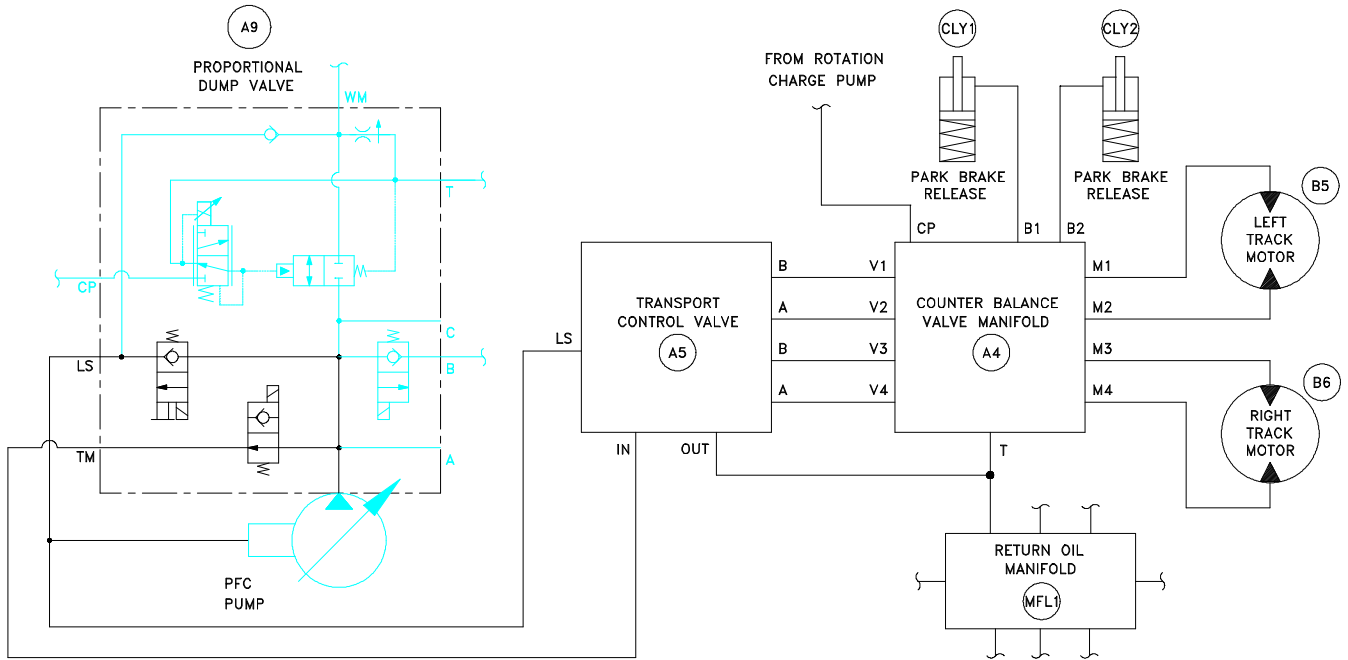


Replace all suction and discharge valve assemblies whenever valve service is required. Replacing only valve assemblies that have visible signs of wear reduces the operating time between service intervals. Replace complete valve assemblies, never individual valve parts.

2. Insert suction valve assemblies (1) into the ports of the fluid cylinder. Position the valve assemblies slightly above the valve seat tapers and drop them into place. If dropped straight, the valve assemblies will seize on the taper and cannot be moved by hand.

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# HYDRAULIC DIAGRAM



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