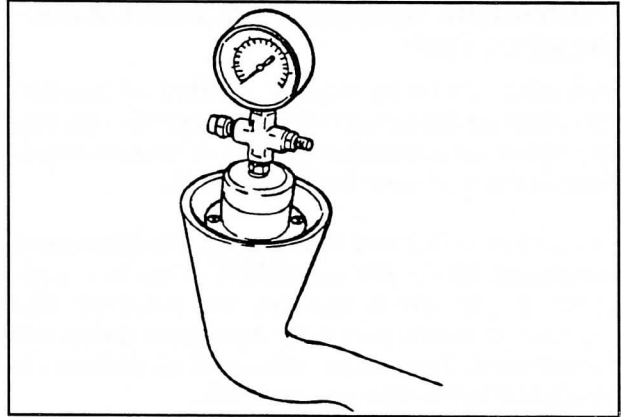


- It may be necessary in some instances (where leakage is occurring on shaft seals into gearboxes or bell housing), to pressurize the reservoir for 2 to 4 hours and monitor the oil level in the gearboxes.
- If the prior checks do not locate the source of the leak, it may be necessary to pressurize each hydrostatic component individually.

To do this it will be necessary to disconnect each case drain line in turn and pressurize using an air line to a maximum pressure of 10 PSI.

**NOTE:** A check valve can be installed in the case drain tube which maintains a 5 PSI pressure in the pump and motor cases. This helps prevent air ingress into the system.



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6. Verify that the hydrostatic pumps are in good condition by performing a case drain test on the pumps. Refer to the pump case drain test procedure as outlined earlier.
7. If either the right or left hand side was appearing weak, and the pump case drain test was within specifications, a check of the total case drain flow from the motors should be performed.
8. Disconnect the hydrostatic motor case drain hose at the hydraulic gear pump at 1, and cap the fitting at the pump.
9. Connect another hose to the end of the motor case drain hose, and run into a suitable container.

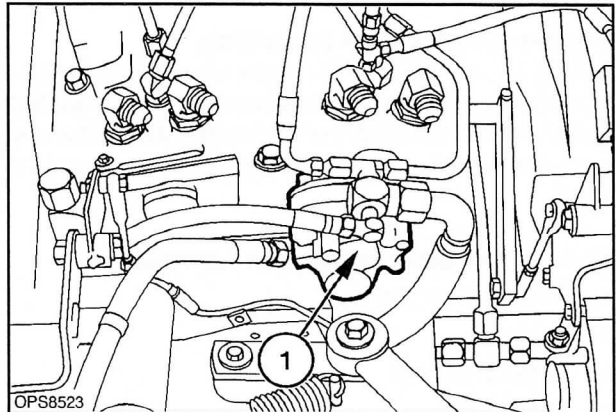
**IMPORTANT:** Check the hydraulic oil level and add if required to ensure sufficient oil for the test.

10. Start the engine and run at full throttle (2225 - 2275 RPM).
11. Stroke the control lever for the side being tested, both forward and reverse, and take a flow reading. Flows in excess of 5.7 l/min. (1.5 GPM) indicate excessive leakage in the motor. This will also indicate the need for either repair or replacement of the motor.

**NOTE:** Even though the case drain flow is for both motors, flow from the unstroked side is not enough to affect the results.



**Always stay clear of moving parts during testing or serious injury could occur.**

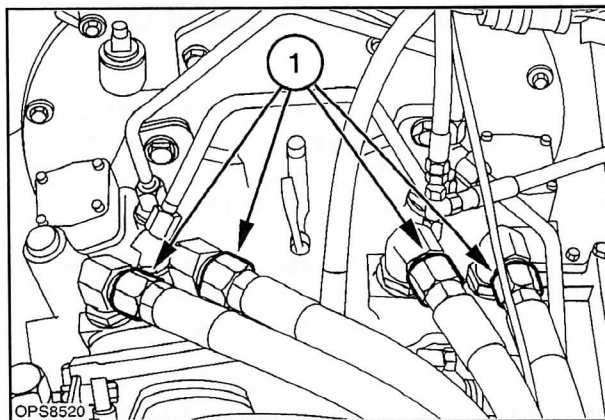


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6. Install a tee fitting, in the high-pressure loop being tested, at the pump outlet, 1.

**IMPORTANT:** Check the hydraulic oil level and add if required to ensure sufficient oil for the test.



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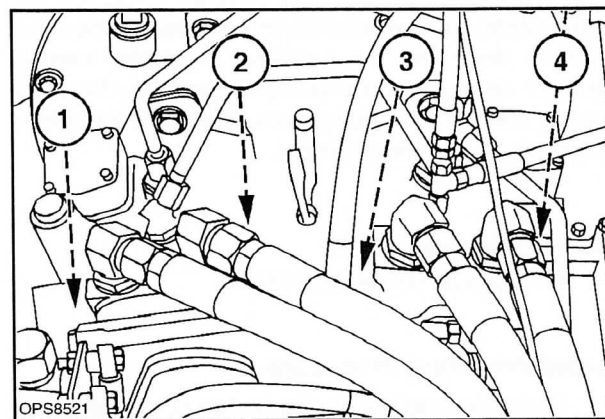
The following hydrostatic pump relief valves protect the forward and reverse direction of the hydrostatic drive motor (tire) rotation.

Right pump controls the right motor

- 1 - Forward
- 2 - Reverse

Left pump controls the left motor

- 3 - Reverse
- 4 - Forward



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7. Start the engine and run it at full throttle (2225 - 2275 RPM).
8. Stroke the hydrostatic lever on the side being tested and in the direction being tested, and take a pressure reading. The pressure should be 345 bar (5000 PSI). If the pressure is not at specification of 345 bar (5000 PSI), replace the suspect relief valve.



**CAUTION**

**Always stay clear of moving parts during testing or serious injury could occur.**

**NOTE:** All four directional relief valves can be tested in this manner.

If the pressure is within specification, refer to the pump/motor case drain test for further testing to locate the problem.



**Right Hand Hydrostatic Pump, 1**

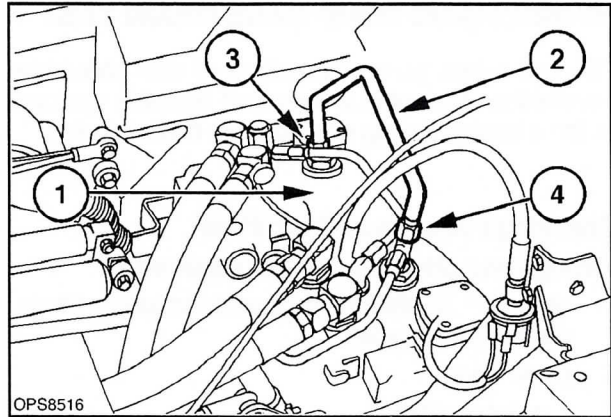
6. Remove the case drain cross tube, 2, at the right and left pump housing outlet ports, 3 and 4. Cap the open fitting at 4, on the left pump. Connect a hose to the case drain fitting at 3, on the right pump, and run into a suitable container.

**IMPORTANT:** Check the hydraulic oil level and add if required to ensure sufficient oil for the test.

7. Start the engine and run at full throttle (2225 - 2275 RPM). Take a flow reading. The maximum flow should be 5.7 l/min. (1.5 gal./min.).
8. Stroke the hydrostatic control levers forward and reverse and take a flow reading in both directions. If the flow exceeds the 5.7 l/min. (1.5 gal./min.), there is excessive leakage from the forward and/or reverse high pressure loops.

**CAUTION**

**Always stay clear of moving parts during testing or serious injury could occur.**



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**Left Hand Hydrostatic Pump, 1**

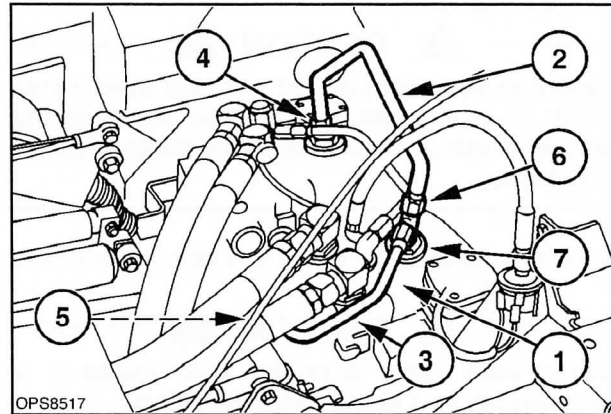
9. Remove the case drain cross tube, 2, and case drain tube, 3. Connect a hose from the case drain port on the right pump at 4, to the open inlet port on the hydraulic gear pump at 5. Remove the tee fitting, 6, connect a hose to the case drain port at 7, on the left pump, and run the hose into a suitable container.

**IMPORTANT:** Check the hydraulic oil level and add if required to ensure sufficient oil for the test.

10. Start the engine and run at full throttle (2225 - 2275 RPM). Take a flow reading. The maximum flow should be 5.7 l/min. (1.5 gal./min.).
11. Stroke the hydrostatic control levers forward and reverse and take a flow reading in both directions. If the flow exceeds the 5.7 l/min. (1.5 gal./min.), there is excessive leakage from the forward and/or reverse high pressure loops.

**CAUTION**

**Always stay clear of moving parts during testing or serious injury could occur.**



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12. If the flow from the hydrostatic pumps is less than 5.7 l/min. (1.5 gal./min.), the problem may be in the motors. Refer to the Hydrostatic Motor Case Drain Test in this section for further details.



6. Disconnect the hose to the Transmission Charge Pressure switch at 1, install a swivel nut run tee, hose and pressure gauge, and reinstall the hose to the charge pressure switch.

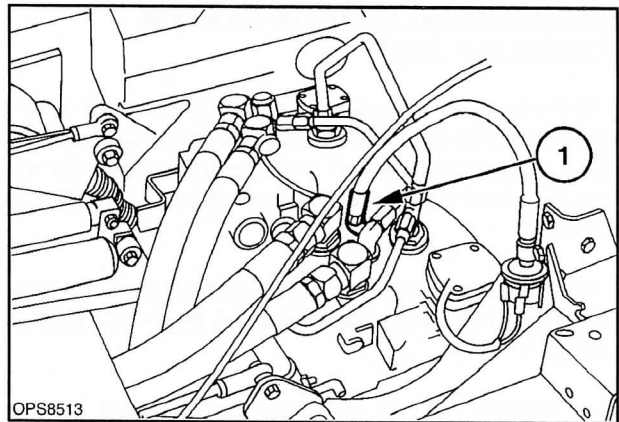
**IMPORTANT:** Check the oil level in the hydraulic oil reservoir and add SAE 10W-30 oil (if required) to make sure there is sufficient oil for the test.

7. Start the engine, run at full throttle (2225 - 2275 RPM), and take a pressure reading. The pressure should be within the 17.2 - 20.7 bar (250 - 300 PSI) allowable range.
8. Operate the hydrostatic control levers in forward and reverse until the system bypasses and take a pressure reading. Return the controls to neutral. The pressure should remain within the range of 17.2 - 20.7 bar (250 - 300 PSI).



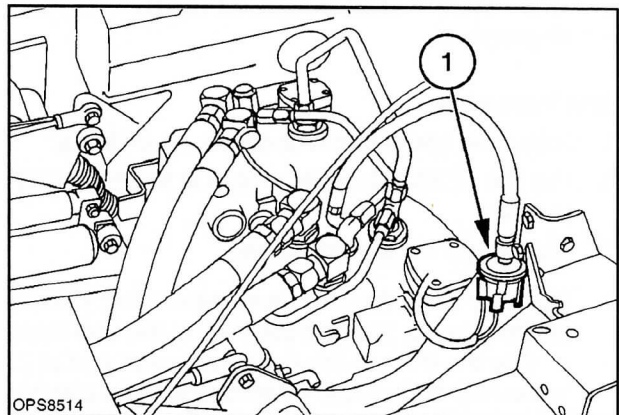
**CAUTION**

**Always stay clear of moving parts during testing or serious injury could occur.**



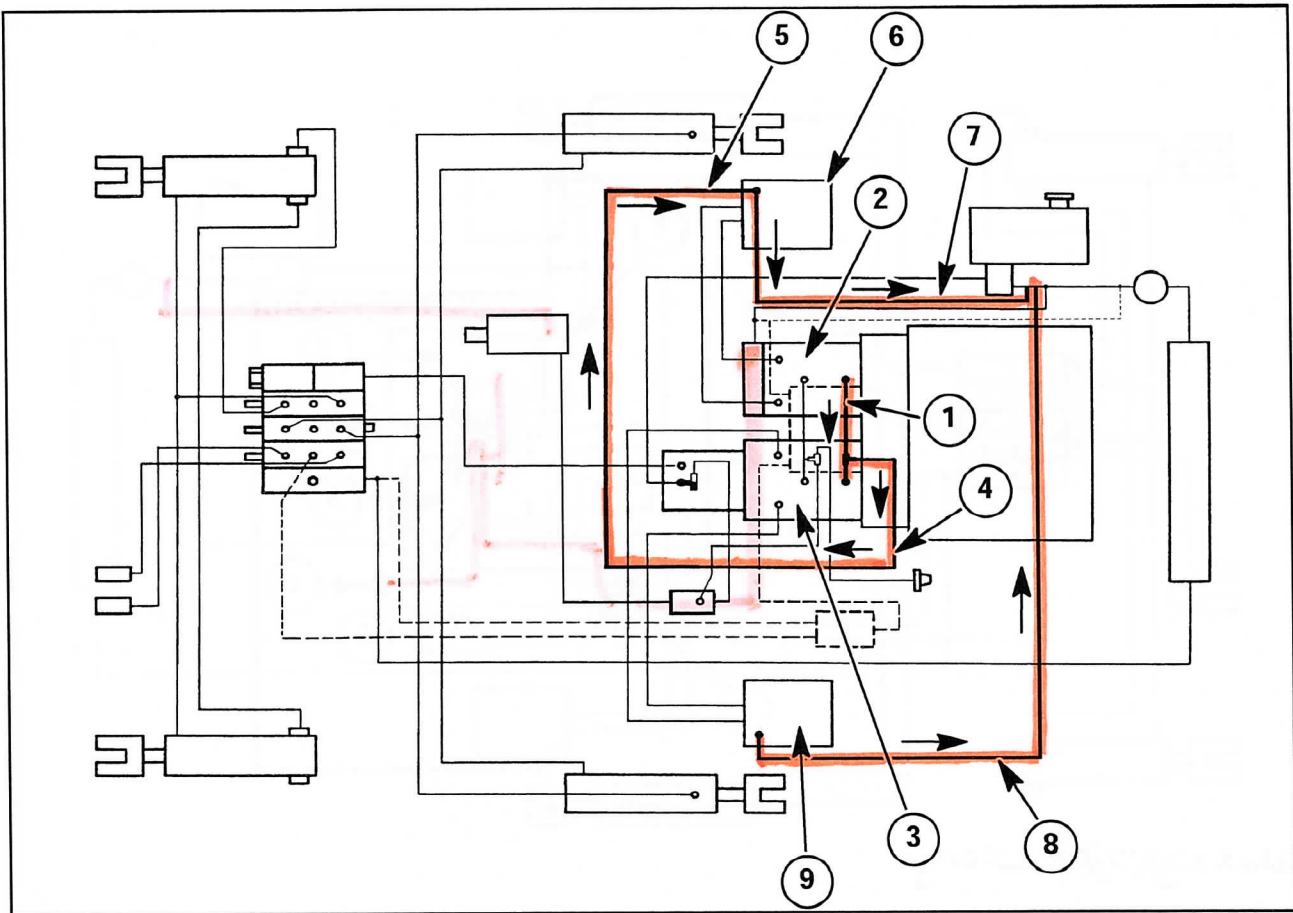
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9. If the charge pressure is within the specified range, but the EIC warning light is on indicating low charge pressure, replace the Transmission Charge Pressure sending unit, 1.
10. If charge pressure is low, refer to the Hydrostatic Pump section for disassembly instructions and check the following:
  - a. Charge pressure relief valve damage:
    1. Broken spring
    2. Damaged poppet seat
    3. Dirt or debris under poppet seat
  - b. Remove charge pump assembly and check:
    1. Gerotor ring wear, both inner and outer
    2. Drive key failure
11. Low charge pressure could also be a result of excess case drain flow from the hydrostatic pumps/motors. This is a result of worn or damaged internal components. Refer to the test procedures outlined in this section to determine the case drain flow. If case drain flow is the problem, refer to the Hydrostatic Pump/Motor Section for service instructions.



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### Hydrostatic Pump and Motor Case Drain Flow (LS180 and LS190 Two-Speed Shown)

**NOTE:** LS180 Models with fixed displacement motors operate the same, without the two-speed selector valve and shift cylinder.

During operation of the hydrostatic pumps and motors, oil from the high-pressure circuits used for lubrication drains into the pump and motor housings.

The lubrication oil will fill the housings approximately half full. This oil then becomes cooling oil and will

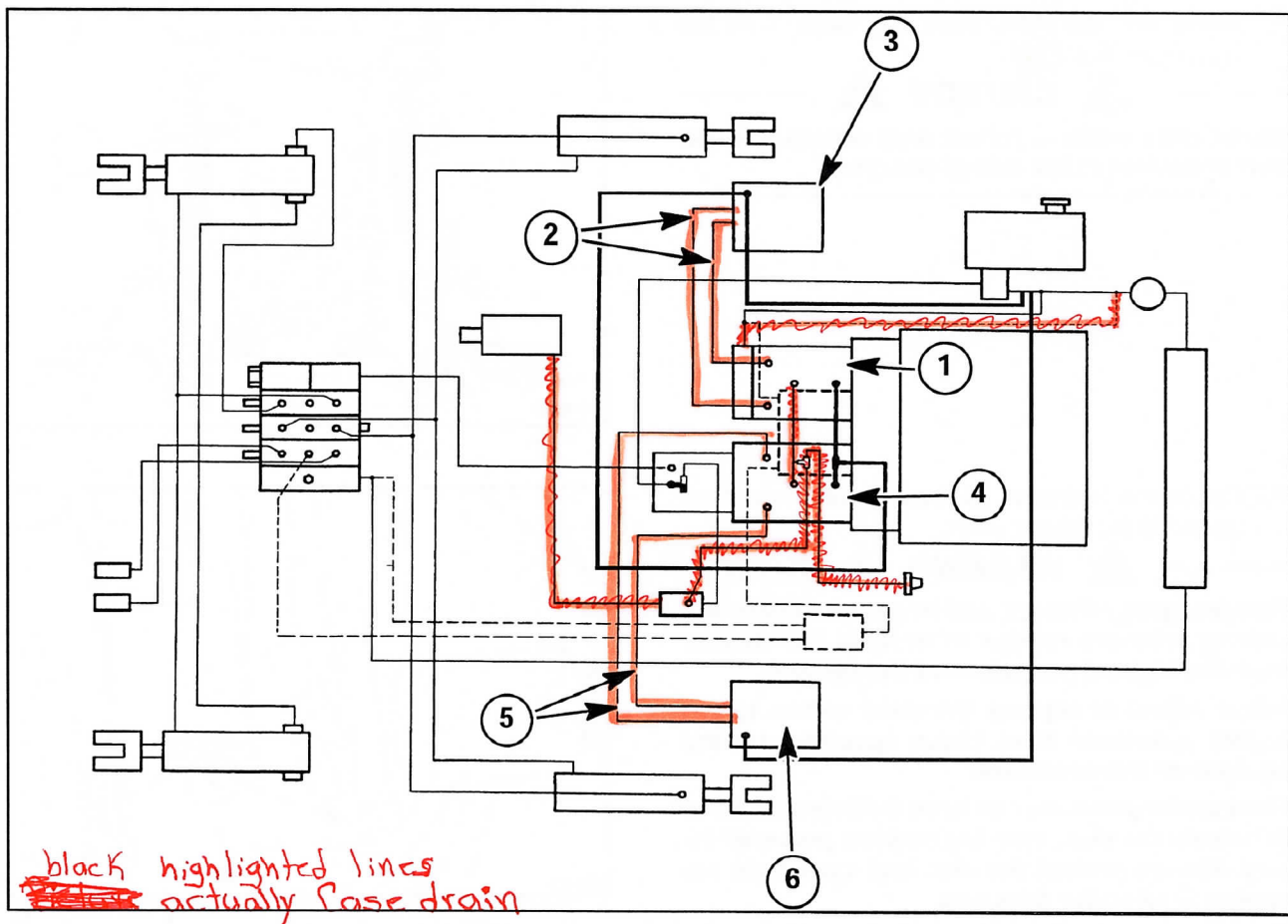
drain from the pump and motor housings (cases) through the case drain lines.

On the hydrostatic pumps, the case drain line, 1, connects the right and left pumps 2 and 3. Line 4 tees into the case drain port, 5, at the rear of the right-hand hydrostatic motor, 6. The hot ~~case drain oil is returned to the hydraulic system (to be cooled and filtered)~~ through the return line, 7.

Tube, 8, from the front case drain port on the left hand hydrostatic motor, 9, tees into the case drain port at the hydraulic reservoir.

→ Case drain ties the hydraulic & hydrostatic systems together





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## HYDROSTATIC SYSTEM OIL FLOW

### Hydrostatic Pumps and Motors High-Pressure Flow

The hydrostatic pumps are driven by the engine through a spur gear configuration in the transmission gearbox.

The right hand hydrostatic pump, 1, supplies high-pressure oil through high-pressure lines, 2, to the right hand hydrostatic motor, 3, when the right forward/reverse control lever is stroked in either direction.

The left hand hydrostatic pump, 4, supplies high-pressure oil through high-pressure lines, 5, to the left hand hydrostatic motor, 6, when the left forward/reverse control lever is stroked in either direction.

The hydrostatic system is protected by four high-pressure relief valves, two in each pump, one for forward and one for reverse. All four high-pressure relief valves are the same and are factory set at 345 bar (5000 PSI). Do not try changing the pressure setting of these relief valves. If during testing the relief valves are found to be incorrectly set, replace the complete valve cartridge.



Before performing any hydraulic tests, operate the skid steer to get the hydraulic oil to operating temperature (approximately 55° C [100° F] above the ambient temperature).

For access to the hydrostatic system, remove any attachment from the skid steer attaching face plate and support the boom on the boom lock pins.

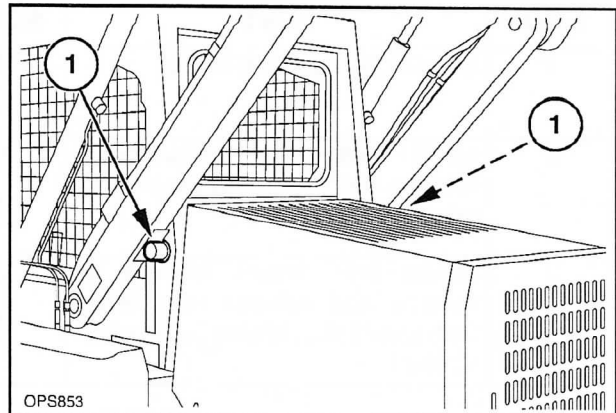
1. Raise the boom, extend the boom lock pins, 1, and rest the boom on the boom lock pins.



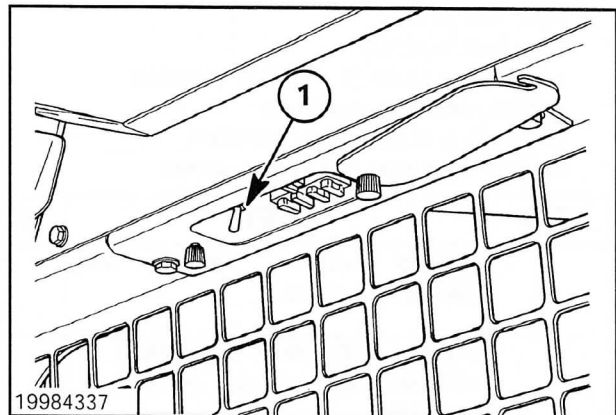
**Never work under a raised boom unless it is properly supported by the boom lock pins.**

**Never work under a raised boom with an attachment. Always remove the attachment from the skid steer.**

2. Stop the engine, turn the key to the run position and operate the boom and bucket pedals to relieve pressure in the boom and bucket circuits.
3. Put the Service/Run switch, 1, in the "SERVICE" position.



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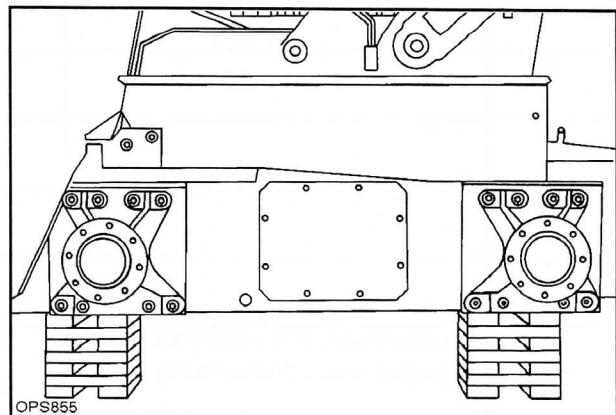


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4. Securely block the skid steer with all four wheels off the ground. Refer to Section 00 for more detailed information on properly supporting the skid steer.



**Failure to securely support the skid steer could result in movement of the skid steer causing serious injury or damage to the equipment.**



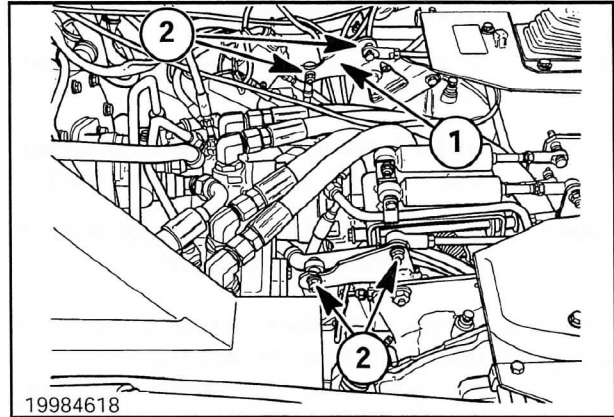
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**LS190 - Nonadjustable steering links**

The steering links, 1, on LS190 skid steers have only two pivot holes, 2, and the link cannot be adjusted. Refer to the LS190 Operator's Manual for proper transmission speed adjustment.

**IMPORTANT:** DO NOT EXCEED the 67 RPM, low range, or 106 RPM, high range, to prevent transmission overspeed and transmission damage.





### **LOW POWER THROUGH THE ENGINE/ TRANSMISSION SYSTEM**

Perceived low power has been noted in certain heavy power demand applications. Possible causes include:

- Machine overloaded - The bucket or attachment is too large for the material being handled.
  - Engine concerns.
  - The operator is not properly trained and is over-steering the servo-controlled transmissions.
1. Match the correct attachment for the material being handled. Use the bucket chart and material density chart found in the attachment section of the operator's manual. It may be necessary to weigh a bucket of material to determine the weight being handled.
  2. Engine Concerns:
    - a. Check fuel quality and grade and replace fuel if necessary.

- b. Check for plugged fuel filters and drain water trap.
  - c. Check engine timing.
  - d. The injection pump calibration has not been found out of range on any complaint machines. However, it could still be a factor.

In most cases, engine performance has been found acceptable, with the exception of bad fuel or plugged fuel filters.

3. Machine operation has been the most significant contributing factor. Operators tend to over-steer the servo-controlled transmission in heavy power demand situations, resulting in the engine lugging down or stopping.

Operators must be instructed to reduce the wheel speed (ground speed) by positioning the steering levers closer to the neutral position in heavy digging, backing out of steep inclines, or turning on pavement-type surfaces with heavy loads.



**Op. 29 100 01****TROUBLESHOOTING**

When performing tests on the hydrostatic system, use the proper test procedures and test equipment.

Before testing, lower the attachment to the ground or remove attachment from the skid steer.

If testing is to be performed with a raised boom, make sure the boom is raised above and resting on the boom lock pins, attachment removed.

Before opening the hydraulic system, clean the area thoroughly to prevent contaminating the system.

Before opening the hydraulic system, relieve all pressure from the system.

Before testing the hydraulic system, check the hydraulic oil level.

Before testing the hydraulic system, the oil must be at normal operating temperature.

If testing requires the skid steer to be raised, use adequate blocking and/or jack stands to securely support the skid steer.

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**! CAUTION !**

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**When connecting test equipment to the hydrostatic system, relieve the pressure in the system. Stop the engine, with the seat belt fastened, turn the ignition switch to the "on" position and operate all hydraulic control valve circuits to relieve pressure. Turn the ignition switch to the "off" position.**

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**! WARNING !**

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**Gauges, gauge fittings, and hoses must have operating pressure ratings of at least 25 percent higher than the highest pressures of the system.**

**Never adjust or replace the relief valves to get higher pressures than those specified by the equipment manufacturer.**

**Fluid under pressure can have sufficient force to penetrate the skin, causing serious personal injury. Always protect the skin and eyes from escaping fluid under pressure.**

**Before disconnecting lines or fittings, be sure to turn off the skid steer engine and relieve all pressure. Before applying pressure to the system, be sure all connections are tight and that lines, pipes, and hoses are not damaged.**

**If injured by escaping fluid, obtain medical assistance at once. Serious infection or reaction can develop if medical treatment is not administered immediately.**

**Remove any attachment from the mounting plate before loosening or disconnecting any hydraulic lines.**

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**! CAUTION !**

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**Use adequate blocking and/or jack stands to ensure that the skid steer is safely supported with all four wheels off the ground.**

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**SPECIFICATIONS****HYDROSTATIC PUMPS**

Type .....	Variable Displacement Piston Pump
Displacement .....	82.3 l/min. (21.47 GPM) @ 2000 RPM
Pressure Relief Setting .....	345 bar (5000 PSI)
Minimum Pump Efficiency .....	80 %
Maximum Pump Case Drain .....	5.7 l/min. (1.5 GPM) per pump
Maximum Pump Case Pressure .....	1.7 bar (25 PSI)

**HYDROSTATIC MOTORS**

<b>LS180, Single-Speed Transmission</b> .....	Fixed Displacement Piston Type
Displacement .....	40.6 cc (2.48 cubic in.)
<b>LS180 and LS190, Two-Speed Transmission</b> .....	Variable Displacement Piston Type
Displacement .....	21.0 - 40.6 cc (1.28 - 2.48 cubic in.)
Minimum Motor Efficiency .....	80 %
Maximum Motor Case Pressure .....	3.8 L (1 GPM) per motor

**CHARGE PRESSURE SYSTEM**

Charge Pump Relief Valve Setting .....	17.2 - 20.7 bar (250 - 300 PSI)
Relief Valve Torque Specifications .....	37 - 41 N·m (27 - 30 ft. lbs.)

**OIL REQUIREMENTS**

Type and Specifications .....	API Service SH/CG-4 10W-30
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**TORQUE SPECIFICATIONS****PUMPS**

Relief Valves Caps .....	136 N·m (100 ft. lbs.)
Backplate and Charge Pump Adaptor .....	37 N·m (27 ft. lbs.)
Servo Control Assembly .....	4.5 N·m (40 in. lbs.)
Gear Pump to Backplate .....	37 N·m (27 ft. lbs.)
Pump Mount to Engine Gearbox .....	61 N·m (45 ft. lbs.)

**MOTORS**

Backplate (Fixed Displacement) .....	20 N·m (15 ft. lbs.)
Backplate (Variable Displacement) .....	37 N·m (27 ft. lbs.)
Gearbox Attaching Bolts .....	61 N·m (45 ft. lbs.)



**Op. 29 100****GENERAL INFORMATION**

The hydrostatic system provides a means to transfer power from the engine to the final drives and wheels. It provides an infinite number of operator speed selections for both forward and reverse directions. The hydrostatic system also furnishes a means to steer the loader.

Each of the two hydrostatic pumps receive power from the engine through a spur gear drive configuration located in the engine to transmission gearbox. The pumps convert rotary power, developed by the engine, to variable pressure/flow fluid power. Fluid power is then transferred to the hydrostatic motors where it is transferred back to rotary motion. The rotary motion from the hydrostatic motors is transferred to the final drive gearboxes, axles, and finally to the wheels.

Hydrostatic pump flow and fluid direction is operator-controlled by levers. Both left and right side pump and motor configurations are operated independently of each other and power each side separately.

**OPERATION**

The hydrostatic system is a closed loop, fluid power system that provides a smooth transition of power from the engine to the wheels. The hydrostatic system is made up of two piston pumps, 1 and two piston motors, 2. Hydrostatic charge pressure is supplied to the pumps by a gerotor charge pump, which is attached to the right hand hydrostatic pump. This provides replenishing oil for the oil that is lost due to leakage for lubrication and cooling purposes.

Steering is controlled by two hand levers located in the operator's cab. These hand levers control the forward and reverse direction and the amount of oil flow for speed of the skid steer. The variable oil flow from the pumps is a result of the rotation of the pump camplates within the individual pumps. The further the control levers are pushed from neutral, the greater the camplate angle. More oil is then pumped to the motors, resulting in an increase in wheel speed. The greatest wheel torque is when the control levers are closest to neutral. When operating the skid steer, more power (torque), is available by destroking the control levers, thus increasing the skid steer efficiency.

