

INGERSOLL

**HYDRAULIC
TEST PROCEDURES
Service Manual 9-99784**



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This safety alert symbol indicates important safety messages in this manual. When you see this symbol, carefully read the message that follows and be alert to the possibility of personal injury or death.

HYDRAULIC SYSTEM SPECIFICATIONS

PUMP SPECIFICATIONS

MODEL & S/N RANGE	3600 RPM- 0 PSI (0 k Pa)		3000 RPM 0 PSI (0 k Pa)		3000 RPM 1000 PSI (6890 k Pa) [1500 PSI (10 340 k Pa) 14 HP and above]	
	GPM	(1/min)	GPM	(1/min)	GPM	(1/min)
180 All						
190 All						
195 All						
442 Prior to S/N 9632452						
130 All						
150 All						
155 All						
220 Prior to S/N 9674235						
222 Prior to S/N 9681170						
442 S/N 9632452 and After						
224 Prior to S/N 9676354	8-1/2	(32)	7	(26-1/2)	6-1/2	(24-1/2)
444 Prior to S/N 9677449						
446 Prior to S/N 9679207						
644 Prior to S/N 9698284						
646 All						
220 S/N 9674235 and After						
222 S/N 9681170 and After						
224 S/N 9676354 and After						
444 S/N 9677449 and After	9-1/2	(36)	8	(30-1/4)	7-1/4	(27-1/2)
446 S/N 9679207 and After						
448 All						
644 S/N 9698284 and After						
648 All						

HYDRAULIC OIL SPECIFICATIONS

Above 32°F (0°C)	Below 32°F (0°C)
API Classification SE or CC SAE 20W40 Motor Oil.	API Classification SE or CC SAE 5W20 Motor Oil

RELIEF VALVE SPECIFICATIONS

MODEL & S/N RANGE	MAIN RELIEF VALVE		ATTACHMENT LIFT RELIEF VALVE	
	CRACKING	FULL OPEN	CRACKING	FULL OPEN
130, 180 All				
150, 190 All				
155, 195 All	1500 [±] 50 PSI	1600 [±] 50 PSI	425 [±] 25 PSI	575 [±] 25 PSI
220, 222 Prior to S/N 9646800	(10 340 [±] 340 kPa)	(11 030 [±] 340 kPa)	(2930 [±] 170 kPa)	(3960 [±] 170 kPa)
442 Prior to S/N 9632452				
220, 222 S/N 9646800 and After				
442 S/N 9632452 and After	2000 [±] 50 PSI	2100 [±] 50 PSI	425 [±] 25 PSI	575 [±] 25 PSI
224 All	(13 790 [±] 340 kPa)	(14 480 [±] 340 kPa)	(2930 [±] 170 kPa)	(3960 [±] 170 kPa)
444 All				
446 All				
448 All				
644 All	2300 [±] 50 PSI	2400 [±] 50 PSI	1050 [±] 50 PSI	1150 [±] 50 PSI
646 All	(15 860 [±] 340 kPa)	(16 540 [±] 340 kPa)	(7240 [±] 340 kPa)	(7930 [±] 340 kPa)
648 All				
Hydraulic power take off valve				

NOTE: Loader bucket relief valve pressures are the same as loader attachment lift relief valves

USE OF THE HYDRAULIC FLOWMETER

INTRODUCTION

Flowmeter testing in accordance with the following procedure will permit complete and accurate diagnosis of the tractor hydraulic drive and lift systems. The flowmeter permits controlled loading of the hydraulic system while measuring the flow in gallons per minute (GPM), the pressure in pounds per square inch (PSI) and the temperature in degrees Fahrenheit (°F).

Be sure to read and follow the directions packed with your flowmeter, as well as this manual, before testing a tractor.

Enter your test results on Form 9-50611, Page 15, Hydraulic System Diagnosis Check Sheet.

FLOWMETER HOOKUP

The flowmeter should be connected to the tractor hydraulic system in accordance with figures one or two

depending whether a shutoff valve or an isolation cap is used in the tee line.

IMPORTANT: Always check oil level after connecting or disconnecting the flowmeter and add oil if required. Refer to the Specification Section of this manual for correct oil type.

A. The "pump test" hookup shown in figures one - A and two - A is used for

1. warming the hydraulic oil
2. testing the suction line
3. testing the pump

With this hookup, total system flow is directed through the flowmeter and back to reservoir.

VERY IMPORTANT: The tractor system relief valve will not function when the flowmeter is connected in the pump test hookup. Do not allow the pressure gauge to exceed normal maximum system pressure (refer to Specification page) when operating the tractor. Failure to observe this procedure may result in damage to the flowmeter and/or tractor hydraulic system.

B. The "tee test" hookup shown in figures one - B and two - B is used for

1. detecting and measuring circuit leakage
2. measuring relief valve cracking and full open pressures.

In this hookup, the total system flow may follow two pathways, one through the flowmeter, the other through the tractor hydraulic system. By energizing one hydraulic circuit at a time and controlling the pressure with the tester load valve, internal leakage may be measured in gallons per minute (GPM) (l/min) in each individual circuit.

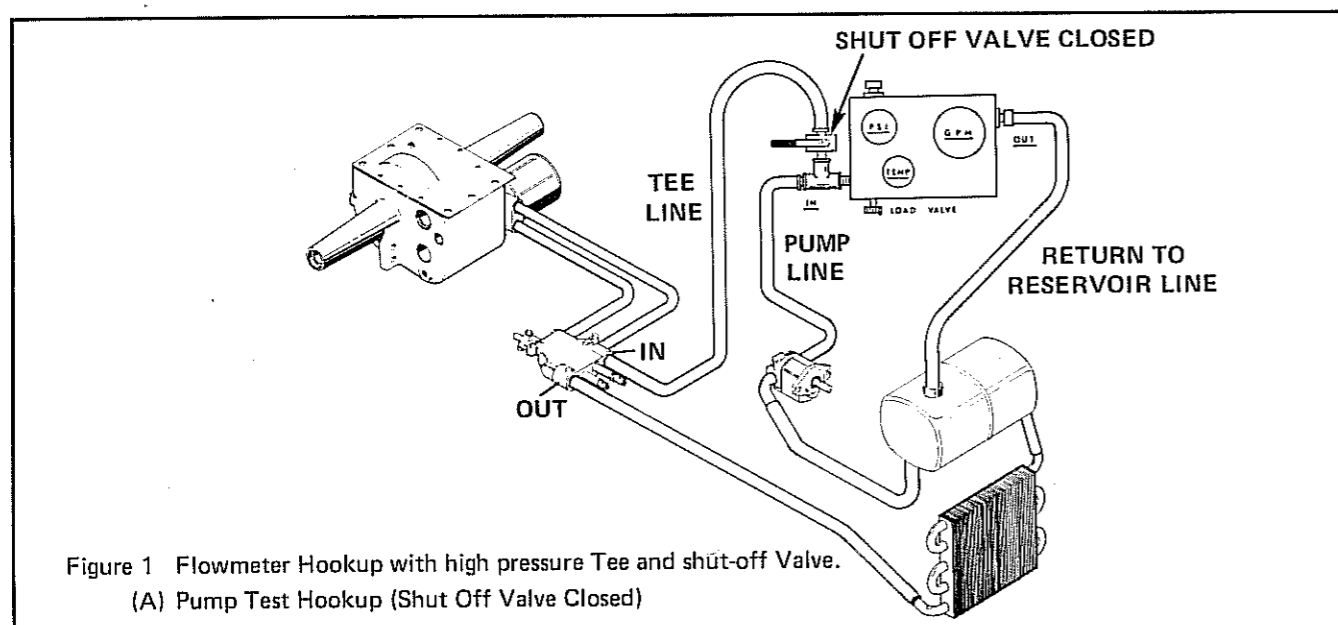
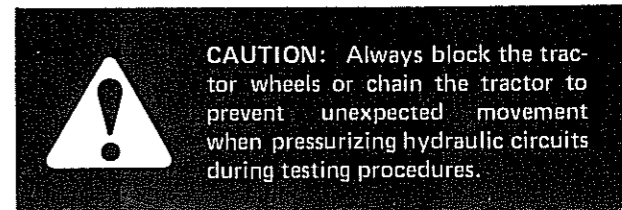


Figure 1 Flowmeter Hookup with high pressure Tee and shut-off Valve.
(A) Pump Test Hookup (Shut Off Valve Closed)

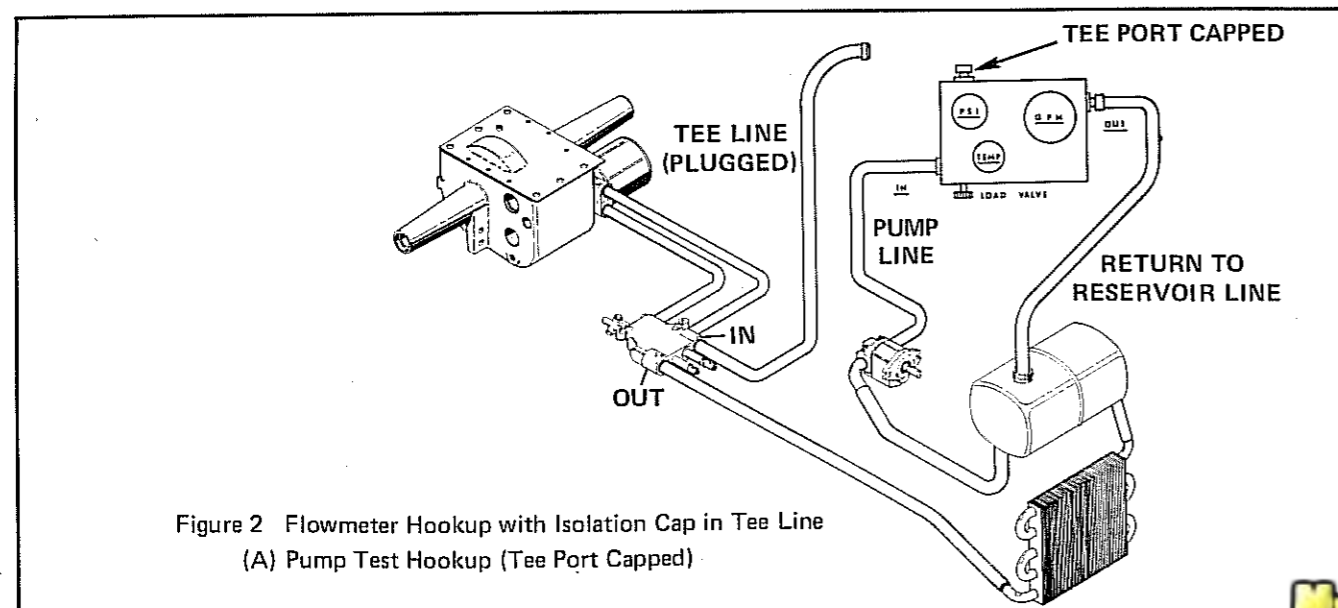


Figure 2 Flowmeter Hookup with Isolation Cap in Tee Line
(A) Pump Test Hookup (Tee Port Capped)

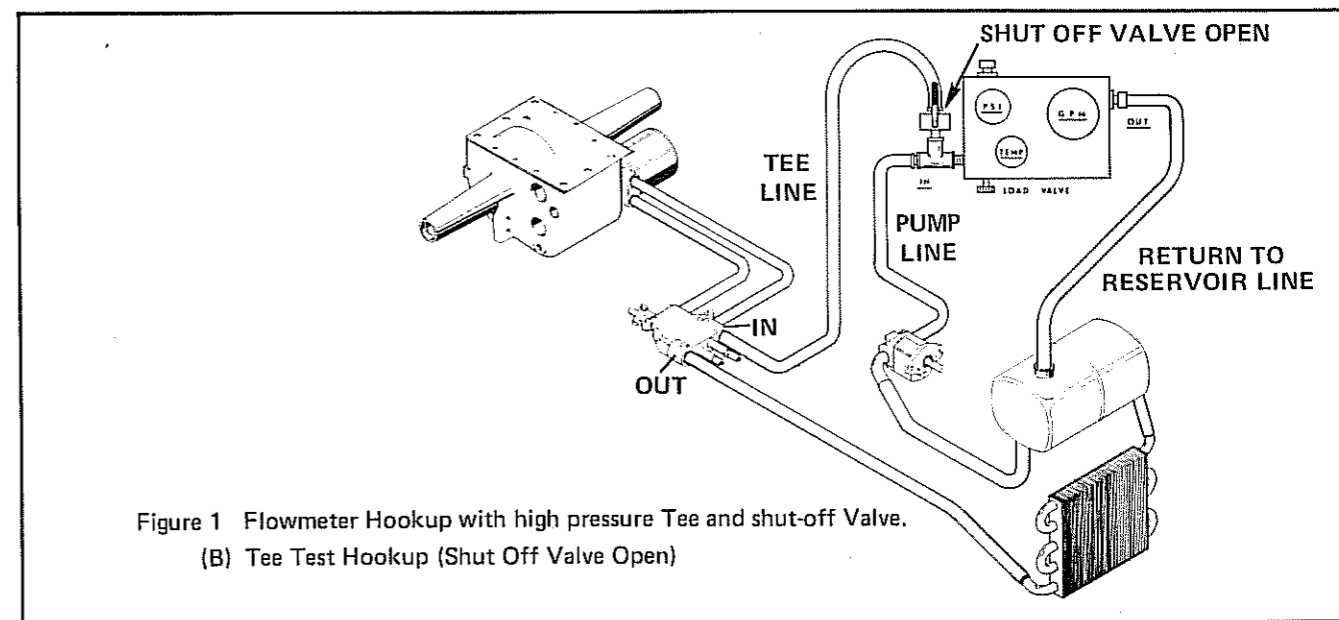


Figure 1 Flowmeter Hookup with high pressure Tee and shut-off Valve.
(B) Tee Test Hookup (Shut Off Valve Open)

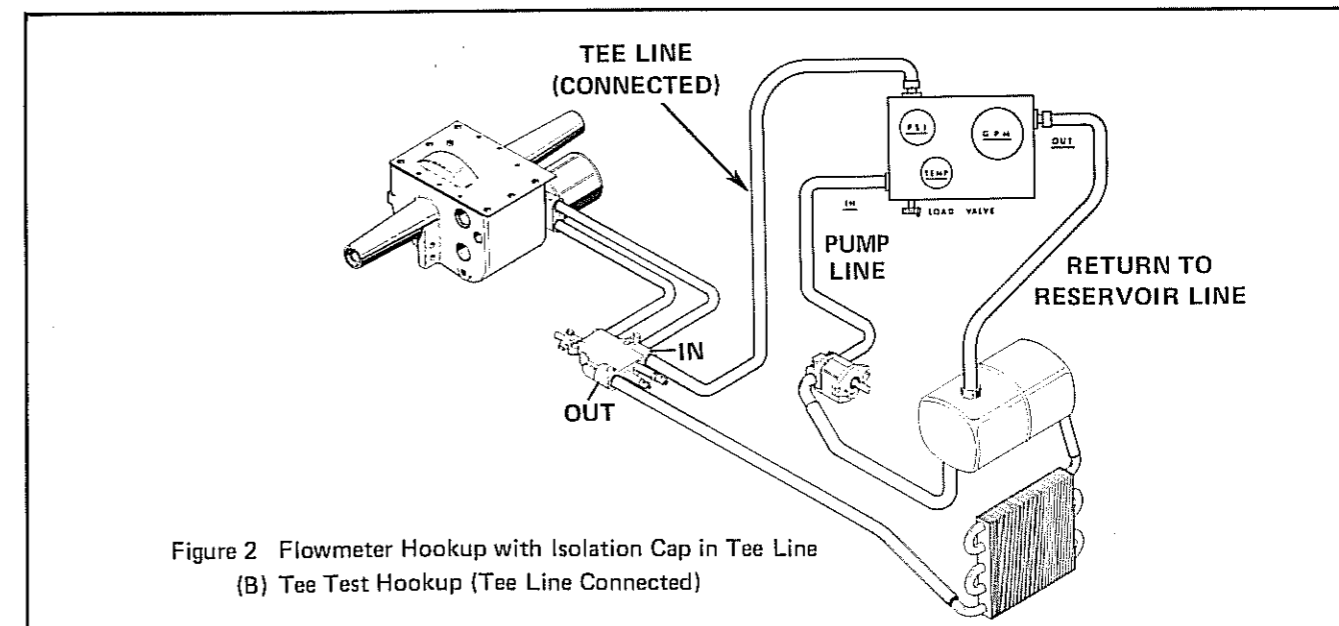


Figure 2 Flowmeter Hookup with Isolation Cap in Tee Line
(B) Tee Test Hookup (Tee Line Connected)

CONNECTING THE FLOWMETER

1. Tractors and Loaders with Hydraulic PTO attached

The flowmeter should always be connected between the pump and first valve in the system to achieve total testing with one hookup. The hydraulic PTO valve becomes the first valve since it is connected in series between the pump and travel valve.

- Disconnect the pump supply tube from the "in" port of the PTO valve.
- Connect the "pump line" from the flowmeter to the pump supply tube using a 216-675 male union.
- Connect the "tee line" to the "in" fitting of the PTO valve.
- Route the flowmeter outlet hose back to reservoir.
- This will allow testing of all tractor circuits and the hydraulic PTO circuit according to the procedure in this manual.

2. Tractors with steel tube between hydraulic pump and travel control valve (Prior to 1973):

- Stroke travel lever full forward to prevent oil loss.
- Remove the pump to valve high pressure tube.
- Install elbow 218-5232 on the pump outlet fitting and valve inlet fitting.
- For Colt Models, and Models 130, 180, 150, 190, 155, 195 use a second pump to valve tube and two 218-430 male reducing unions.
- Connect flowmeter as shown in Figure #1 or #2 as applicable.

3. Tractors with high pressure rubber hose between hydraulic pump and travel control valve (1973 and after):

- Stroke travel lever full forward to prevent oil loss.

- Remove pump to valve high pressure hose at the valve inlet fitting only.
- Install one 218-675 male union to the pump pressure hose. Install one 218-5232 elbow to the valve inlet fitting.
- Connect the flowmeter as shown in Figure #1 or #2 as applicable.

4. Loaders with steel tube between hydraulic pump and travel control valve:

- Position the direction selector in forward and clamp the travel pedal fully depressed to prevent oil loss.
- Remove the pump to valve high pressure tube. Rotate tube axially 180° (so end that connected to pump is now extending under the tractor) and reconnect to travel valve inlet fitting.
- Install one 218-675 male union to the pump to valve tube.
- Connect the flowmeter as shown in Figure #1 or #2 as applicable.

5. Loaders with high pressure hose between hydraulic pump and travel control valve (Model 644 1973 and after):

- Position the direction selector in forward and clamp the travel pedal fully depressed to prevent oil loss.
- Remove the pump to valve high pressure hose at the valve inlet fitting only.
- Install one 218-675 male union to the pump pressure hose.
- Route the tee line from the flowmeter to the travel valve around in front of the left hand loader support post to the travel valve inlet fitting.
- Connect the flowmeter as shown in Figure #1 or #2 as applicable.

HYDRAULIC FITTINGS AVAILABLE FROM CASE SERVICE PARTS SUPPLY

PART NO.	DESCRIPTION	SIZE	APPLICATION
218-675	Male Union	5/8" tube x 5/8" tube	To connect two female 5/8" tube hose ends.
218-430	Male Reducing Union	1/2" tube x 5/8" tube	Adapt flowmeter hose ends to Colt Models and Models 130, 180, 150, 190, 155, 195
218-755	Cap Nut	1/2" tube	Isolation testing travel Circuit for Colt Models and Models 130, 180, 150, 190, 155, 195
218-756	Cap Nut	5/8" tube	Isolation testing - travel circuit 200, 400 and 600 series Flowmeter Tee port cap
218-5232	Elbow	5/8" tube male x 5/8" tube female swivel	Travel valve inlet port

FLOWMETER TEST PROCEDURE

I. Warming the hydraulic oil:

NOTE: Hydraulic oil temperature should be maintained between 120°F and 140°F (49°C-60°C) throughout the testing procedure.

A. Preparation:

- Connect the flowmeter in the "pump test" hookup.
- Open flowmeter load valve.

B. Testing:

- Start tractor and run at 1/2 throttle.
- Close tester load valve to approximately 1,000 PSI (6890 k Pa).
- When oil has reached 120°F (49°C) testing may begin.

II. Suction Line Test:

A. Preparation:

- Connect the flowmeter in the "pump test" hookup.
- Maintain oil temperature between 120°F and 140°F (49°C-60°C).
- Open tester load valve all the way.

B. Testing:

- Adjust throttle setting to 3,000 RPM.

- Read and record GPM (l/min) indicated on the flowmeter.

- Adjust throttle setting to 3,600 RPM.

- Read and record GPM (l/min) indicated on the flowmeter.

C. Results:

- If the test results are within specifications listed in the pump specification section of this manual, proceed to III, Pump Efficiency Test.
- If the test results are less than that listed in the pump specification section of this manual, refer to the "Flowmeter Test Interpretation" section of this manual.

III. Pump Efficiency Test: (This test will also establish base figures for circuit leakage testing to be performed later).

A. Preparation:

- Connect the flowmeter in the "pump test" hookup.
- Maintain oil temperature between 120°F and 140°F (49°C-60°C).
- Open tester load valve.

- Adjust throttle setting to 3,000 RPM and be sure to maintain this engine speed as load is applied. Failure to do this will result in inaccurate test results.

B. Testing:

1. a. For Tractors:

- (1.) Close the load valve until 300 PSI (2070 k Pa) is obtained.
- (2.) Read and record the GPM (l/min) indicated on the flowmeter.

b. For Loaders:

- (1.) Close the load valve until 600 PSI (4140 k Pa) is obtained.
- (2.) Read and record the GPM (l/min) indicated on the flowmeter.

2. a. For 10 and 12 HP Tractors:

- (1.) Close the load valve until 1,000 PSI (6890 k Pa) is obtained.
- (2.) Read and record the GPM (l/min) indicated on the flowmeter.

b. For Tractors and Loaders 14 HP and above:

- (1.) Close the load valve until 1500 PSI (10 340 k Pa) is obtained.
- (2.) Read and record the GPM (l/min) indicated on the flowmeter.

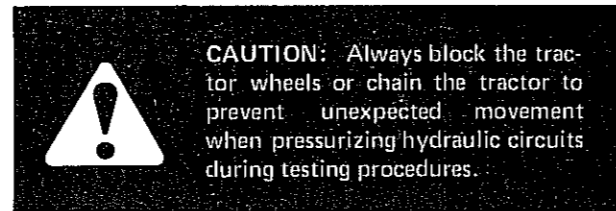
C. Results:

1. If test results are within specifications listed in the pump specification section of this manual, proceed to IV, drive circuit leakage tests.
2. If test results are less than specified refer to the "Flowmeter Test Interpretation" section of this manual.

IV. Drive Circuit Leakage Tests:

A. Preparation:

1. Connect the flowmeter in the "tee test" hookup.
2. Maintain oil temperature between 120°F and 140°F (49°C-60°C).
3. Open tester load valve.
4. Put the two-speed transaxle in high range, lock the brakes and chain the tractor or block the wheels to prevent unexpected movement. (Disconnect the travel spool control rod on models prior to S/N 9641000 before locking the brakes, then actuate the travel spool manually as required).



5. Adjust throttle setting to 3,000 PRM and be sure to maintain this engine speed as load is applied. Failure to do this will result in inaccurate test results.

B. Testing (Valve & Motor, Forward & Reverse):

1. Move the travel lever to full forward and hold (Loaders - depress pedal).

2. a. For 10 and 12 HP Tractors:

- (1.) Close the load valve until 1,000 PSI (6890 k Pa) is obtained.
- (2.) Read and record the GPM (l/min) indicated on the flowmeter.

b. For Tractors and Loaders 14 HP and above:

- (1.) Close the load valve until 1500 PSI (10 340 k Pa) is obtained.
- (2.) Read and record the GPM (l/min) indicated on the flowmeter.

3. Repeat Steps 1 and 2 above for reverse.

C. Results:

1. If the test results are within 10% of those obtained in the Pump Efficiency Test, proceed to V, Hydraulic Attachment Lift Circuit Leakage Tests.
2. If the test results indicate more than 10% loss when compared to the Pump Efficiency Test results, proceed to "D" below.

D. Preparation For Drive Circuit Isolation Test:

1. Disconnect the valve to motor hydraulic tubes and cap the valve port fittings. This will isolate the hydraulic motor from the system.

E. Testing (Valve only, Forward & Reverse)

1. Repeat Steps 1, 2, and 3 under B above.

F. Results:

1. Refer to the "Flowmeter Test Interpretation" section of this manual.

V. Hydraulic Attachment Lift Circuit Leakage Tests:

A. Preparation:

1. Connect the flowmeter in the "tee test" hookup.
2. Maintain oil temperature between 120°F and 140°F (49°C-60°C).
3. Open tester load valve.
4. Adjust throttle setting to 3,000 RPM and be sure to maintain this engine speed as load is applied. Failure to do this will result in inaccurate test results.

B. Testing (Valve and Cylinder, Raise & Lower):

1. Move the attachment lift lever to full raise and hold.

2. a. For Tractors:

- (1.) Close the load valve until 300 PSI (2068 k Pa) is obtained.
- (2.) Read and record the GPM (l/min) indicated on the flowmeter.

b. For Loaders:

- (1.) Close the load valve until 600 PSI (4136 k Pa) is obtained.
- (2.) Read and record the GPM (l/min) indicated on the flowmeter.

3. Repeat Steps 1 and 2 above for lower.

C. Results:

1. If test results are within 10% of those obtained in Pump Efficiency Test results, proceed to VI, Loader Lift Circuit Leakage Tests if testing a loader or directly to VIII main relief valve test if testing a tractor.
2. If test results indicate more than 10% loss when compared to the Pump Efficiency Test results, proceed to "D" below.

D. Preparation for Hydraulic Attachment Lift Isolation Test:

1. Disconnect the valve to cylinder hose-tubes and cap the valve port fittings. This will isolate the lift cylinder from the system.

E. Testing (valve only, Raise & Lower)

1. Repeat Steps 1, 2, and 3 under B above.

F. Results:

1. Refer to the "Flowmeter Test Interpretation" section of this manual.

VI. Loader Lift Circuit Leakage Tests:

A. Preparation:

1. Connect the flowmeter in the "tee test" hookup.
2. Maintain oil temperature between 120°F and 140°F (49°C-60°C).
3. Open tester load valve.
4. Adjust throttle setting to 3,000 RPM and be sure to maintain this engine speed as load is applied. Failure to do this will result in inaccurate test results.

5. Be sure to have adequate overhead clearance so loader lift arms may be raised fully.
6. Be sure the flowmeter return to reservoir hose is routed under the lift arms so it will not be pulled out of the tank when the arms are raised.

B. Testing (Valve & Cylinders, Raise & Lower):

1. Move the loader control lever to the full raise position and hold.
2. Close the tester load valve until 600 PSI (4136 k Pa) is obtained.
3. Read and record the GPM (l/min) indicated on the flowmeter.
4. Repeat Steps 1, 2, and 3 for "Lower." Be sure not to overstroke the spool into the float position.

C. Results:

1. If test results are within 10% of those obtained in Pump Efficiency Test results, proceed to VII, Loader Bucket Circuit Leakage Tests.
2. If the test results indicate more than 10% loss when compared to the Pump Efficiency Test results, proceed to "D" below.

D. Preparation for Loader Lift Circuit Leakage Isolation-Test:

1. Disconnect the valve to cylinder hose-tubes one at a time and cap the valve port fittings. This will isolate the cylinders from the control valve.

E. Testing (Valve & One Cylinder & Valve Only, Raise & Lower):

1. Repeat Steps 1, 2, 3 and 4 under "B" above.

F. Results:

1. Refer to the "Flowmeter Test Interpretation" section of this manual.

VII. Loader Bucket Circuit Leakage Tests:

A. Preparation:

1. Connect the flowmeter in the "tee test" hookup.
2. Maintain oil temperature between 120°F and 140°F (49°C-60°C).
3. Open Tester Load Valve.
4. Adjust throttle setting to 3,000 RPM and be sure to maintain this engine speed as load is applied. Failure to do this will result in inaccurate test results.

B. Testing (Valve & Cylinder, Dump & Rollback):

1. Move the loader control lever to dump and hold.
2. Close the tester load valve until 600 PSI (4136 k Pa) is obtained.
3. Read and record the GPM (l/min) indicated on the flowmeter.
4. Repeat Steps 1, 2, and 3 for rollback.

C. Results:

1. If test results are within 10% of those obtained in Pump Efficiency Test results proceed to VIII Main Relief Valve.
2. If test results indicate more than 10% loss when compared to the Pump Efficiency Test results, proceed to "D" below.

D. Preparation for Bucket Circuit Leakage Isolation Test:

1. Disconnect the valve to cylinder hose-tubes and cap the valve port fittings. This will isolate the cylinder from the control valve.

E. Testing (Valve Only):

1. Repeat Steps 1, 2, 3, and 4 under "B" above.

* Tests marked with an (*) may be done using a 3,000 PSI (20680 k Pa) pressure gauge. See Procedure on Page 14.

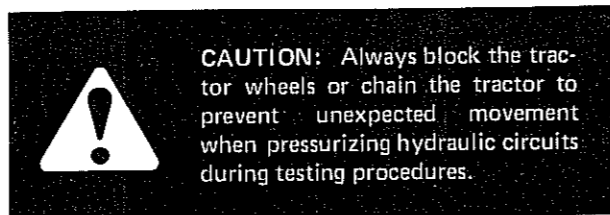
F. Results:

1. Refer to the "Flowmeter Test Interpretation" section of this manual.

*VIII. Main Relief Valve Test:

A. Preparation:

1. Connect the flowmeter in the "tee test" hookup.
2. Maintain oil temperature between 120°F and 140°F (49°C-60°C).
3. Open tester load valve.
4. Put the two speed transaxle in high range, lock the brakes and chain the tractor or block the wheels to prevent unexpected movement. Disconnect the travel spool control rod on models prior to S/N 9641000 before locking the brakes, then actuate the travel spool manually as required.



5. Adjust throttle to 3600 RPM.

B. Testing:

1. Move travel lever full forward (loader-depress pedal).
2. Close tester load valve until GPM (l/min) needle begins to drop. This is the relief valve cracking point.
3. Read and record pressure indicated on the flowmeter.
4. Continue to close tester load valve until the flow gauge reads zero GPM (l/min).
5. Read and record the pressure indicated on the flowmeter. This is the relief valve full open point.

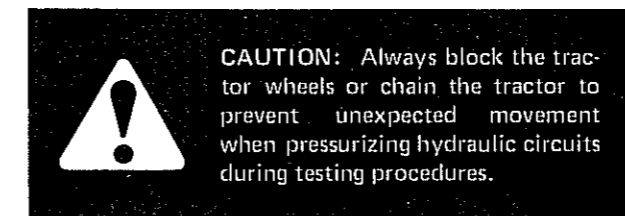
C. Results:

1. If test results are the same as listed in the hydraulic specification section of this manual, proceed to IX, Attachment Lift Relief Valve Test.
2. If test results are more or less than listed in the hydraulic specification section of this manual, increase or decrease the pressure as required and retest.

NOTE: Ten and twelve horsepower tractors may lose engine RPM before a meaningful travel relief valve opening point is established.

An alternative method for establishing relief valve full opening point is as follows:

1. Check to make sure shut off valve is open. Close tester load valve all the way.
2. Adjust engine throttle to 3600 RPM.
3. Put the two speed transaxle in high range, lock the brakes and chain the tractor or block the wheels to prevent unexpected movement. Disconnect the travel spool control rod on models prior to S/N 9641000 before locking the brakes, then actuate the travel spool manually as required.



4. Operate travel control spool into full forward and read and record maximum pressure indication before engine RPM drops. A telltale relief valve squeal should be noted in this test.

*IX. Attachment Lift Relief Valve Test:

A. Preparation:

1. Connect the flowmeter in the "tee test" hookup.
2. Maintain oil temperature between 120°F and 140°F (49°C-60°C).
3. Open tester load valve.
4. Adjust throttle to 3,600 RPM.

B. Testing:

1. Move attachment lift lever to the full raise position and hold.
2. Close tester load valve until GPM (l/min) needle begins to drop. This is the relief valve cracking point.
3. Read and record the pressure indicated on the flowmeter.
4. Continue to close the tester load valve until the flow gauge reads 0 GPM (l/min).

* Tests marked with an (*) may be done using a 3,000 PSI (20680 k Pa) pressure gauge. See Procedure on Page 14.

5. Read and record the pressure indicated on the flowmeter. This is the relief valve full open point.

C. Results:

1. If test results are the same as listed in the hydraulic specification section of this manual, proceed to X, Loader Bucket Relief Valve Test.
2. If test results are more or less than listed in the hydraulic specification section of this manual, increase or decrease the pressure as required and retest.

*X. Loader Bucket Relief Valve Test:

A. Preparation:

1. Connect the flowmeter in the "tee test" hookup.
2. Maintain oil temperature between 120°F and 140°F (49°C-60°C).
3. Open tester load valve.
4. Adjust throttle to 3600 RPM.

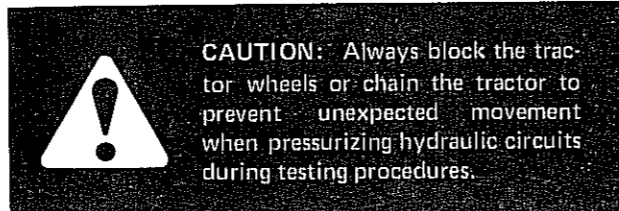
B. Testing:

1. Move loader control lever to full rollback and hold.
2. Close tester load valve until GPM (l/min) needle begins to drop. This is the relief valve cracking point.
3. Read and record the pressure indicated on the flowmeter.
4. Continue to close the tester load valve until the flow gauge reads 0 GPM (l/min).
5. Read and record the pressure indicated on the flowmeter. This is the relief valve full open point.

C. Results:

1. If test results are the same as listed in the hydraulic specification section of this manual, conclude the test.
2. If test results are more or less than listed in the hydraulic specification section of this manual, increase or decrease the pressure as required and retest.

Relief valve pressure settings may be determined using a 3,000 PSI (20 680 kPa) pressure gauge connected to the travel valve pressure test port. The procedure for checking the valves would be as follows:



A. Preparation:

1. Connect pressure gauge to travel valve pressure test port.
2. Adjust throttle to 3,600 RPM.
3. Operate circuits several times to stabilize oil temperature.

B. Testing:

1. Operate the circuit in which the relief valve is located full stroke and hold.

2. Read and record the pressure indicated on the pressure gauge. This is the full open pressure.

I. Oil Temperature should be maintained between 120°F and 140°F (49°C-60°C) throughout the testing procedure.

II. SUCTION LINE	3000 RPM @ 0 PSI [0 k Pa]	_____ GPM
	3600 RPM @ 0 PSI [0 k Pa]	_____ GPM
III. PUMP EFFICIENCY (3000 RPM)	@300 psi [2068 k Pa] (600 psi for loaders) [4136 k Pa]	_____ GPM
	@1000 psi [6890 k Pa] (1500 psi on 14 hp and above) [10 340 k Pa]	_____ GPM

CIRCUIT LEAKAGE TESTS (3000 RPM)

IV. DRIVE CIRCUIT TESTS	Valve & Motor	Valve only
1. FORWARD @ 1000 psi [6890 k Pa] (1500 psi on 14 hp and above) [10 340 k Pa]	_____ GPM	_____ GPM
2. REVERSE @ 1000 psi [6890 k Pa] (1500 psi on 14 hp and above) [10 340 k Pa]	_____ GPM	_____ GPM

V. HYDRAULIC ATTACHMENT LIFT CIRCUIT TESTS	Valve & Cylinder	Valve only
1. RAISE @ 300 psi [2068 k Pa] (600 psi on loaders) [4136 k Pa]	_____ GPM	_____ GPM
2. LOWER @ 300 psi [2068 k Pa] (600 psi on loaders) [4136 k Pa]	_____ GPM	_____ GPM

VI. LOADER LIFT CIRCUIT TESTS	Valve & Cylinders	Valve Only	Valve and one Cylinder
1. RAISE @ 600 psi [4136 k Pa]	_____ GPM	_____ GPM	_____ GPM
2. LOWER @ 600 psi [4136 k Pa]	_____ GPM	_____ GPM	_____ GPM

VII. LOADER BUCKET CIRCUIT TESTS	Valve & Cylinder	Valve Only
1. ROLL BACK @ 600 psi [4136 k Pa]	_____ GPM	_____ GPM
2. DUMP @ 600 psi [4136 k Pa]	_____ GPM	_____ GPM

VIII. MAIN RELIEF VALVE: (3600 RPM)	CRACKING _____ PSI	FULL OPEN _____ PSI
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IX. HYDRAULIC ATTACHMENT LIFT RELIEF VALVE: (3600 RPM)	CRACKING _____ PSI	FULL OPEN _____ PSI
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X. LOADER, RELIEF VALVE: (3600 RPM)	CRACKING _____ PSI	FULL OPEN _____ PSI
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COMPACT TRACTORS — HYDRAULIC SYSTEM DIAGNOSIS

I. Oil Temperature should be maintained between 120°F and 140°F (49°C-60°C) throughout the testing procedure.

II. SUCTION LINE	3000 RPM @ 0 PSI [0 k Pa]	_____	GPM
	3600 RPM @ 0 PSI [0 k Pa]	_____	GPM

III. PUMP EFFICIENCY (3000 RPM)	@300 psi [2068 k Pa] (600 psi for loaders) [4136 k Pa]	_____	GPM
	@1000 psi [6890 k Pa] (1500 psi on 14 hp and above) [10 340 k Pa]	_____	GPM

CIRCUIT LEAKAGE TESTS (3000 RPM)

IV. DRIVE CIRCUIT TESTS

	Valve & Motor	Valve only
1. FORWARD @ 1000 psi [6890 k Pa] (1500 psi on 14 hp and above) [10 340 k Pa]	_____ GPM	_____ GPM
2. REVERSE @ 1000 psi [6890 k Pa] (1500 psi on 14 hp and above) [10 340 k Pa]	_____ GPM	_____ GPM

V. HYDRAULIC ATTACHMENT LIFT CIRCUIT TESTS

	Valve & Cylinder	Valve only
1. RAISE @ 300 psi [2068 k Pa] (600 psi on loaders) [4136 k Pa]	_____ GPM	_____ GPM
2. LOWER @ 300 psi [2068 k Pa] (600 psi on loaders) [4136 k Pa]	_____ GPM	_____ GPM

VI. LOADER LIFT CIRCUIT TESTS

	Valve & Cylinders	Valve Only	Valve and one Cylinder
1. RAISE @ 600 psi [4136 k Pa]	_____ GPM	_____ GPM	_____ GPM
2. LOWER @ 600 psi [4136 k Pa]	_____ GPM	_____ GPM	_____ GPM

VII. LOADER BUCKET CIRCUIT TESTS

	Valve & Cylinder	Valve Only
1. ROLL BACK @ 600 psi [4136 k Pa]	_____ GPM	_____ GPM
2. DUMP @ 600 psi [4136 k Pa]	_____ GPM	_____ GPM

VIII. MAIN RELIEF VALVE: (3600 RPM) CRACKING _____ PSI FULL OPEN _____ PSI

IX. HYDRAULIC ATTACHMENT LIFT RELIEF VALVE: (3600 RPM) CRACKING _____ PSI FULL OPEN _____ PSI

X. LOADER, RELIEF VALVE: (3600 RPM) CRACKING _____ PSI FULL OPEN _____ PSI

FLOWMETER TEST INTERPRETATION

I. Warming Oil - Hydraulic oil temperature should be maintained between 120°F and 140°F (49°C-60°C). Temperatures outside this range may lead to false test results.

II. Suction Line Test

If the no-load flow is less than acceptable, one or more of three problem possibilities can exist; suction line air entry, suction line restriction, or a bad pump. To assist in determining the problem source:

A. Open tester load valve.

B. Close shut-off valve.

C. Increase load on the pump with the tester load valve to 600-800 psi and adjust RPM, if necessary.

D. Observe and make note of the GPM reading and of the stability of the pressure gauge needle.

E. Release load and use the following chart to determine problem type and probable source. The normal no-load flow may exceed the rated load GPM specification.

TESTER INDICATIONS	TYPE OF PROBLEM	PROBLEM POSSIBILITIES
GPM — NO OR LITTLE DROP FROM NO-LOAD READING PSI — NEEDLE FLUCTUATING BADLY AT 600-800 psi [4136 - 5515 k Pa] PUMP IS NOISY	1. Suction line air leakage	<ol style="list-style-type: none"> 1. Low reservoir oil level. 2. Loose suction line clamps. 3. Small hole in hose or steel line. 4. Loose fittings at pump inlet. 5. Air entry at pump shaft seal caused by severe suction line restriction, overspeeding pump, or use of incorrect oil.
GPM — NO OR LITTLE DROP FROM NO-LOAD READING PSI — NEEDLE STEADY AT 600-800 psi [4136 - 5515 k Pa] PUMP IS NOISY	2. Suction line restriction, (Cavitation)	<ol style="list-style-type: none"> 1. Use of incorrect oil (too heavy). 2. Reservoir vent plugged. 3. Foreign material blocking reservoir outlet. 4. Foreign material lodged in suction line. 5. Collapsed hose section. 6. Bent or crushed pump suction line.
GPM — NOTICEABLE OR SEVERE DROP FROM NO-LOAD READING PSI — NEEDLE STEADY AT 600-800 psi [4136 - 5515 k Pa]	3. Pump efficiency loss	<ol style="list-style-type: none"> 1. Deficient pump.

III. Pump Test

The pump specification section of this manual allows an approximate 10% drop in GPM between 0 PSI (0 k Pa) and 1500 PSI (10 340 k Pa). A pump should be considered new and serviceable if it tests within this range.

Pump flow reading lower than this may still be acceptable depending on intended usage of the machine. Generally, a pump that has dropped to 75% efficiency should be replaced.

parison (or base) figures for circuit leakage testing are established in the Pump Efficiency Test Section of the test procedures.

A loss of 10% or more from any circuit when compared with the base figure would require, first isolation testing to identify the component and repair or replacement to eliminate the leakage.

IV, V, VI and VII All Circuit Leakage Tests

The circuit leakage tests determine circuit (valve and cylinder or valve and motor) leakage by comparing the loaded circuit tests with the flow available from the pump at the same load. The com-

VIII, IX, X Relief Valve Tests

The purpose of the relief valve tests is to determine the maximum operating pressure in each circuit. A pressure setting that is too high will cause reduced system operating life and possibly component (pump, valve, cylinder, motor, lines, or hose) failure. A pressure setting that is too low will cause reduced power in either the drive system or hydraulic lift system and can also cause excessive heat.

HAND PUMP TESTING OF RELIEF VALVES

Relief valve cracking points may be determined with the valve assembly removed from the tractor by using a hydraulic hand pump. Two acceptable hand pump hook-ups are shown below.

HAND PUMP TEST PROCEDURE

1. Connect the hose from the hand pump to the Inlet port of the control valve assembly to be tested.

2. Cap the control valve assembly work ports.
3. Move the valve spool full stroke in either direction.
4. Pump the hand pump to pressurize the valve.
5. The highest pressure obtainable is the relief valve cracking point.

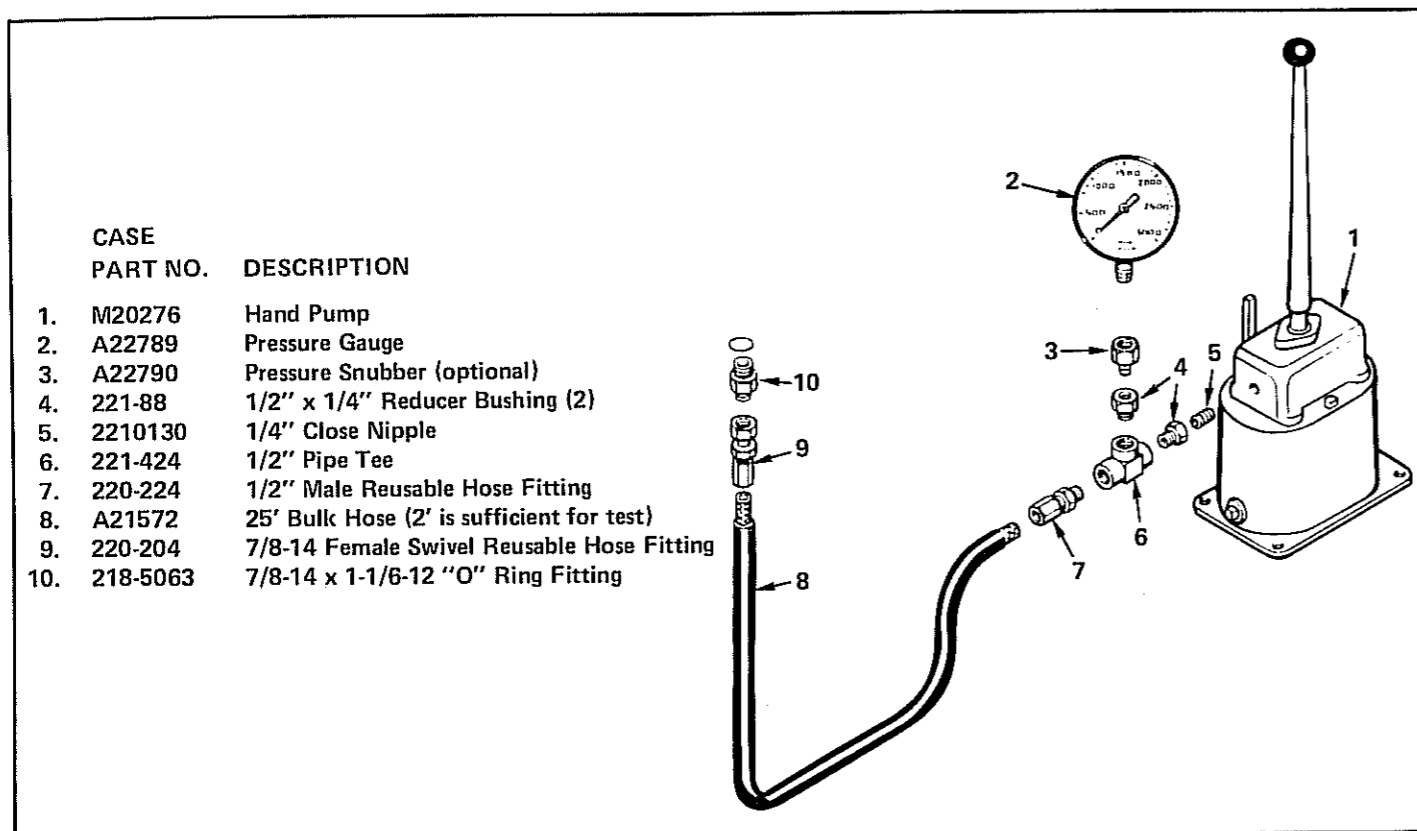


Figure 3 Hand Pump and Fittings to Check Relief Valve Cracking Pressures

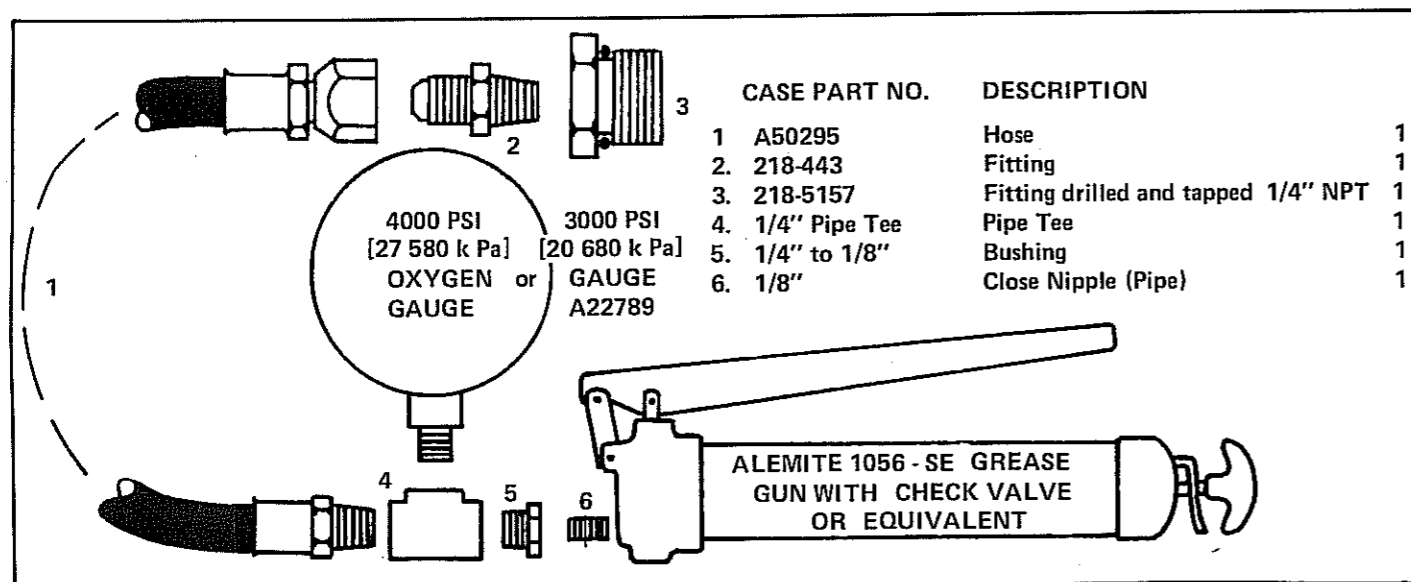


Figure 4 Grease Gun and Fittings to Check Relief Valve Cracking Pressures

RETARD ADJUSTMENT

The restriction of return oil from the hydraulic motor provides dynamic braking in the hydraulic drive system. This restriction can be measured and adjusted according to the following procedure:

A. Preparation:

1. Install 3,000 PSI (20 680 k Pa) gauge in the travel valve pressure test port.
2. Place the two speed transaxle in neutral.
3. Adjust engine throttle to 3,600 RPM.

B. Testing:

1. Slowly move the travel lever from neutral to full forward and from neutral to full reverse while monitoring the pressure gauge. A high pressure reading of approximately

300 PSI (2070 k Pa) should occur when the travel lever is in the retard detent. This would indicate that retard is properly adjusted.

2. If the high pressure reading occurs at a point other than the retard detent, adjust the ball joint at the travel valve spool until a reading is obtained as in 1 above.

NOTE: The absolute retard pressure may vary slightly from tractor to tractor due to oil temperature and valve tolerances. If the highest retard pressure cannot be obtained in both forward and reverse, adjustment should be made to balance the pressures as closely as possible. Failure to achieve a high retard pressure as in 1 above in either forward or reverse would indicate a defective control valve.