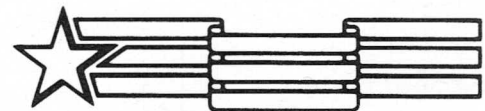


Ingersoll

**HYDRAULIC SYSTEM
SPECIFICATIONS AND
TEST PROCEDURES
Service Manual 9-99786**



QUALITY IN THE AMERICAN TRADITION

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HYDRAULIC PUMP SPECIFICATIONS

MODEL & SERIAL NUMBER		3600 RPM @ 0 PSI (0 kPa) GPM (1/MIN)	3000 RPM @ 0 PSI (0 kPa) GPM (1/MIN)	3000 RPM @ 1000 PSI (6890 kPa) 1500 PSI (10340 kPa) on 14 HP & ABOVE GPM (1/MIN)
180	ALL	10 (37.75)	8.25 (31.25)	7.5 (28.25)
190	ALL			
195	ALL			
442	PRIOR TO S/N 9632452			
130	ALL	8.5 (32)	7 (26.5)	6.5 (24.5)
150	ALL			
155	ALL			
220	PRIOR TO S/N 9674235			
222	PRIOR TO S/N 9681170			
224	PRIOR TO S/N 9676354			
442	S/N 9632452 AND UP			
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 UP	9.50 (36)	8 (30.25)	7.25 (27.50)
222	S/N 9681170 AND UP			
224	S/N 9676354 AND UP			
444	S/N 9677449 AND UP			
446	S/N 9679207 AND UP			
448	ALL			

HYDRAULIC PUMP SPECIFICATIONS

MODEL & SERIAL NUMBER		3600 RPM @ 0 PSI / (0 kPa) GPM (1/MIN)	3000 RPM @ 0 PSI / (0 kPa) GPM (1/MIN)	3000 RPM @ 1000 PSI (6890 kPa) 1500 PSI (10340 kPa) ON 14 HP & ABOVE GPM (1/MIN)																
644	S/N9698284 AND UP	9.5 (36)	8 (30.25)	7.25 (27.5)																
648	ALL																			
3010, 3012	ALL																			
3014, 3016	ALL																			
3018, 3020	ALL																			
4014, 4016	ALL																			
4018, 4020	ALL																			
3016PS 3018PS 3020PS 4016PS 4018PS 4020PS	ALL ALL ALL ALL ALL ALL	11.25 (42.75)	9.5 (36)	8.25 (31)																
3118 4116 4118 4120	ALL ALL ALL ALL	FRONT SECTION * 11.25 (42.75) REAR SECTION ** 2.50 (9.75)	FRONT SECTION * 9.5 (36) REAR SECTION ** 2..25 (8.5)	FRONT SECTION * 8.25 (31) REAR SECTION ** 1.75 (6.75)																
6018	ALL			FRONT SECTION * 8.8 (33.3) REAR SECTION ** 4.8 (18.2)																
<div>* FRONT PUMP SECTION - SECTION NEAREST FRONT OF TRACTOR</div> <table><tr><td>MODELS</td><td>CIRCUIT</td></tr><tr><td>3100, 4100</td><td>PTO, TRAVEL, ATTACHMENT LIFT</td></tr><tr><td>6018 LOADER</td><td>POWER-STEERING, LOADER</td></tr><tr><td>6018 LOADER/BACKHOE</td><td>BACKHOE, POWER-STEERING, LOADER</td></tr></table> <div>** REAR PUMP SECTION - SECTION NEAREST REAR OF TRACTOR</div> <table><tr><td>MODELS</td><td>CIRCUIT</td></tr><tr><td>3100, 4100</td><td>P O W E R - S T E E R I N G</td></tr><tr><td>6018 LOADER</td><td>PTO, TRAVEL, ATTACHMENT LIFT</td></tr><tr><td>6018 LOADER/BACKHOE</td><td>TRAVEL</td></tr></table>					MODELS	CIRCUIT	3100, 4100	PTO, TRAVEL, ATTACHMENT LIFT	6018 LOADER	POWER-STEERING, LOADER	6018 LOADER/BACKHOE	BACKHOE, POWER-STEERING, LOADER	MODELS	CIRCUIT	3100, 4100	P O W E R - S T E E R I N G	6018 LOADER	PTO, TRAVEL, ATTACHMENT LIFT	6018 LOADER/BACKHOE	TRAVEL
MODELS	CIRCUIT																			
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3100, 4100	P O W E R - S T E E R I N G																			
6018 LOADER	PTO, TRAVEL, ATTACHMENT LIFT																			
6018 LOADER/BACKHOE	TRAVEL																			

RELIEF VALVE SPECIFICATIONS

MODEL & SERIAL NUMBER		TRAVEL RELIEF VALVE SETTINGS	ATTACHMENT LIFT RELIEF VALVE SETTINGS	PTO RELIEF VALVE SETTING	POWER STEERING RELIEF VALVE SETTING
130	ALL	1600 ± 50 PSI (11030 ± 340 kPa)	575 ± 25 PSI (3960 ± 170 KPa)		
150	ALL				
155	ALL				
180	ALL				
190	ALL				
195	ALL				
220	PRIOR TO S/N 9646800				
222	PRIOR TO S/N 9646800				
442	PRIOR TO S/N 9632452				
220	S/N 9646800 AND UP	2100 ± 50 PSI (14480 ± 340 kPa)	575 ± 25 PSI (3960 ± 170 kPa)	2200 ± 50PSI (15169 ±340 kPa)	460 ± 25 PSI (3172 ± 170 kPa)
222	S/N 9646800 AND UP				
224	ALL				
442	S/N 9632452 AND UP				
444	ALL				
446	ALL				
448	ALL				
3010	ALL				
3012	ALL				
3014	ALL				
3016	ALL				
3018	ALL				
4014	ALL				
4016	ALL				
4018	ALL				
4020	ALL				

RELIEF VALVE SPECIFICATIONS

MODEL & SERIAL NUMBER		MAIN RELIEF VALVE * SETTINGS	ATTACHMENT LIFT RELIEF VALVE SETTINGS	POWER STEERING RELIEF VALVE SETTINGS	
3118	ALL	2800 ± 50 PSI 19320 ± 340 kPa	575 ± 25 PSI 3960 ± 170 kPa		
4116	ALL			460	
4118	ALL			± 25 PSI	
4120	ALL			(3172 ± 170 kPa)	
* REGULATES MAX. PRESSURE IN PTO AND TRAVEL CIRCUITS.					

MODEL & SERIAL NUMBER		TRAVEL RELIEF VALVE SETTINGS	ATTACHMENT LIFT RELIEF VALVE ** SETTINGS	PTO RELIEF VALVE SETTINGS	
644	ALL	2400 ± 50 PSI	1150 ± 50 PSI	2500 ±50 PSI	
646	ALL	(16540 ± 340 kPa)	7930 ± 340 kPa)	(17238 ± 340 kPa)	
648	ALL				
** REGULATES MAX. PRESSURE IN ATTACHMENT LIFT AND LOADER CIRCUITS					
BACKHOE RELIEF VALVES:					
644 AND 646 PRIOR TO PIN 9732040 W/2 HOSES TO BACKHOE 2000 PSI (13790 kPa)					
646B AND 648 W/3 HOSES TO BACKHOE 2300 PSI (16000 kPa)					

MODEL & SERIAL NUMBER		TRAVEL RELIEF VALVE SETTINGS	LIFT RELIEF (3 PT) VALVE SETTINGS	PTO RELIEF VALVE SETTINGS	POWER STEERING/ LOADER RELIEF VALVE SETTINGS
6018	PRIOR TO S/N14153029	2400 ± 50 PSI (16540 ± 340 kPa)	1200 ± 25 PSI (8274 ± 170 kPa)	2500 ± 50 PSI	1500 ± 50 PSI
6018	S/N14153029 AND UP	2750 ± 50 PSI (18961± 340 kPa)		(17238 ± 340 kPa)	(10343 ± 340 kPa)
BACKHOE RELIEF VALVES:					
MODEL BH750WD 2000 PSI (13790 kPa)					
MODEL BH65WD 2400 PSI (16548 kPa)					

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 minutes (GPM), the pressure in pounds per square inch (PSI) and the temperature in degrees Fahrenheit (°F).

In this section, we will show four types of flowmeter connections.

1. To show connections for dealers with Case or Ingersoll Hydra-Sleuth tester. This tester configuration has three hose connections and can be used to perform a number of tests after the initial hook-up.

Two types of Hydra-Sleuths are currently being used. Type 1 has high pressure tee and shut-off valve as in Figures 1 & 5. Type 2 has internal tee line and isolation cap as in Figures 2 & 6.

2. For connection to standard flowmeter which has fittings, shutoff valve and three line connection. With this configuration, tester can perform same tests as Case/Ingersoll Hydra-Sleuth. This tester is shown in Figures 3 & 7.
3. For connection to standard flowmeter. This tester has two line configuration. This tester is shown in Figure 4.

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

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.

PUMP TEST FLOWMETER CONNECTIONS

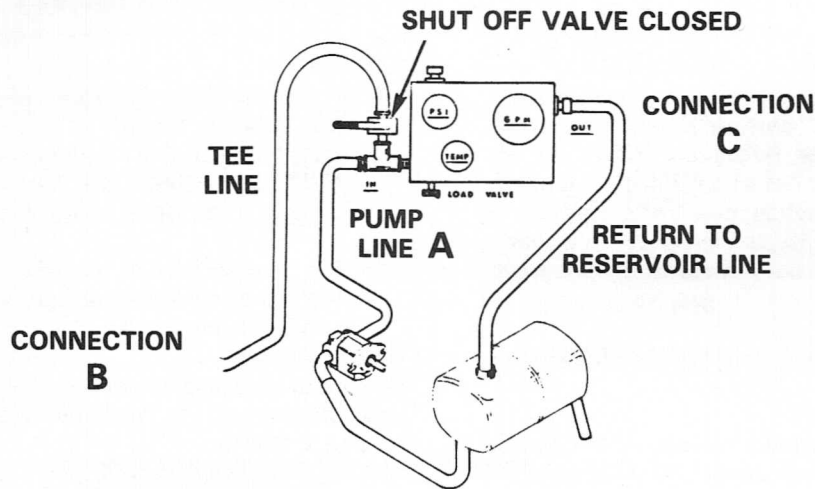


Figure 1 - Flowmeter Connections with High Pressure Tee and Shut-off Valve --
Pump Test Hook-up (Shut-off valve closed)

PUMP TEST CONNECTIONS

The "pump test" hookup shown in Figures 1-4 is used for

- warming the hydraulic oil
- testing the suction line
- 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.

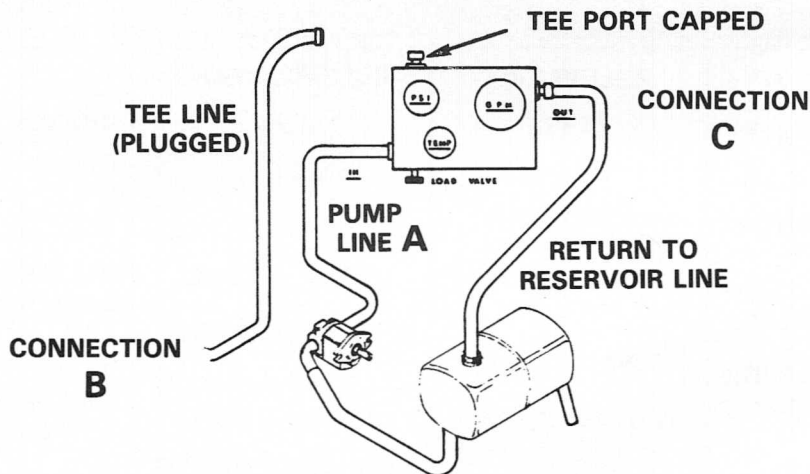


Figure 2 - Flowmeter Connections with Isolation Cap in Tee Line --
Pump Test Hook-up (Tee Port Capped)

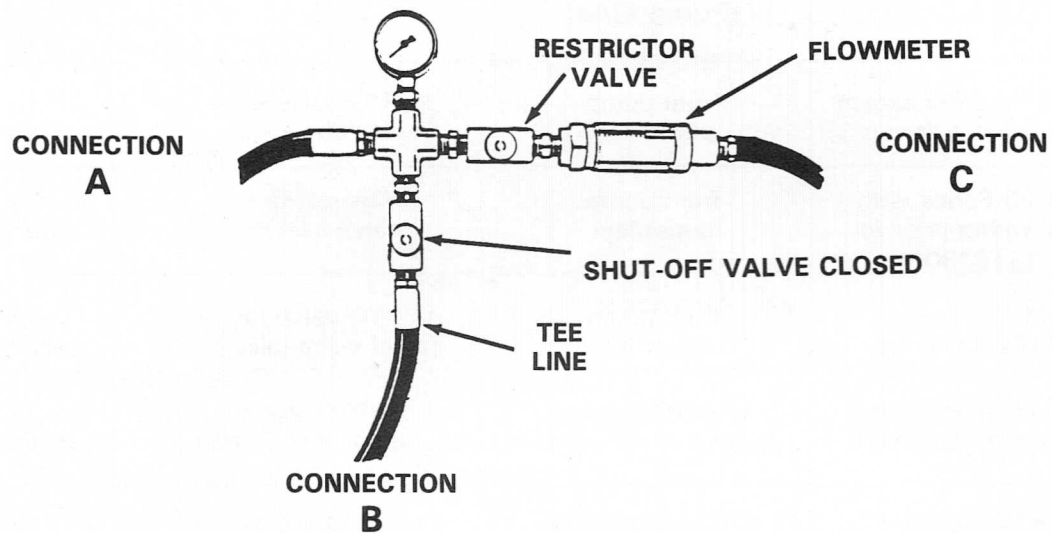


Figure 3 - Standard Flowmeter Connections with High Pressure Tee and Shut-off Valve
-- Pump Test Hook-up (Shut-off Valve Closed)

Connect flowmeter to tractor as follows:

1. Determine type of flowmeter you have as shown in Figures 1, 2, 3 or 4.
2. Stroke travel lever to full forward position to prevent oil loss.
3. Connect flowmeter to tractor. Refer to appropriate illustration and FLOWMETER CONNECTION CHART on following pages.

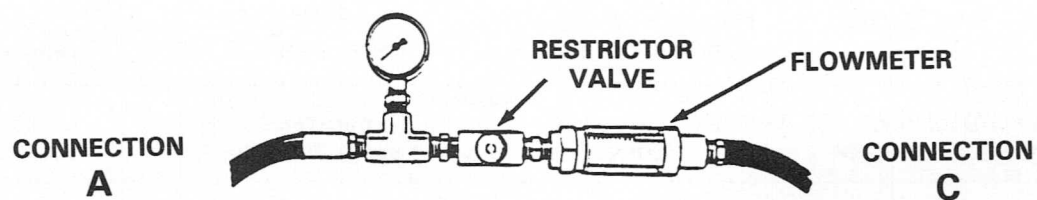


Figure 4 - Standard Flowmeter Connections -- Pump Test Hookup

FLOWMETER CONNECTIONS CHART

TRACTOR MODELS	Flowmeter Inlet (Pump Line) A	Flowmeter Tee Line B	Flowmeter Outlet C
All Garden Tractors except those listed below	from pump outlet line	to PTO valve or travel valve inlet	to reservoir
3000/4000 Series with power steering prior to PIN 14167800	from pump outlet line	to flow divider valve inlet	to reservoir
3000/4000 Series PIN 14167800 & Up	from pump outlet line	to PTO valve or travel valve inlet	to reservoir
Quick test* (if equipped) with floor mounted PTO)	from PTO valve - coupler at L.H. fender	from PTO valve - coupler at R.H. fender	to reservoir
3100/4100 Series - Front section	from front pump section outlet line	to tee fitting at main relief valve	to reservoir
Quick test*	from PTO valve - coupler at L.H. fender	from PTO valve - coupler at R.H. fender	to reservoir
3100/4100 Series - Rear section	from rear pump section outlet line	NOT RECOMMENDED	to reservoir
600 Series Loader	from pump outlet line	to PTO valve or travel valve inlet	to reservoir
600 Series Loader/Backhoe	from pump outlet line	to backhoe valve inlet	to reservoir
6018 Loader - Front Section	from front pump outlet line	to tee at power steering loader relief valve	to reservoir
6018 Loader - Rear Section	from front pump section outlet line	to PTO valve inlet	to reservoir
6018 Loader/Backhoe - Front Section	from rear pump section outlet line	to backhoe valve inlet	to reservoir
6018 Loader/Backhoe - Rear Section	from rear pump section outlet line	to travel valve inlet	to reservoir

* Quick test - This test is suggested due to ease of connections to flowmeter. To perform quick pump flow test:

1. Connect flowmeter to PTO couplers as identified previously.
2. Be sure flowmeter restrictor valve is open before starting tractor.
3. Start tractor and engage PTO valve. See NOTE.
4. Complete pump flow tests as identified in PUMP FLOW TEST PROCEDURES.

5. If pump flow results recorded are below specifications, flowmeter should be reconnected directly to pump and retested. Perform this retest to ensure excessive leakage is not occurring in PTO valve.

NOTE: Due to safety interlocks in electrical system, operator must remain in operator's seat during this test. Otherwise, tractor engine will be automatically, shut-off when PTO is engaged.

TEE TEST FLOWMETER CONNECTIONS

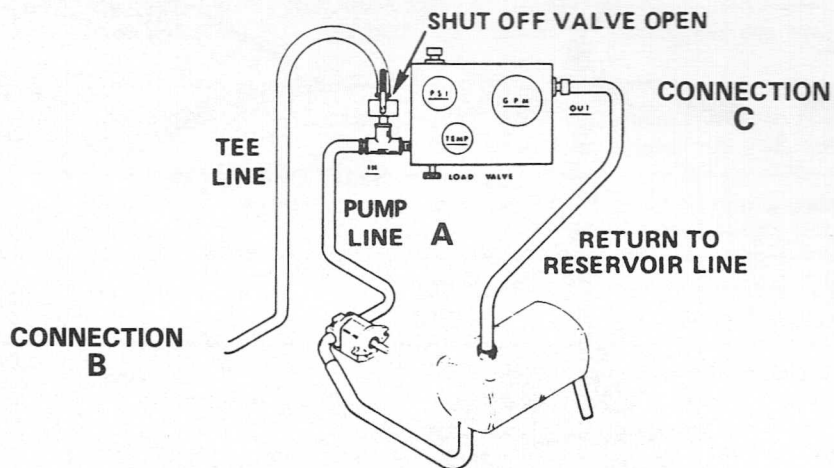


Figure 5 - Flowmeter Connections with High Pressure Tee and Shut-off Valve -- Tee Test Hookup (Shut-off valve open)

TEE TEST CONNECTIONS

The "tee test" hookup shown in figure 5-7 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.

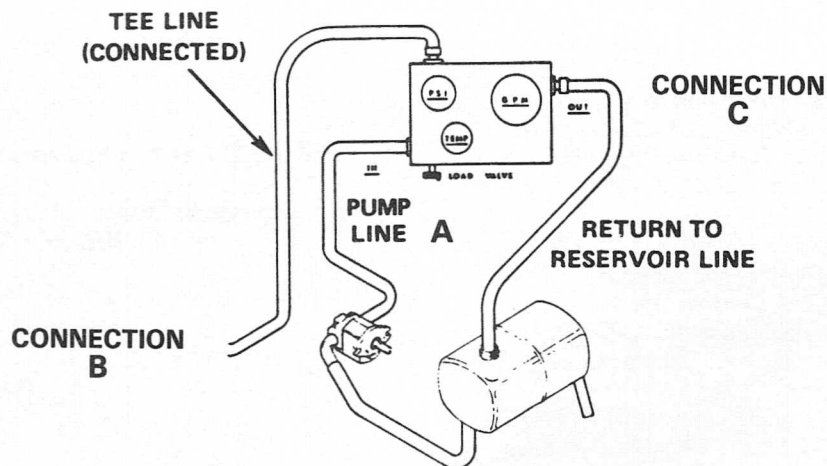


Figure 6 - Flowmeter Connections with Isolation Cap in Tee Line -- Tee Test Hookup (Tee Line Connected)

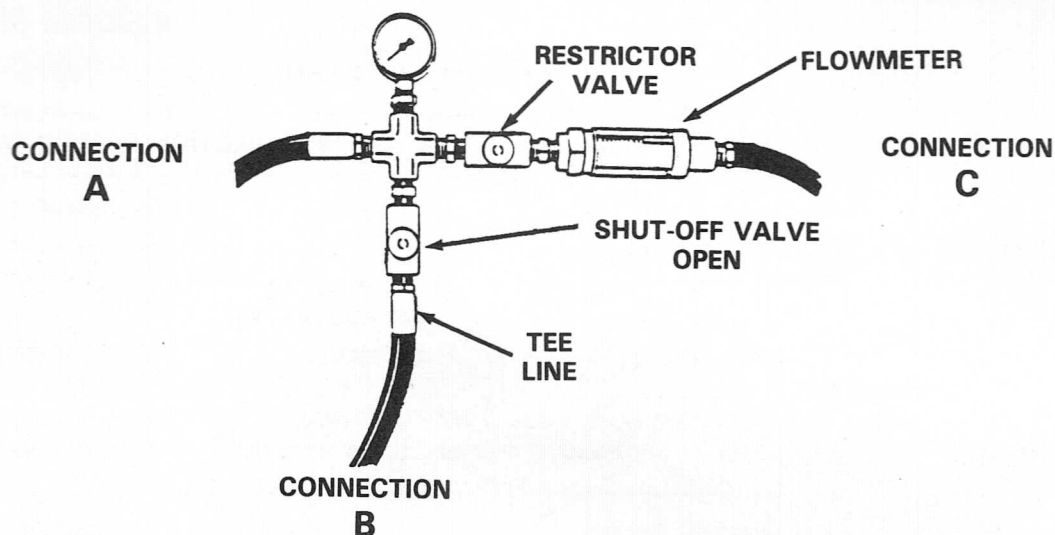


Figure 7 - Standard Flowmeter Connections with High Pressure Tee and Shut-off valve -- Tee Test Hookup (shut-off valve open)



CAUTION: Always block the tractor wheels or chain the tractor to prevent unexpected movement when pressurizing hydraulic circuits during testing procedures.

Connect flowmeter to tractor as follows:

1. Determine type of flowmeter you have as shown in Figures 5, 6 or 7.
2. Connect flowmeter to tractor. Refer to appropriate illustration and FLOWMETER CONNECTION CHART on previous pages.

HYDRAULIC FITTING AVAILABLE FROM SERVICE PARTS SUPPLY .Y

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>SIZE</u>	<u>APPLICATION</u>
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 thru 6000 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 CIRCUIT FLOW TEST

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:

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

B. Testing:

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

II. Suction Line Test:

A. Preparation:

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

B. Testing:

1. Adjust throttle setting to 3000 RPM.
2. Read and record GPM (l/min) indicated on the flowmeter.
3. Adjust throttle setting to 3600 RPM.
4. Read and record GPM (l/min) indicated on the flowmeter.

C. Results:

1. If the test results are within specifications listed in the pump specification section of this manual, proceed to III, Pump Efficiency Test.
2. 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:

1. Connect the flowmeter in the "pump 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 3000 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).



CAUTION: Always block the tractor wheels or chain the tractor to prevent unexpected movement when pressurizing hydraulic circuits during testing procedures.

5. Adjust throttle setting to 3000 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 3000 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 Hydraulic PTO Valve Leakage Tests or directly to Travel Relief/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. Hydraulic PTO Valve 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. Cap or plug work ports at PTO valve. On tractors with floor mounted PTO, disconnect attachment hoses from couplers at fenders.
5. Adjust throttle setting to 3000 RPM and **be sure to maintain this engine speed as load is applied**. Failure to do this will result in inaccurate test results.

B. Test (PTO valve)

1. Engage PTO valve to the normal detented position.
2. Close the load valve until 1000 PSI (6890 k Pa) is obtained.
3. Read and record the GPM (l/min) indicated on the flowmeter.

C. Results:

1. If the test results are within 10% of those obtained in the Pump Efficiency Test, proceed to control/main relief valve test if testing a tractor.
2. If the test results indicate more than 10% loss when compared to the pump efficiency test, refer to Flowmeter Test Interpretation section in this manual.

VII 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 3000 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 VIII. 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.

VIII 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 3000 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 IX 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.

F. Results:

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

RELIEF VALVE TESTS WITH FLOWMETER

Tests marked with an () may be done using a 3000-5000 PSI (20,680-34,475 k Pa) pressure gauge. See Procedure on RELIEF VALVE TESTS WITH PRESSURE GAUGE.

*I. Travel Relief/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.



CAUTION: Always block the tractor wheels or chain the tractor to prevent unexpected movement when pressurizing hydraulic circuits during testing procedures.

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. Continue to close tester load valve until the flow gauge reads zero GPM (l/min). Do not exceed 3000 PSI (20,680 k Pa).
4. 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 II, 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.



CAUTION: Always block the tractor wheels or chain the tractor to prevent unexpected movement.

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.

*II 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 3600 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. Continue to close the tester load valve until the flow gauge reads 0 GPM (l/min). Do not exceed 1000 PSI (6780 k Pa).
4. 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 III, PTO 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.

*III PTO Relief Valve Test

Some early production units do not have a relief valve in the PTO circuit. DO NOT perform this test on those units.

A. Preparation

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

B. Testing:

1. Move PTO valve lever to the engaged position.
2. Close tester load valve until GPM (l/min) needle begins to drop. This is the relief valve cracking point.
3. Continue to close the tester load valve until the flow gauge reads 0 GPM (l/min). Do not exceed 3000 PSI (20,680 k Pa).
4. 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 IV, Power Steering 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.

*IV Power Steering Relief Valve Test

Checking power steering relief valve is performed more simply with pressure gauge. Refer to RELIEF VALVE TESTS WITH PRESSURE GAUGE..

V. 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. Continue to close the tester load valve until the flow gauge reads 0 GPM (l/min). DO NOT EXCEED.

4. 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 TESTS WITH PRESSURE GAUGE

I. Travel Relief/Main Relief/Attachment Lift Relief Tests

A. Preparation:

1. Connect 3000-5000 PSI (20.680-34,475 k Pa) pressure gauge to test port near inlet fitting on travel control valve. On 3100/4100 tractors, gauge can be connected to L.H. PTO line coupling at L.H. fender.
2. Adjust engine throttle to 3600 RPM.
3. Operate circuits several times to stabilize oil temperature.

B. Testing:

1. Travel Relief Valve Test

- a. 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.



CAUTION: Always block the tractor wheels or chain the tractor to prevent unexpected movement when pressurizing hydraulic circuits during testing procedures.

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

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

2. Main Relief Valve Test

On 3100/4100 tractors, if pressure gauge is connected to travel control valve port, main relief valve can be tested by performing tests 1 a, b & c above.

If pressure gauge is connected to L.H. PTO line coupler engage PTO valve and read and record maximum pressure indication before engine RPM drops. A telltale relief valve squeal should be noted in this test.

3. Attachment Lift Relief Test

- a. move attachment lift lever to raise position.
- b. After lift is completely raised, read and record the pressure indicated on the pressure gauge.

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. Main relief valve on 3100/4100 is not adjustable.

II. PTO Relief Valve Test

Some early production units do not have a relief valve in the PTO circuit. DO NOT perform this test on those units.

On 3100/4100, PTO circuit is controlled by main relief valve. Perform Main Relief Test explained previously.

On tractors equipped with relief valve in PTO valve, perform following tests:

A. Preparation:

1. Connect 3000 PSI (20,680 k Pa) pressure gauge to pressurized work port when PTO valve is engaged.

If valve spool is moved into valve body during engagement, the work port nearest spool end of valve is the pressurized port. If valve spool moves out of valve body, the work port farthest from the spool end of valve becomes the pressurized port.

2. Operate tractor to stabilize oil temperature.

B. Testing:

1. Adjust engine throttle to 3600 RPM.
2. Slowly engage PTO valve. Read and record maximum pressure indication before engine RPM drops.

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.

III. Power Steering Relief Valve Test

A. Preparation:

1. Tee 3000 PSI (20,680 k Pa) pressure gauge to either line at power steering cylinder.

B. Testing:

1. Adjust engine throttle to 3600 RPM.
2. Turn steering wheel to pressurize steering cylinder end where pressure gauge is connected.
3. When steering reaches turn stop, continue to hold pressure with steering wheel. Read and record maximum pressure indication.

C. Results:

1. If test results are the same as listed in hydraulic specification section of this manual, conclude the test.
2. If test results are more or less than listed in hydraulic specification section, inspect and/or replace relief valve as required and retest. Power steering relief valves are not adjustable.

IV Loader/Backhoe Relief Tests

A. Preparation:

1. Tee 3000 PSI (20,680 k Pa) pressure gauge at inlet of appropriate valve or at hydraulic cylinder ports.

B. Testing:

1. Adjust engine throttle to 3600 rpm.
2. Operate the circuit in which the gauge and relief valve is located to full stroke and hold.
3. Read and record the pressure indicated on the pressure gauge.

C. Results:

1. If test results are the same as listed in hydraulic specification section of this manual, conclude the test.
2. If test results are more or less than listed in hydraulic specification section inspect, repair or replace relief valve as required and retest.

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 (4136-5575 k Pa) 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
<p>GPM - NO OR LITTLE DROP FROM NO-LOAD READING</p> <p>PSI - NEEDLE FLUCTUATING BADLY AT 600-800 psi (4136 - 5515 k Pa)</p> <p>PUMP IS NOISY</p>	<p>1. Suction line air leakage</p>	<p>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.</p>
<p>GPM - NO OR LITTE DROP FROM NO-LOAD READING</p> <p>PSI - NEEDLE STEADY AT 600-800 psi (4136 - 5515 k Pa)</p> <p>PUMP IS NOISY</p>	<p>2. Suction line restriction. (Cavitation)</p>	<p>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.</p>
<p>GPM - NOTICEABLE OR SEVERE DROP FROM NO-LOAD READING</p> <p>PSI - NEEDLE STEADY AT 600-800 psi (4136 - 5515 k Pa)</p>	<p>3. Pump efficiency loss</p>	<p>1. Deficient pump.</p>

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.

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 comparison (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.

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.

RETARD ADJUSTMENT

EARLY 200/400/600 SERIES TRACTORS WITHOUT HOLD VALVE

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.

GARDEN TRACTOR/LOADER/BACKHOE TRACTORS - HYDRAULIC SYSTEM DIAGNOSIS

CIRCUIT FLOW TESTS

- | | | |
|------|---|-------------|
| I. | Oil Temperature should be maintained between 120° and 140°F (49°C-60°C) throughout the testing procedure. | |
| II. | SUCTION LINE 3000 RPM @ PSI (O k Pa) | GPM (l/min) |
| | 3600 RPM @ PSI (O k Pa) | GPM (l/min) |
| III. | PUMP EFFICIENCY @300 psi (2068 k Pa) (600 psi for loaders) (4136 k Pa) | GPM (l/min) |
| | @1000 psi (6890 k Pa) (1500 psi on 14 hp and above) (10 340 k Pa) | GPM (l/min) |

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 (l/min) | GPM (l/min) |
| 2. | REVERSE @ 1000 psi (6890 k Pa) (1500 psi on 14 hp and above) (10 340 k Pa) | GPM (l/min) | GPM (l/min) |
| V. | HYDRAULIC ATTACHMENT LIFT CIRCUIT TESTS | Valve & Motor | Valve Only |
| 1. | RAISE @ 300 psi (2068 k Pa) (600 psi on loaders) (4136 k Pa) | GPM (l/min) | GPM (l/min) |
| 2. | LOWER @ 300 psi (2068 k Pa) (600 psi on loaders) (4136 k Pa) | GPM (l/min) | GPM (l/min) |
| VI. | HYDRAULIC PTO VALVE CIRCUIT TESTS | | |
| 1. | PTO engaged @ 1000 psi (6890 k Pa) | | GPM (l/min) |

- | | | | | |
|-------|---------------------------------|-------------------|------------------|------------------------|
| VII. | LOADER LIFT CIRCUIT TESTS | Valve & Cylinders | Valve Only | Valve and one Cylinder |
| 1. | RAISE @ 600 psi (4136 k Pa) | GPM (l/min) | GPM (l/min) | GPM (l/min) |
| 2. | LOWER @ 600 psi (4136 k Pa) | GPM (l/min) | GPM (l/min) | GPM (l/min) |
| VIII. | LOADER BUCKET CIRCUIT TESTS | | Valve & Cylinder | Valve Only |
| 1. | ROLL BACK @ 600 psi (4136 k Pa) | | GPM (l/min) | GPM (l/min) |
| 2. | DUMP @ 600 psi (4136 k Pa) | | GPM (l/min) | GPM (l/min) |

RELIEF VALVE TESTS

- | | | |
|------|--|------------|
| I. | TRAVEL RELIEF/ MAIN RELIEF VALVE: (3600 RPM) | PSI (k Pa) |
| II. | HYDRAULIC ATTACHMENT LIFT RELIEF VALVE: (3600 RPM) | PSI (k Pa) |
| III. | PTO RELIEF VALVE: (3600 RPM) | PSI (k Pa) |
| IV. | POWER STEERING RELIEF VALVE: (3600 RPM) | PSI (k Pa) |
| V. | LOADER, RELIEF VALVE: (3600 RPM) | PSI (k Pa) |
| VI. | BACKHOE RELIEF VALVE: (3600 RPM) | PSI (k Pa) |