

Troubleshooting, Testing & Adjusting

When the test is completed, connect the return hose to the valve and fully lower the implement. If the valve section had an acceptable leakage rate, it should remain in service. But, if the leakage was beyond specifications, a new valve section should be installed. To determine the cause of excess leakage, pull the spool from the valve body and inspect them both at all their mating surfaces. If the finish of the spool lands and housing bores have scratches, then oil contamination is the cause. (See Fig. 27)

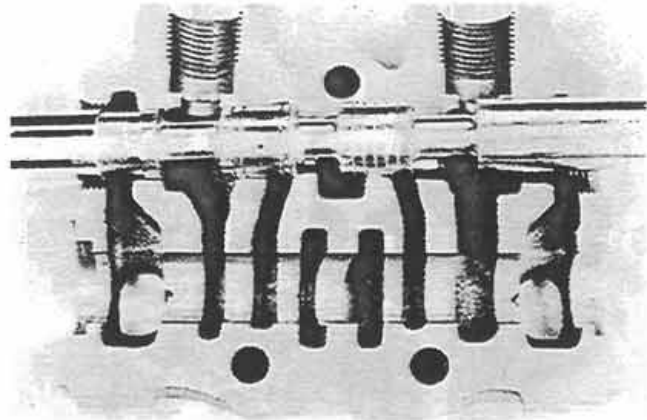


Figure 27:

But when the finishes of both the spool and housing are still good, the housing has been stretched or expanded in all directions because of excessive hydraulic pressure. Maybe a faulty cylinder or misapplication is the real cause. Each spool and housing are a matched set. Re-fitting the housing with another spool is not recommended. Replace as an assembly. (See Fig. 28)

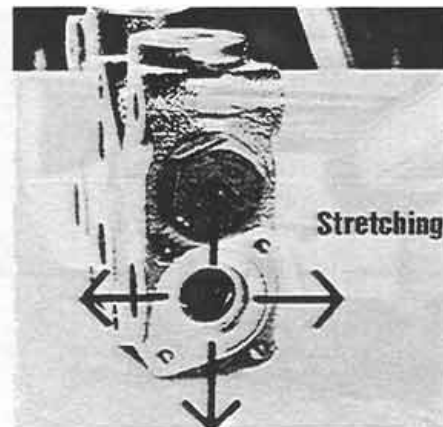


Figure 28:

One non-instrument test can be done on the pump. If engine oil is going into the hydraulic system, or vice versa, seal leakage of the pump drive shaft should be suspected. (See Fig. 29)

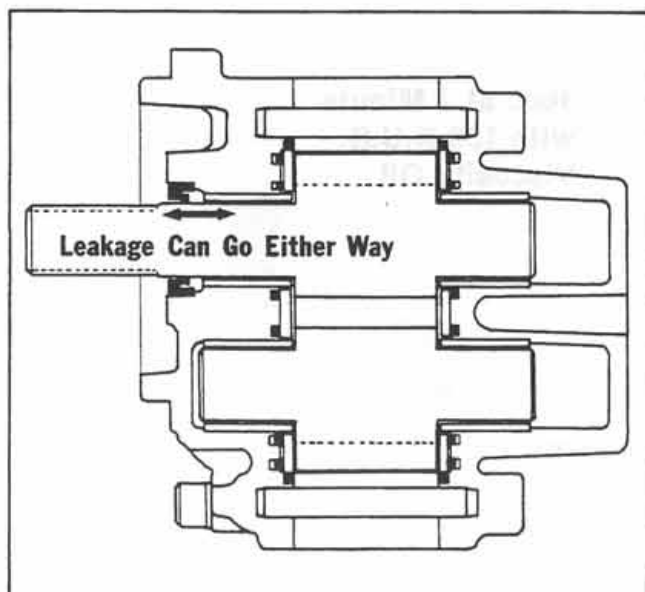


Figure 30:

Troubleshooting, Testing & Adjusting

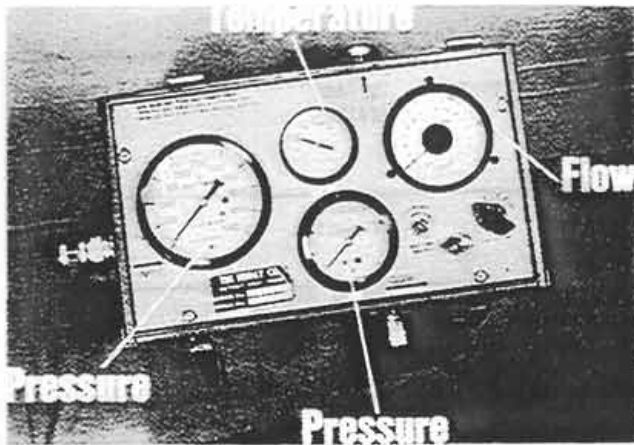


Figure 30:

When testing an entire system, begin at the pump since it generates the flow which must overcome pressures imposed upon the system by the loads. Pump performance must be tested with a hydraulic analyzer which can determine system variables seen by the pump, such as flow, pressure and temperature. (See Fig. 30)

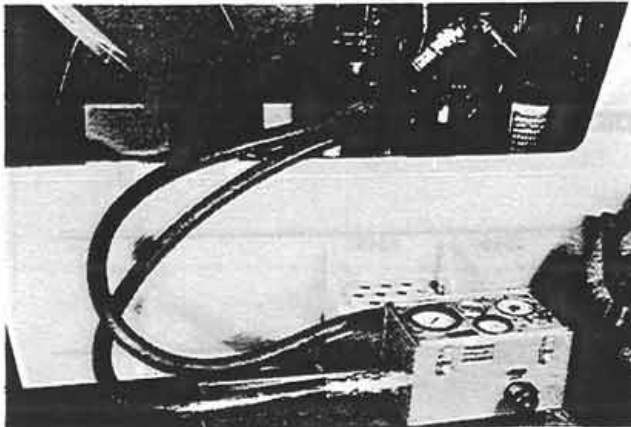


Figure 31:

If the tractor has a pressurized reservoir, relieve the pressure before testing. Disconnect the discharge line at the pump and adapt the analyzer inlet port to the pump discharge, then connect the analyzer outlet port to the line that was previously removed from the pump discharge. (See Fig. 31)

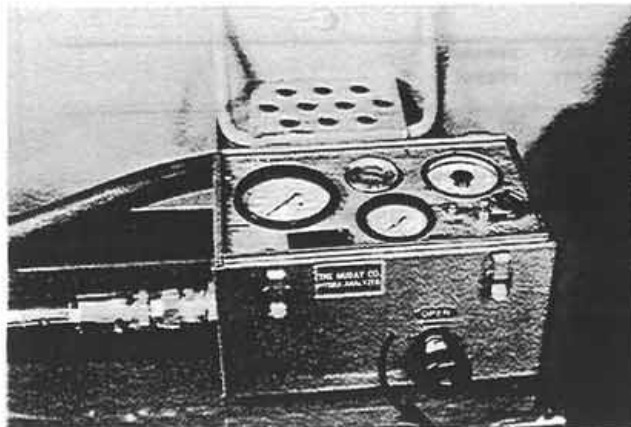


Figure 32:

Completely open the LOAD VALVE on the analyzer and start the engine. (See Fig. 32)



WARNING: Completely open the load valve **BEFORE** starting the engine. The relief valve will not be able to open if pressure is excess during this test. To ignore this warning may cause severe personal injury or damage.

Review your specifications for the particular tractor model being worked on. Note that the pump performance values correspond with given engine speeds. If you have any reason to question the accuracy of the tractor's tachometer, temporarily install a calibrated tachometer for use during testing. (See Fig. 33)

Troubleshooting, Testing & Adjusting

TRACTOR MODEL	ST 210 RC 210	ST 220 ST 251 ST 310	PT 225 PT 250 ST 250 PT 270 ST 270	ST 320 PT 350 ST 350.	ST 325	ST 450 (#130)
	MODEL USED IN FOLLOWING TEST					
	CAT 3208	Cummins N-855 NT-855 NTA-855	Cat 3306	Cummins VT-903	Cat 3406	Cummins KTA-1150
Engine Make And Model	CAT 3208	Cummins N-855 NT-855 NTA-855	Cat 3306	Cummins VT-903	Cat 3406	Cummins KTA-1150
Engine Idle Speed(RPM)	830	830	830	830	830	Use 830 for test purposes
Engine Rated Speed	2800	2100	2200	2600	2100	2100
Maximum Pump Output GPM at idle-No Load	7.1	11.3	12.2	10.5	12.4	15.9
Minimum Pump Output GPM at idle-No Load	6.4	10.2	11.0	9.5	11.2	14.3
Minimum Pump Output GPM at idle-2250 PSI Pressure	4.3	8.5	9.1	6.3	9.3	11.9
Maximum Pump Output GPM at rated speed No Load	23.9	28.7	32.4	33.8	32.9	38.9
Minimum Pump Output GPM at rated speed No Load	21.5	25.8	29.1	30.4	29.6	35.0
Minimum Pump Output GPM at rated speed 2250 PSI Pressure	19.1	22.9	25.9	27.0	26.3	31.1
Minimum Main And Secondary Relief Valve Setting PSI. Locate Lowest Pressure Curve Area	2250	2250	2250	2250	2250	2250
Maximum Main And Sec- ondary Relief Valve Setting PSI At High- est Area Of Pressure Curve	2450	2450	2450	2450	2450	2450
Steering Circuit Load Sense Relief Valve Pressure Setting PSI	2000	2000	2000	2000	2000	2000
Detent Release Pres- sure Setting PSI	2150	2150	2150	2150	2150	2150
Minimum Control Pres- sure PSI at idle speed	150	150	150	150	150	80
Maximum Control Pres- sure PSI at rated speed With Flow Regulator at Highest Flow	340	270	ST-300 PT-350	ST-350 PT-460	340	430
Reservoir Pressure Relief Setting PSI	5	Atmos- pheric	5-PT only ST-Atmos- pheric	5-PT only ST-Atmos- pheric	Atmos- pheric	5
Oil Temperature Dur- ing all Testing °F and °C	160 71	160 71	160 71	160 71	160 71	160 71
Steering Performance Time in Seconds Req. to turn lock to lock. Check at test idle speed & traveling on hard surface.	5.2 to 6.3	4.5 to 5.4	ST-4.4 to 5.2 PT 4.9 to 5.9	ST-4.8 to 5.7 PT-5.4 to 6.5	4.5 to 5.4	6.5 to 8.0 see note
Flow Regulator Val- ve Adjustment Range GPM	8 to 20	8 to 20	8 to 20	8 to 20	8 to 20	12 to 25
Neutral Pressure at steering valve ex- haust - PSI at test idle speed.	2 to 3	2 to 3	2 to 3	2 to 3	2 to 3	8 to 10
Neutral Pressure at steering valve ex- haust -PSI at rated speed	5 to 7	5 to 7	ST 5 to 7 PT 7 to 9	ST 5 to 7 PT 8 to 10	5 to 7	15 to 20

NOTE: On ST 450 Models, steering performance at low engine speed is influenced by the flow regulator setting for the power brake booster. Ensure the regulator is adjusted according to the brake systems service manual before judging the remainder of the system.

Figure 33:

Troubleshooting, Testing & Adjusting

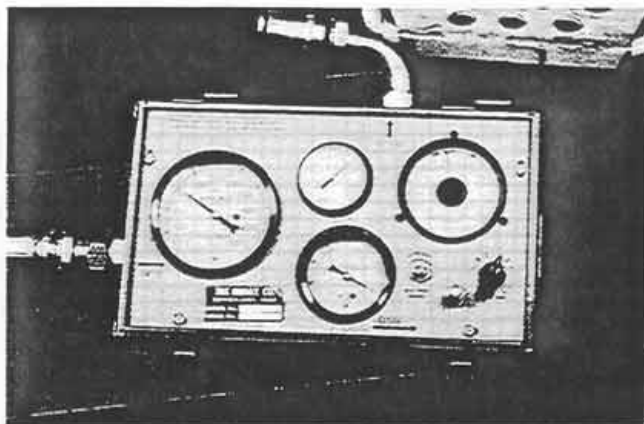


Figure 34:

Oil temperature during the test should be 160°F. If the temperature is too low, increase it by running the engine at about 1800 RPM, then slowly close the load valve on the analyzer until the pressure gauge reads between 1500 to 2000 PSI. (See Fig. 34)



WARNING: After the pressure is set, DO NOT increase engine speed, as further high pressure will be generated, possibly causing damage and/or injury! After the temperature is stable, idle the engine and completely open the load valve.

There are two basic tests to perform in order to gather information needed to evaluate pump performance. The FREE FLOW TEST is done with minimum system pressure (or control pressure) existing during the test procedure. A pump EFFICIENCY TEST is done when the pump is exposed to maximum rated system pressure. Begin with the free flow test.

Run the engine at its proper low idle speed and record the flow shown on the flow meter when the load valve is completely open. (See Fig. 35)

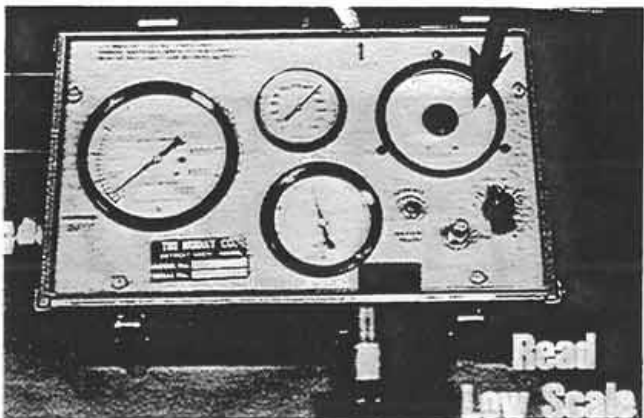


Figure 35:

Then, run the engine at RATED speed and record the meter reading. (See Fig. 36)

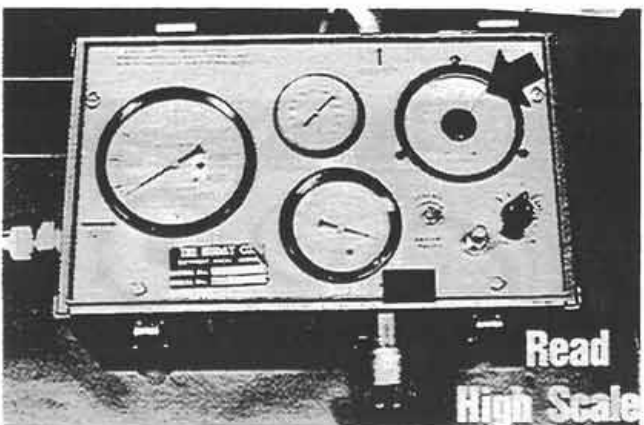


Figure 36:

Troubleshooting, Testing & Adjusting

(You may wish to sketch a chart like the one shown so you can quickly compare your test results with specifications.) Proceed to the efficiency test. (See Fig. 37)

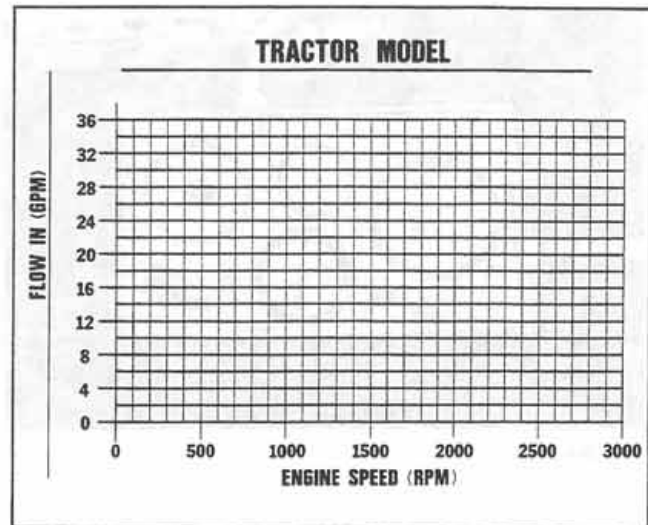


Figure 37:

With the engine at RATED speed, begin to slowly close the load valve until the pressure reaches 2250 PSI, then observe the flow meter reading and record as before. Ensure that the engine was still at proper speed when the pump was under load. (See Fig. 38)

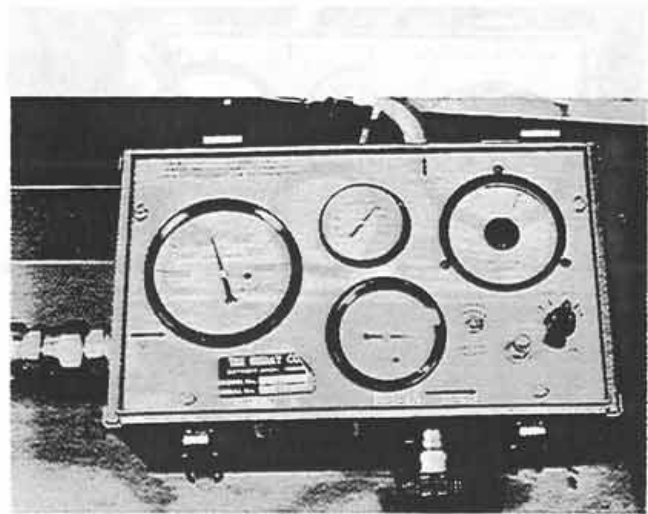


Figure 38:

Reduce the engine speed to its correct low idle. Maintain that speed while slowly closing the load valve until the pressure reaches 2250 PSI and record the flow reading. (See Fig. 39)

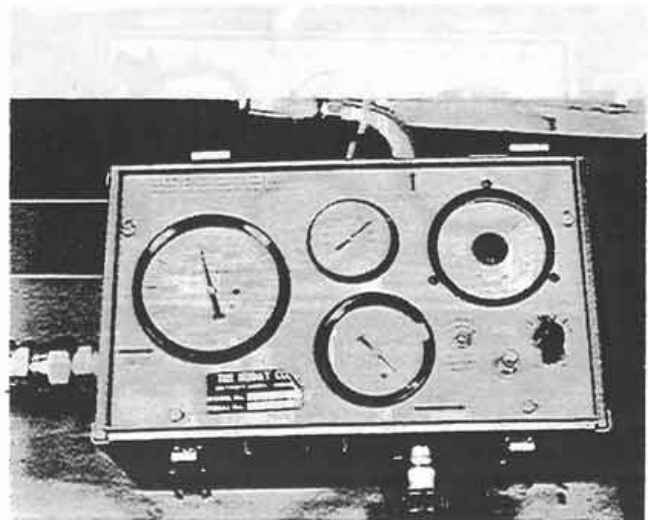
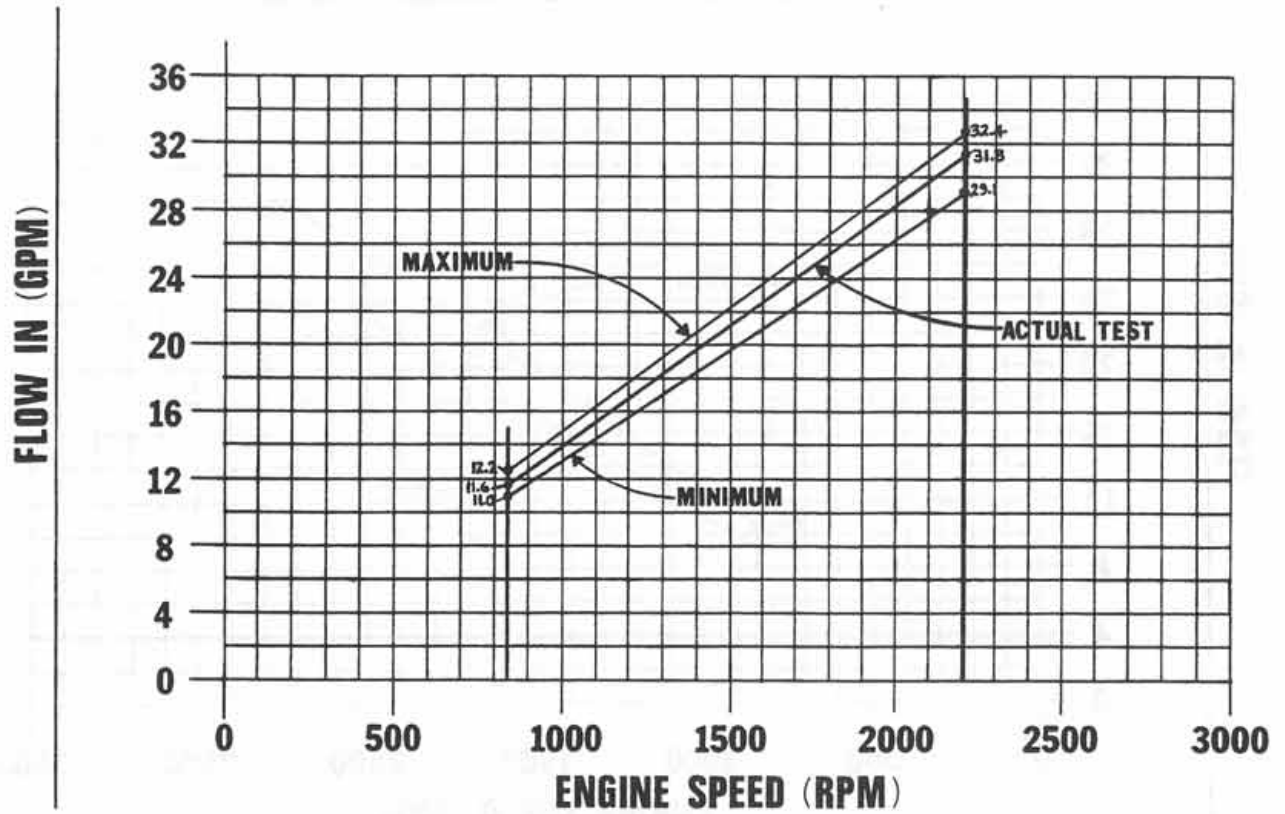


Figure 39:

Completely open the load valve and stop the engine. To evaluate the free flow test, look at the minimum no-load flow readings that you found, and compare them to the minimum values that are specified. If either or both readings do not meet the minimum values, the pump is worn, has a restricted inlet, is drawing air (cavitating) or possibly any combination of these. (See Fig. 40)

To determine pump efficiency, look at the minimum flow readings that you found at maximum rated pressure and compare these to the corresponding minimum values that are specified. If the readings are above the minimum values, the pump is suitable for further service. If either or both readings are below the minimum values, the pump is excessively worn or has been damaged and must be repaired or replaced. (See Fig. 41)

ST270 FREE FLOW TEST EXAMPLE

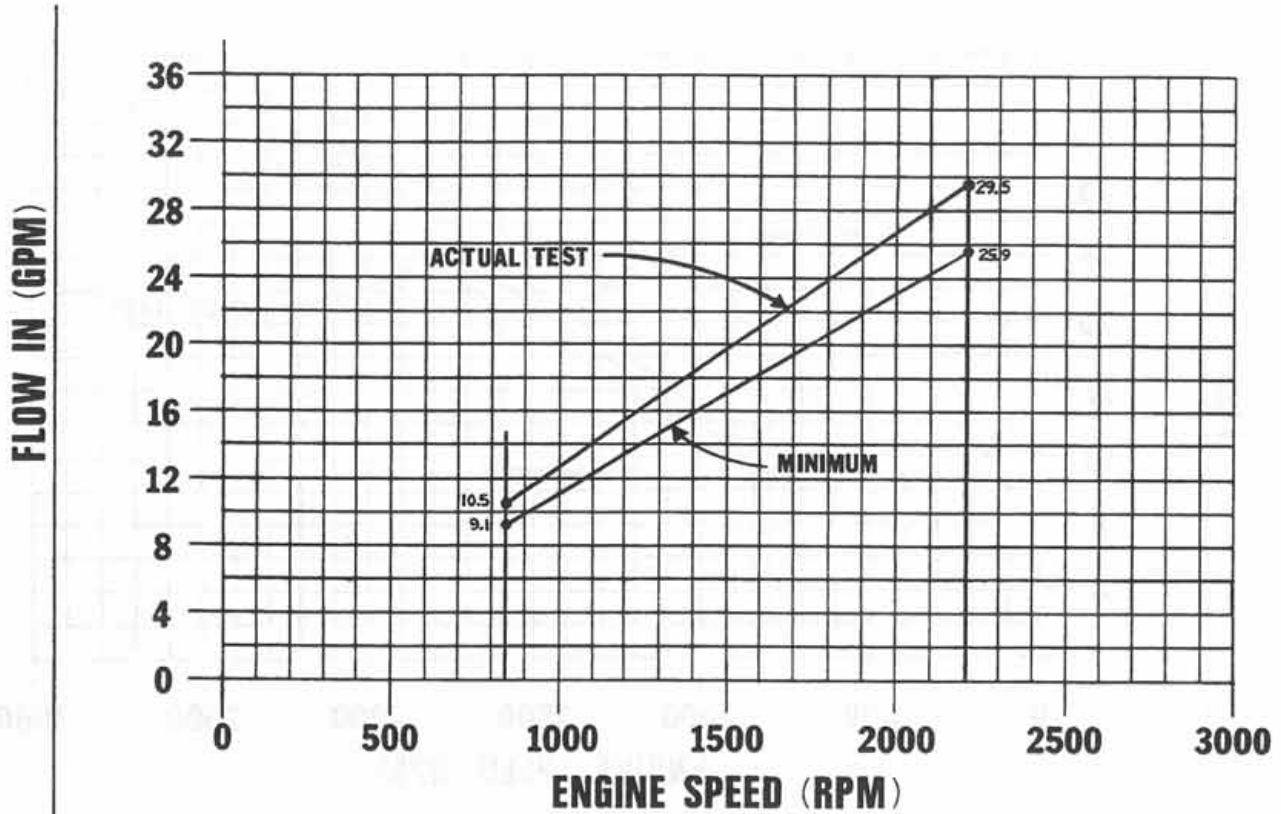


TRACTOR MODEL	ST 210 RC 210	ST 220 ST 251 ST 310	PT 225 PT 250 ST 250 PT 270 ST 270	ST 320 PT 350 ST 350	ST 325	ST 450 (#130)
Engine Make And Model	CAT 3208	Cummins N-855 NT-855 NTA-855	Cat 3306	Cummins VT-903	Cat 3406	Cummins KTA-1150
Engine Idle Speed(RPM)	830	830	830	830	830	Use 830 for test purposes
Engine Rated Speed	2800	2100	2200	2600	2100	2100
Maximum Pump Output GPM at Idle-No Load	7.1	11.3	12.2	10.5	12.4	15.9
Minimum Pump Output GPM at Idle-No Load	6.4	10.2	11.0	9.5	11.2	14.3
Minimum Pump Output GPM at idle-2250 PSI Pressure	4.3	8.5	9.1	6.3	9.3	11.9
Maximum Pump Output GPM at Rated Speed No Load	23.9	28.7	32.4	33.8	32.9	38.9
Minimum Pump Output GPM at Rated Speed No Load	21.5	25.8	29.1	30.4	29.6	35.0
Minimum Pump Output GPM at rated speed 2250 PSI Pressure	19.1	22.9	25.9	27.0	26.3	31.1
Minimum Main And Secondary Relief Valve Setting PSI. Locate Lowest Pressure Curve Area	2250	2250	2250	2250	2250	2250

Figure 40:

Troubleshooting, Testing & Adjusting

ST270 PERFORMANCE TEST EXAMPLE



TRACTOR MODEL	ST 210 RC 210	ST 220 ST 251 ST 310	PT 225 PT 250 ST 250 PT 270 ST 270	ST 320 PT 350 ST 350	ST 325	ST 450 (#130)
Engine Make And Model	CAT 3208	Cummins N-855 NT-855 NTA-855	Cat 3306	Cummins VT-903	Cat 3406	Cummins KTA-1150
Engine Idle Speed (RPM)	830	830	830	830	830	Use 830 for test purposes
Engine Rated Speed	2800	2100	2200	2600	2100	2100
Maximum Pump Output GPM at idle-No Load	7.1	11.3	12.2	10.5	12.4	15.9
Minimum Pump Output GPM at idle-No Load	6.4	10.2	11.0	9.5	11.2	14.3
Minimum Pump Output GPM at idle-2250 PSI Pressure	4.3	8.5	9.1	6.3	9.3	11.9
Maximum Pump Output GPM at rated speed No Load	23.9	28.7	32.4	33.8	32.9	38.9
Minimum Pump Output GPM at rated speed No Load	21.5	25.8	29.1	30.4	29.6	35.0
Minimum Pump Output GPM at rated speed 2250 PSI Pressure	19.1	22.9	25.9	27.0	26.3	31.1
Minimum Main And Secondary Relief Valve Setting PSI. Locate Lowest Pressure Curve Area	2250	2250	2250	2250	2250	2250

Figure 41:

Troubleshooting, Testing & Adjusting

Reduce the engine speed in 200 RPM increments and record the pressure reading for each throttle setting. Do this until low idle is reached. If you wish, you can arrange the pressure points in the same fashion as shown in this graphic example. Whatever the method used, you must determine where your pressure curve lies in relation to the minimum and maximum limits described earlier. (See Fig. 45)

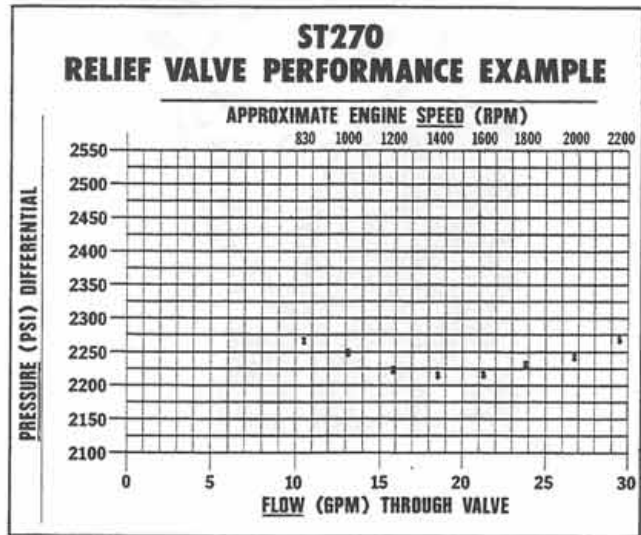


Figure 45:

If the lowest part of your pressure curve falls beneath the minimum limit, adjust the pressure by adding shims between the spring and poppet of the relief valve. Whenever the adjustment is changed, retesting is necessary to determine whether or not proper performance has been obtained. (See Fig. 46)



CAUTION: Whenever performing adjustments or replacements on the hydraulic system, ensure that no residual pressure exists and that the temperature is not high enough to cause burns on the skin.

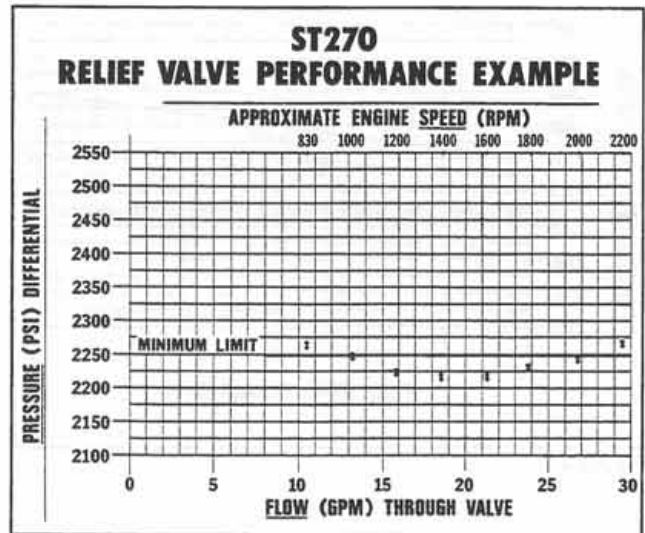


Figure 46:

If the highest part of the pressure curve exceeds the maximum limit, some adjusting shims must be removed. Again, retesting must be done. (See Fig. 47)

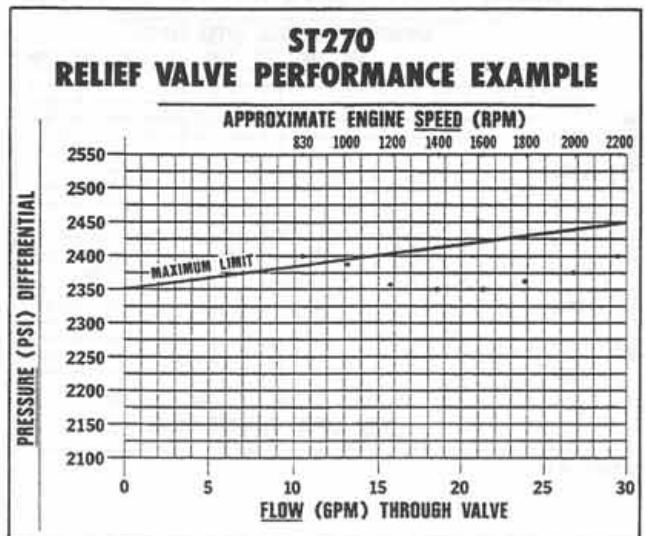


Figure 47:

Troubleshooting, Testing & Adjusting

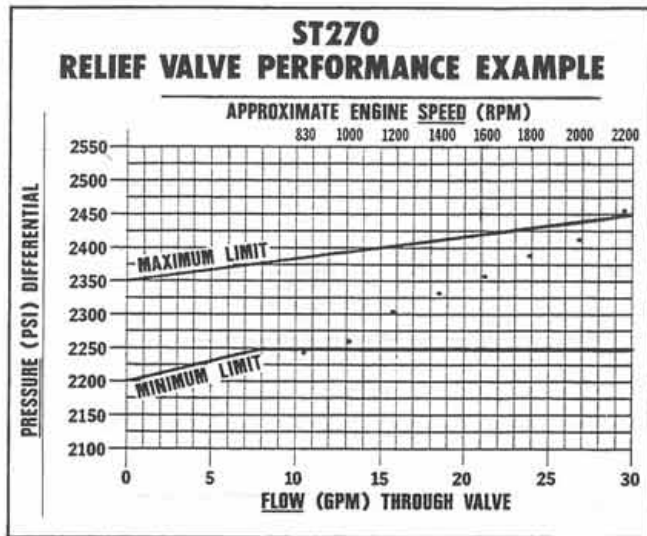


Figure 48:

If the pressure curve demonstrates low pressure at any point AND high pressure at high flow as shown here on the graph, the relief valve cartridge should be changed. Either the spring is being fully compressed before the poppet is fully opened, the cartridge seals are leaking badly, or the poppet is sticking. Regarding the spring, the fully compressed condition is called COIL BIND, and is caused by excessive shimming to overcome settling of the spring length. (See Fig. 48)

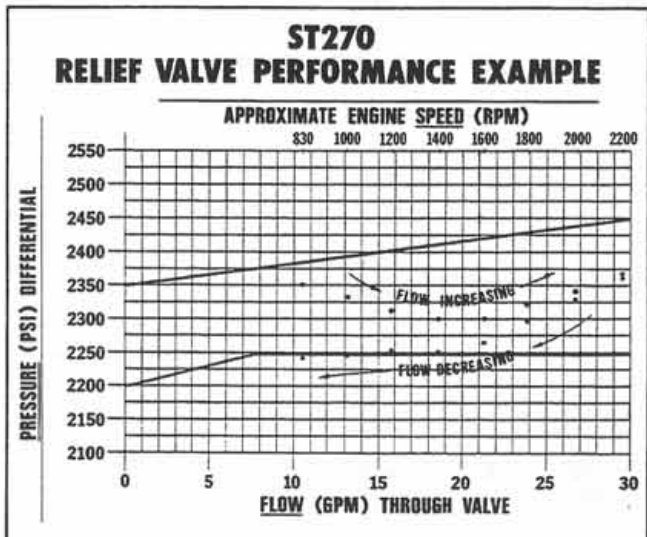


Figure 49:

Note the reading difference between engine speed increasing and speed decreasing. If the difference in pressure is more than 100 PSI for the same flow rate (or engine speed), then the relief poppet is not able to move freely enough and requires cleaning or replacement. (See Fig. 49)

The priority valve and steering valve can be tested with the flow analyzer still connected. Pressure readings should be obtained with the load valve fully opened. The flow analyzer will now be used to measure temperature and control pressure only. The test data obtained here is valuable in identifying how certain problems influence the hydraulic system. To begin with, measure the control pressure with the engine at low idle, then at rated speed. Record the readings and compare them against the minimum and maximum pressures that are specified for the tractor model being tested. (See Fig. 50)