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Consulting Report

November 19th and 20th, 2002
Jack Weeks

Reason for Consult

The consult was initiated because of heavy shock conditions causing leakage and breaking of fittings in the Catch and Load and Log Kicker machines. I was also asked to look at the Bucking Saws, the Strapper and the Quadrant Feeder. One of the Bucking Saws slows almost to a stall when both saws move. But it moves well when it is manually actuated singularly. The Strapper platen was stopping before reaching position. The Quadrant Feeder experiences similar shock and leakage problems as the Catch and Load and Log Kicker machines, only not as severe.

Actions Taken

Catch and Load

An initial inspection of the Catch and Load indicated pressure settings that were too high. The designer specifications are for 1200 PSI, but actual settings were closer to 1700 PSI. The accumulators were precharged to between 1000 and 1100 PSI, which was actually not far from the designer spec of 1000 PSI. But because of the pressure fluctuations, it appeared the system could be starved for flow at certain points of the cycle, so I recommended reducing the precharge to 600 PSI to increase the effectiveness of the accumulators. There will be no ill effects to providing more flow than the designer has called for and the lower precharge will increase bladder life.

Upon lowering the system pressure, a significant reduction in shock was observed. The cylinders were still bottoming out hard, but spikes were reduced significantly. One heavily contributing factor to the shock of bottoming out is the shape of the Catch and Load. Once the cylinder extends past a pivot point, the Catch and Load is heavier on the side opposite the cylinder. Past that point, the cylinder is no longer pushing the load. The load is instead pulling the cylinder. This results in a severe pressure drop, at times all the way to 0 PSI. The result is a heavy spike once the cylinder bottoms out and system pressure is immediately restored. At 1700 PSI (where I found the system set upon arrival), this spike could reach as high as 5100 PSI, more than sufficient to damage fittings and spring leaks. Lowering the system pressure helped, but it was necessary to stop the pressure drop past the pivot point to bring spikes down to an acceptable level. Flow controls at the cylinders are installed for controlling their speed. Since they are meter out flow controls, the adjustment at the rod side controls the extend speed and the adjustment at the piston side controls the retract speed. Once the cylinder speed had been adjusted, the heavy shock spikes were removed from the system, particularly the ones at the extend cycle. By adding resistance with the flow control to the extend cycle, the pressure no longer drops at the pivot point, decreasing the range of the spike by the amount of the system pressure, 1200 PSI. I expect the broken fittings and leaks to cease with the changes we made. The only snag we hit with the reduced speed was on the #3 Catch and Load. Reducing the speed of the cylinders brought the cycle outside the electrical limits of the PLC program, causing the directional valve to be closed prior to the completion of the cycle. This caused the Catch and Load not to fully extend to its home position. It was necessary to alter the PLC programming slightly to compensate for this. As of this writing, the Catch and Load is operating much more smoothly and quietly.

The settings I recommend be maintained in the system are as follows:

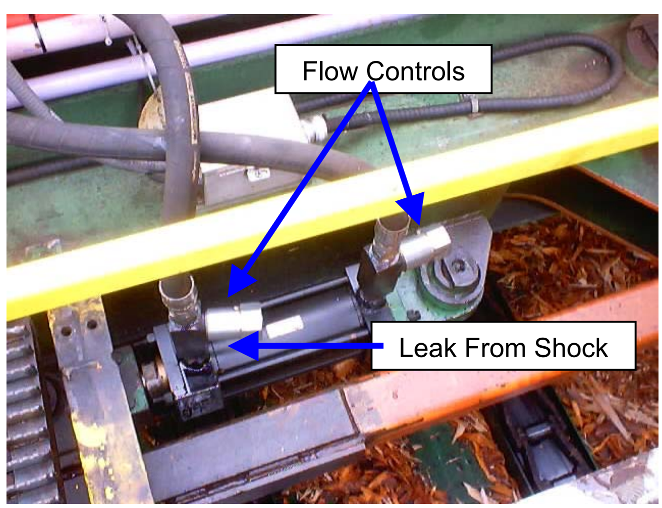
Pump Compensators – 1200 PSI
System Relief Valves – 1450 PSI
Accumulator Precharge – 600 PSI

The compensator on the #3 pump was found to be stuck closed when pressure settings were being made. This should be corrected as soon as is practical. The relief valve setting was lowered to 1300 PSI for the time being until it can be replaced. Once the compensator is replaced, set the compensator to 1200 PSI and the relief valve to 1450 PSI.

It was also noted that the mount on the #1 accumulator has been broken by shock in the system. This should be corrected as soon as possible. The steel accumulator shell is currently coming in direct contact with the steel mount. If this is allowed to continue, the integrity of the accumulator shell could be compromised and the accumulator could explode.

Log Kickers

Since the Log Kickers operate from the same power supply as the Catch and Load, much of the shock was eliminated from these machines as well once the pressure was lowered. There was still some heavy bottoming of the cylinders, however, so it was necessary to make some speed adjustments on the flow controls at these cylinders as well. They now move more



smoothly, and I expect them to operate even more so once the brass bushings are replaced. The wear to the mechanical components should be reduced drastically now that a significant amount of the shock has been eliminated.

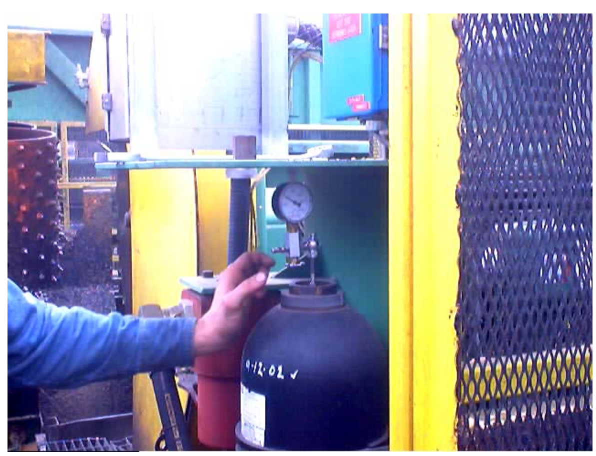
Strapper

I observed the operation of the Strapper and watched it stop out of position, but it didn't appear to be a hydraulic problem. I noted that the directional valve did in fact close at that point, so hydraulically the machine was doing as it was told. The problem appeared to be one of input, not of execution. A closer inspection revealed a photo eye that was not quite lined up with the reflector. If I stood directly behind the reflector and sighted to the photo eye, I could see focus just outside the bound of the reflector at about the 10 o'clock position. Once the photo eye was realigned, the machine began functioning normally again for a few cycles. Again it stopped out of position and I noted that the photo eye had once more come out of alignment. It is tightened down well, but perhaps a worn bracket or mount is causing it to lose its alignment. Either the eye or its mount (if they are available separately) may need to be replaced if the problem persists.

Bucking Saws

The problem with the Bucking Saws is somewhat more complex. Whenever both saws are extending at the same time, the stationary saw seems to move properly, but the moving saw hesitates before reaching the log and builds speed only when the stationary saw slows to cut or has fully retracted. I was told that this has not always been the case, but instead began only once the line was sped up. It was noted that when both saws are moving, the system pressure drops severely. This is indicative of the system calling for more fluid than the combination of the pump and the accumulator can deliver. Shutting the system down to troubleshoot would have interrupted production, but we did confirm that the problem is being caused by a lack of flow. There are only a limited number of causes for this, so the problem should be rectified fairly easily. I will offer here some of the available solutions.

First, ensure that all available flow is in fact being delivered to the system. Heat can be felt all over the accumulator, suggesting that it is undercharged. On this system, 600 PSI will deliver the greatest amount of additional flow, though the system designer has specified 1000 PSI. Also, check the case drain flow of the pump. The pump is a 38 GPM Denison piston pump. Case flow, if the pump is in good condition, should be no more than 1 – 3% of



Precharge Should Be Set To 600 PSI

the total output of the pump, or about .38 – 1.14 GPM. Removing the case drain line, diverting the flow into a bucket of a known size and timing how long it takes to fill can measure this. Divide the size of the bucket by the time (in minutes) to find case flow in GPM. A rough approximation of the flow can be determined with a heat gun. Measure the temperature of the case drain line and the temperature of the suction line. Since every 15.9 degrees Farenheit of temperature gain represents 1 HP of power loss, the flow can be determined using the hydraulic horsepower formula:

$$HP = GPM \times PSI \times .000583 \text{ or:}$$

$$GPM = (T_{Case\ Drain} - T_{Suction\ Line}) \div (PSI \times .0093)$$

Enter the system pressure as regulated by the pump compensator (1200 PSI in this case) to determine the amount of case flow. As an example, if the case drain line measures 130 degrees Farenheit and the suction line measures 120 degrees, the approximate case flow would be .9 GPM.

From feeling the suction and case drain lines, I doubt there is excessive case flow at this time. But this check should be made on a monthly basis to track the condition of this pump and all other externally drained pumps in the facility. A more convenient and accurate check would be to permanently install a flow meter in each case drain line. Case drain checks would then be a simple matter of recording the reading once a month.

If correcting the precharge of the accumulator does not resolve the problem and the pump is found to be delivering an acceptable amount of flow, then the system is being operated faster than it was designed to do and an upgrade will be in order. This will amount to either installing a higher flow pump (and perhaps installing larger hydraulic lines to accommodate the increased flow without developing heat and turbulence problems) or installing a larger accumulator. Since there is usually a significant amount of time between logs requiring the use of both saws simultaneously, I would recommend the latter. It would certainly be less expensive to install a larger accumulator than to replace the pump and all of the pressure lines. Not to mention the additional energy costs that would be incurred by running a very high flow pump destroked most of the time. A larger accumulator will deliver a greater burst of flow when required to operate the second saw without expending energy between cycles. The current accumulator is a 5-gallon Greer bladder type. Greer also makes a 20-gallon bladder accumulator that should be more than sufficient to resolve this issue. Once installed, precharge it to 600 PSI to achieve the maximum additional flow.

One final remark I should make about the Bucking Saws concerns the current system pressure. When setting the pressure on the Catch and Loads, the pressure was lowered to 1200 PSI on the Bucking Saws as well by mistake. But upon putting the saws back in service, the 1200 PSI seemed sufficient to operate them despite the designer specification of 1500 PSI. Unless future problems occur in the Bucking Saw, such as a log with a knot that cannot be sawed through causing a stall, I would recommend keeping the pressure at 1200 PSI. This will minimize shock in the system as well as lower energy costs. However, should it become necessary to raise the pressure, be sure to adjust the system relief valve and the accumulator precharge accordingly. The relief valve should be kept adjusted to 250 PSI above the compensator and the accumulator should be precharged to half the compensator setting.

Quadrant Feeder

The shock problems in the Quadrant Feeder do not appear to be as severe as those in the Catch and Load and Log Kicker circuits. I did note pressures higher than the designer specifications. By setting the pressures to specs, precharging the accumulator and adjusting the flow controls at the actuators as was done with the other circuits, the shock problems should be taken care of. The correct settings are as follows:

Pump 1 compensator – 1800 PSI
Pump 2 compensator – 1700 PSI
System Relief Valves – 2350 PSI
Accumulator Precharge – 1000 PSI

The design setting of 2350 PSI seems a little high. Better shock protection would be provided at 2050 PSI, but perhaps there are some characteristics to the particular Sun relief valve that I am unaware of. I recommend setting the relief valves to 2050 PSI and monitor the system for heat. If it is detected by using the heat gun that significant heat is generated at the relief valve, then the pressure may be raised back to the designer specification of 2350 PSI.

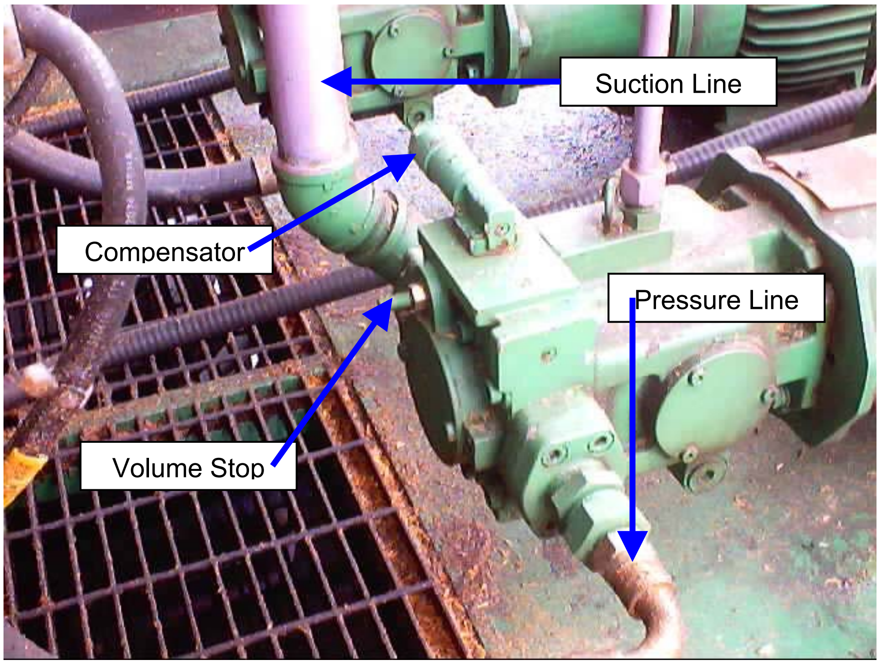
Pressure Setting Procedure

The following procedure should be used to set the pressures on all pressure compensating pump systems that have relief valves:

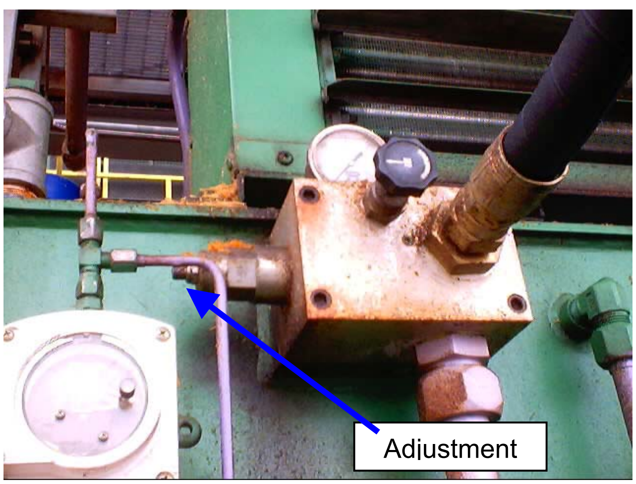
1. Shut down the system.
2. Turn the compensator adjustment clockwise to raise its pressure well above the relief valve setting. You may want to just turn it all the way. This will be acceptable for a short period of time while the settings are made, but do not allow fluid to dump at high pressure through the relief valve for any extended period of time.
3. Turn the relief valve fully counterclockwise.
4. Block all flow in the system to ensure that the only path back to the reservoir is through the relief valve.
5. Turn the system on. Fluid should be dumping through the relief valve at a very low pressure.
6. Gradually raise the relief valve pressure by turning the adjustment clockwise. Set it 250 PSI above the desired pump compensator setting. The full pump flow will now be dumping across the relief valve at high

pressure. Do not allow this to continue any longer than necessary to avoid oil breakdown.

7. Lower the pressure of the pump compensator to the desired setting. A more stable pressure setting is made if it is approached from below, so it is recommended that the pressure be turned down at least 200 PSI below the desired setting then raised back.



Denison PVT38 38 GPM Piston Pump



Sun System Relief Valve

These settings should be checked and corrected monthly and after any extended shutdown (any shutdown long enough for oil and component temperatures to drop to ambient levels) for continued efficient operation.

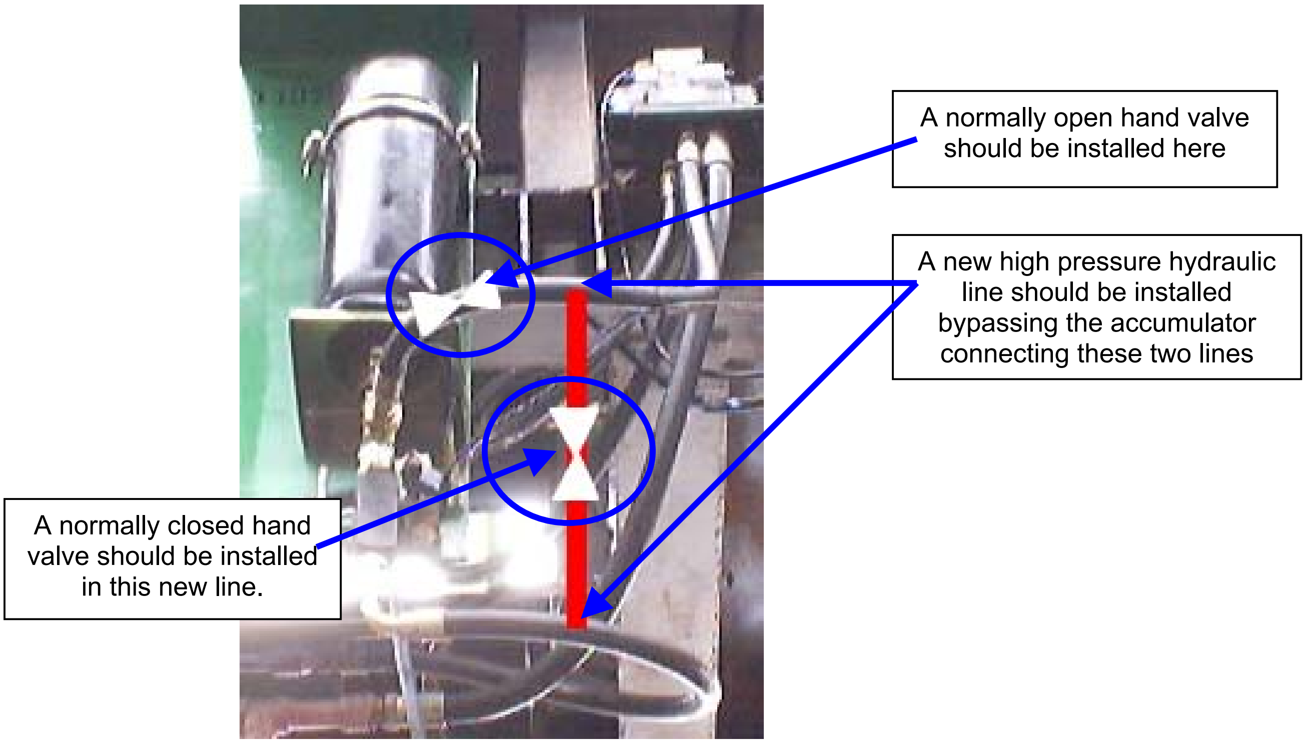
Most of the circuits have a relief valve built into the automatic accumulator dump valve. Some confusion seems to exist about the nature of this valve. It is important to note that the pressure setting of this valve is NOT what is recommended as system pressure. The valve is to automatically dump the accumulator when the system is shut down and limit the pressure inside the accumulator during system operation. A normally open solenoid actuated directional valve drains the accumulator whenever the system is shut down and closes whenever the system is turned on to direct flow to this relief. The purpose of the relief valve is to limit the pressure in the accumulator. The maximum test pressure of the accumulator shell is 3000 PSI. Exceeding that pressure could be deadly. This valve ensures that the pressure can never get this high. With a proper compensator and relief valve setting, the only time the pressure could ever approach this amount would be during a shock spike. This valve will therefore also help to absorb shock in the system as well as protect the accumulator from over pressurizing. The design specification calls for a setting of 2250 PSI for this relief valve. I do not recommend setting this pressure while it is on the machine. The procedure is complicated and to do so requires raising the system pressure above 2250 PSI. A much simpler and safer way of setting this valve is on a test bench. A test bench may be built very easily and inexpensively using a small fixed displacement pump, relief valve and reservoir.

There is also a manual hand valve on the block. This manual hand valve bypasses the solenoid valve in case it becomes stuck. If system pressure does not drop all the way to 0 PSI when the system is shut down, chances are that the solenoid valve has stuck closed and the accumulator cannot dump. Whenever there is any doubt that pressure has been bled down in the system, this valve should be opened before any servicing is performed. I realize that the location of the valve is inconvenient to be included as normal lockout procedure, but at the very least this valve should be opened if failure of the solenoid valve is ever suspected. If there is any oil at all remaining in the accumulator, the machine can still move and technicians can be exposed to high pressure, even if the system is completely locked out.

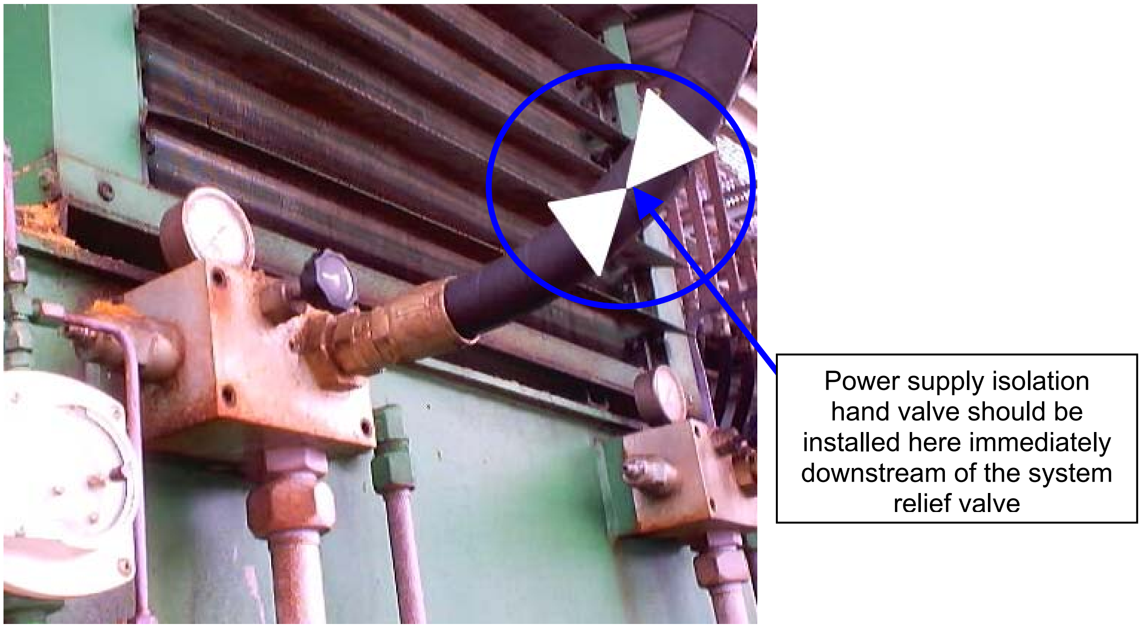
Additional Recommendations

In addition to the recommendations I have made above, there are two very simple and inexpensive modifications that can be made to assist in troubleshooting and perform routine maintenance without interrupting production.

There is no need to shut a system down to precharge an accumulator if it can be isolated from the system. If such and isolation valve had been in place, we could have adjusted the precharge of the Bucking Saws while I was on site. Isolating the accumulator may slow a machine down, but will not interrupt production entirely. Because of the automatic dump valve arrangement that is in place on all of the accumulators, this will require two hand valves and a hydraulic line. In order to bypass the accumulator, a hydraulic line must bypass the accumulator as shown in the figure below. A hand valve in this line should be normally kept closed unless maintenance is being performed on the accumulator while the machine is running. The second hand valve should be installed between the junction of the new line and the accumulator. During normal operation, this second hand valve should remain open. To isolate the accumulator for maintenance or troubleshooting, close the hand valve between the accumulator and the new junction and open the hand valve in the newly installed bypass line. The manual dump valve should be opened since voltage will remain on the automatic dump valve keeping it closed. The accumulator will drain and maintenance may be performed.



One of the first steps to troubleshooting a hydraulic power supply is to isolate it from the rest of the system. Unfortunately, that cannot be done at . With an isolation hand valve in the pressure line immediately down stream from the power supply, the pump can be deadheaded for setting the compensator and relief valve as well as eliminating the power supply as a possible cause of system pressure problems. Installing such a valve will be very simple and inexpensive and save considerable maintenance time. The valve should be installed in the pressure line immediately downstream of the system relief valve as shown in the illustration below:



I would like to thank for the opportunity to help with your hydraulic problems. In particular, I would like to thank for their assistance and support during my visit. We at GPM look forward to any further assistance we may provide in the future.

Sincerely,

Jack D. Weeks, Jr.
Consultant,
GPM Hydraulic Consulting, Inc.