Prince Manufacturing Corporation

Hydraulic Systems

Trouble Shooting

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Notes

Please visit the Prince Manufacturing Corporation web site at www.princehyd.com and review our comprehensive catalog pages and user manuals for the hydraulic control valves that we offer.

These manuals and catalog pages will help you identify the type of hydraulic control valve you have (mono block, stack valve, flow control valve, etc…). In these pages you will find detailed diagrams on how a hydraulic circuit works and what the major components of a hydraulic system are. Using this information will greatly increase your success in solving your hydraulic problem.

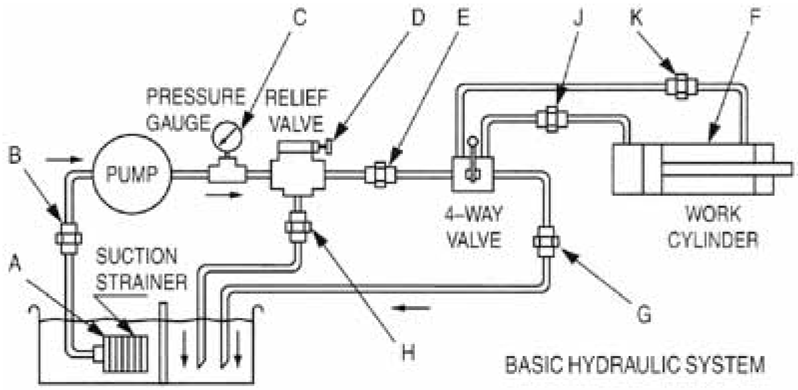
Hydraulic Systems Trouble Shooting

Many of the failures in a hydraulic system show similar symptoms: a gradual or sudden loss of high pressure, resulting in loss of power or speed in the cylinders. In fact, the cylinders may stall under light loads or may not move at all. Often the loss of power is accompanied by an increase in pump noise, especially as the pump tries to build up pressure.

Any major component (pump, relief valve, directional valve, or cylinder) could be at fault. In a sophisticated system other components could also be at fault, but this would require the services of an experienced technician.

By following an organized step-by-step testing procedure in the order given here, the problem can be traced to a general area, then if necessary, each component in that area can be tested or replaced.

1. Pump Suction Strainer

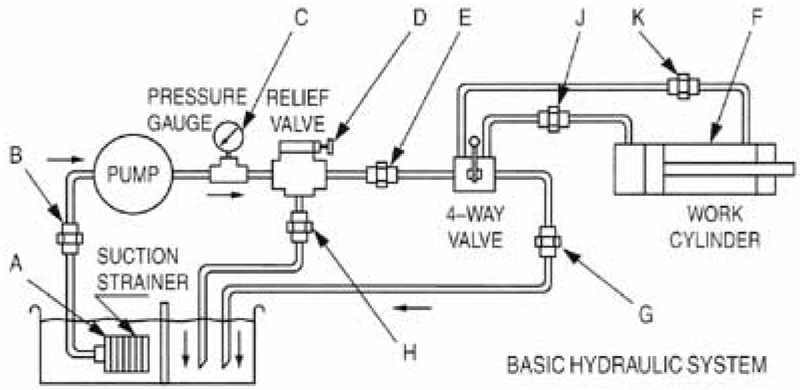


Probably the field trouble encountered most often is cavitation of the hydraulic pump inlet caused by restriction due to a dirt build-up on the suction strainer. This can happen on a new as well as an older system. It produces the symptoms described above: increased pump noise, loss of high pressure and/or speed.

If the strainer is not located in the pump suction line it will be found immersed below the oil level in the reservoir (point A), See Fig. 1.1. Some operators of hydraulic equipment never give the equipment any attention or maintenance until it fails. Under these conditions, sooner or later, the suction strainer will probably become sufficiently restricted to cause a breakdown of the whole system and damage to the pump.

The suction strainer should be removed for inspection and should be cleaned before re-installation. Wire mesh strainers can best be cleaned with an air hose, blowing from inside out. They can also be washed in a solvent which is compatible with the reservoir fluid. Kerosene may be used for strainers operating in petroleum base hydraulic oil. Do not use gasoline or other explosive or flammable solvents. The strainer should be cleaned even though it may not appear to be dirty. Some clogging materials cannot be seen except by close inspection. If there are holes in the mesh or if there is mechanical damage, the strainer should be replaced. When reinstalling the strainer, inspect all joints for possible air leaks, particularly at union joints (points B, E, G, H, J, and K), See Fig. 1.1. There must be no air leaks in the suction line. Check the reservoir oil level to be sure it covers the top of the strainer by at least 3" at minimum oil level, with all cylinders extended. If it does not cover to this depth there is the danger of a vortex forming which may allow air to enter the system when the pump is running.

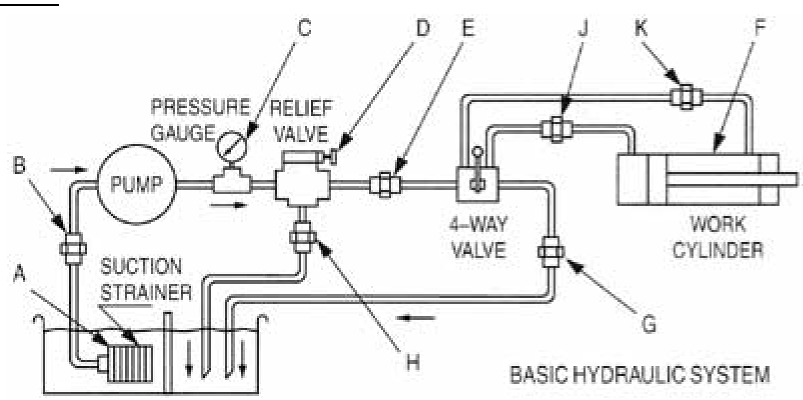
2. Pump and Relief Valve



If cleaning the pump suction strainer does not correct the trouble, isolate the pump and relief valve from the rest of the circuit by disconnecting at point E so that only the pump, relief valve, and pressure gauge remain in the pump circuit. Cap or plug both ends of the plumbing which was disconnected. The pump is now deadheaded into the relief valve.

Start the pump and watch for pressure build-up on the gauge while tightening the adjustment on the relief valve. If full pressure can be developed, obviously the pump and relief valve are operating correctly, and the trouble is to be found further down the line. If full pressure cannot be developed in this test, continue with Step 3.

3. Pump or Relief Valve



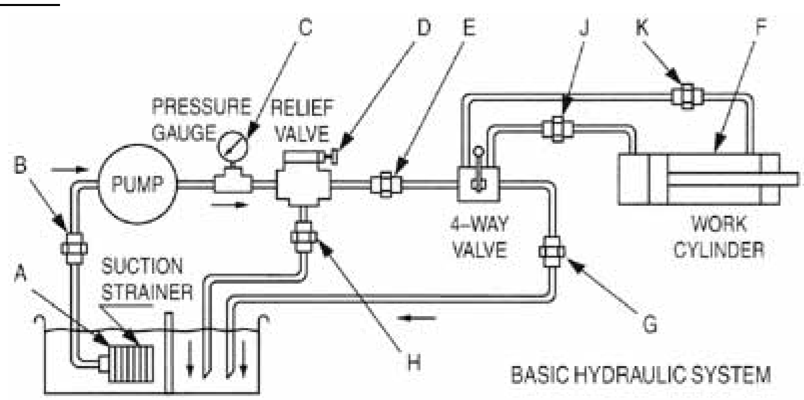
If high pressure cannot be obtained in Step 2 by running the pump against the relief valve, further testing must be conducted to see whether the fault lies in the pump or in the relief valve. Proceed as follows:

If possible, disconnect the reservoir return line from the relief valve at point H. Attach a short length of hose to the relief valve outlet. Hold the open end of this hose over the reservoir filler opening so the rate of oil flow can be observed. Start the pump and run the relief valve adjustment up and down while observing the flow through the hose. If the pump is bad, there will probably be a full stream of oil when the relief adjustment is backed off, but this flow will diminish or stop as the adjustment is increased.

If a flowmeter is available, the flow can be measured and compared with the pump catalog rating. If a flowmeter is not available, the rate of flow on small pumps can be measured by discharging the hose into a bucket while timing with a watch. For example, if a volume of 10 gallons is collected in 15 seconds, the pumping rate is 40 GPM.

If the gauge pressure does not rise above a low value, say 100 PSI, and if the volume of flow does not substantially decrease as the relief valve adjustment is tightened, the relief valve is probably at fault and should be cleaned or replaced as instructed in Step 5. If the oil substantially decreases as the relief valve adjustment is tightened, and if only a low or moderate pressure can be developed, this indicates trouble in the pump. Proceed to Step 4.

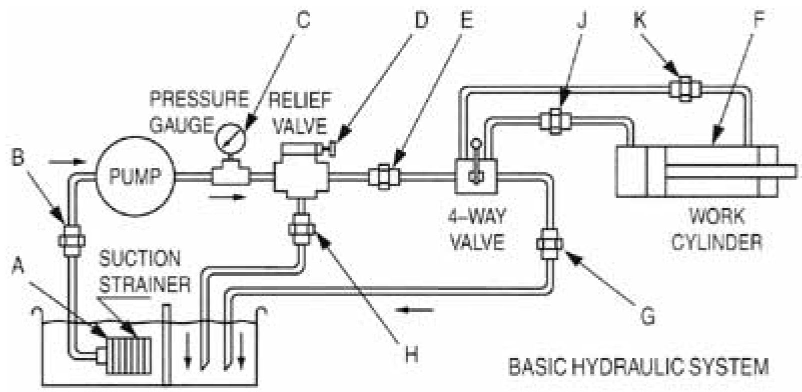
4. Pump



If a full stream of oil is not obtained in Step 3, or if the stream diminishes as the relief valve adjustment is tightened, the pump is probably at fault. Assuming that the suction strainer has already been cleaned and the inlet plumbing has been examined for air leaks, as in Step 1, the oil is slipping across the pumping elements inside the pump. This can mean a worn-out pump, or too high an oil temperature. High slippage in the pump will cause the pump to run considerably hotter than the oil reservoir temperature. In normal operation, with a good pump, the pump case will probably run about 20°F above the reservoir temperature. If greater than this, excess slippage, caused by wear, may be the cause.

Check also for slipping belts, sheared shaft pin or key, broken shaft, broken coupling, or loosened set screw.

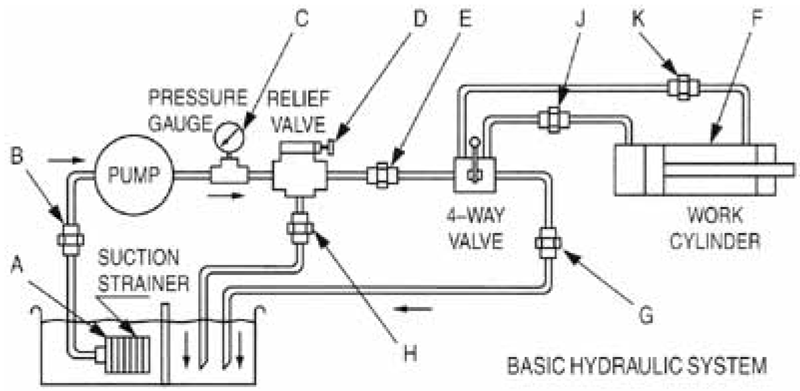
5. Relief Valve



If the test in Step 3 has indicated the trouble to be in the relief valve (Point D) the quickest remedy is to replace the valve with one known to be good. The faulty valve may later be disassembled for inspection and cleaning. Pilot-operated relief valves have small orifices which may be blocked with accumulations of dirt. Blow out all passages with an air hose and run a small wire through orifices.

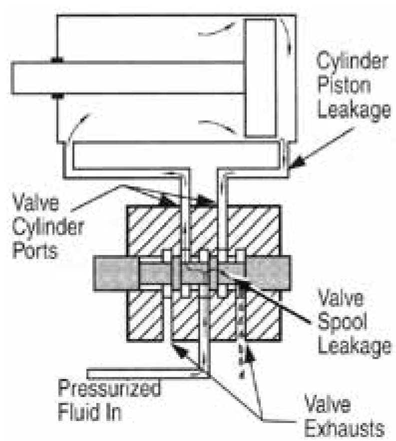
Check also for free movement of the spool. In a relief valve with pipe thread connections in the body, the spool may bind if pipe fittings are over-tightened. If possible, test the spool for bind before unscrewing threaded connections from the body, or screw in fittings tightly during inspection of the valve.

6. Cylinder



If the pump will deliver full pressure when operating across the relief valve in Step 2, both pump and relief valve can be considered good, and the trouble is further downstream. The cylinder should be tested first for worn-out or defective packings by the method described in the section Cylinder and Valve Testing.

7. Cylinder and Valve Testing



Two Leak Paths

On an air system, if air is detected escaping from a 4-way valve exhaust while the cylinder is stopped, this air is either blowing by worn-out piston seals, or is leaking across the spool in the 4-way valve. These two leakage paths are shown in the figure to the right.

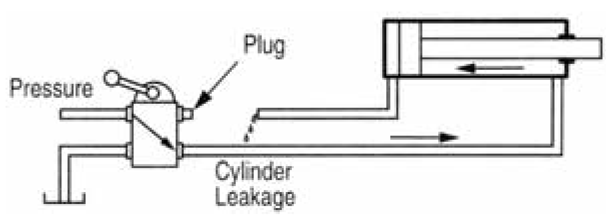
Most cylinders and valves have soft seals and should be leak-tight. However, those air valves having a metal-to-metal seal between spool and body may be expected to have a small amount of leakage. If leakage is noted, it is more likely to be coming through the cylinder than across the valve spool, and the cylinder should be tested first.

8. Cylinder Testing

Run the piston to one end of its stroke and leave it stalled in this position under pressure. Crack the fitting on the same end of the cylinder to check for fluid leakage.

After checking, tighten the fitting and run the piston to the opposite end of the barrel and repeat the test. Occasionally a cylinder will leak at one point in its stroke due to a scratch or dent in the barrel. Check suspected positions in mid-stroke by installing a positive stop at the suspected position and run the piston rod against it for testing. Once in a great while a piston seal make le ak intermittently. This is usually caused by a soft packing or O-ring moving slightly or rolling into different positions on the piston, and is more likely to happen on cylinders of large bore.

When making this test on hydraulic cylinders, the line should be completely removed from a cylinder port during the test. The open line from the valve should be plugged or capped since a slight back pressure in the tank return line would spill oil from the line if not plugged. Pistons with metal ring seals can be expected to have a small amount of leakage across the rings, and even "leak-tight" soft seals may have a small bypass during new seal break-in or after the seals are well worn.



9. 4-Way Valve Testing

For testing 4-way valves, either air or hydraulic, it is necessary to obtain access to the exhaust or tank return ports so that the amount of leakage can be observed. To make the test, disconnect both cylinder lines and plug these ports on the valve. Start up the system and shift the valve to one working position. Any flow out the exhaust or tank return line while the valve is under pressure is the amount of leakage. Repeat the test in all other working conditions of the valve.