Shocks in Hydraulic Systems

By Walt Flippo

There are a few types of applications where an accumulator will not solve your shock problem – it will actually add to the problem.

Let's take an application where you are pressing a heavy load and, after there is a tremendous shock in the line going to the cylinder, the entire machine may tend to jump. An accumulator in the inlet line where the shock is taking place will only add to the shock problem by adding stored energy to the system.

To begin, let's take a look at how the shock is being generated. In a pressing type application, all the members of the machine are in tension. The fluid is being compressed and it is sitting there like a big spring ready to return to its neutral state.

When the directional valve is shifted to retract the cylinder, all the machine members, as well as the compressed fluid, want to release the stored energy and return to their neutral state. When this happens, there is an instantaneous release of energy in the system. As a result, a very high flow of fluid exits in a very short time, creating the shock. These types of shocks in a system can be controlled or eliminated by installing a decompression valve, a soft shift directional control valve, or a servo valve on the side of the cylinder where the compressed fluid is being released. This valve is set up to release the stored energy over a controlled period of time, letting the machine members return to their neutral position and allowing the compressed fluid to expand at a slower rate, thus eliminating the shock.

Another application is shearing or punching holes in thick sheet metal. On an application such as a hydraulic shear or press where the cylinder may be punching or shearing heavy plate steel, hydraulic shock is generated in the system when the cylinder breaks through the heavy steel. On these applications, the cylinder is usually a short stroke cylinder and in many of these applications, several cylinders may be set up to punch on a single machine simultaneously.

The cylinders are advanced to the steel under virtually no load. Once the contact is made with the steel, the hydraulic pressure builds until the punch penetrates and punches through the steel. As a result of the build-up of the hydraulic pressure, all the members of the machine are under tension. In many instances, the hydraulic fluid is compressed to 5000 psi or more. As the punch breaks through the steel, there is a rapid drop-off in pressure in the cap end of the cylinder and the cylinder meeting no resistance accelerates forward, creating a very high flow out of the rod end of the cylinder. In most instances, the cylinder would have a large two-to-one oversize rod and, as a result, the pressures are intensified to over 150% above the pressure on the cap end of the cylinder.

The flow rate for a short time can be extremely high, due to the machine members returning to their neutral state and the fluid expanding to its original neutral state. This extremely high rate of flow trying to leave the rod end of the cylinder and the pressure on the cap end of the cylinder building back to relief valve setting then being intensified, can strip off the piston and then when the pressure on the rod end of the cylinder decompresses very rapidly it can actually pull the rod seal out of the rod gland.

This problem can be solved by installing a flow control with a ball check on the outlet of the cylinder in conjunction with a direct acting relief valve between the port of the cylinder and the flow control valve. The flow control valve will keep some pressure on the rod end of the cylinder to keep the cylinder from accelerating when the punch breaks through the steel and the direct acting relief valve will keep the excess flow generated by the breakthrough of the punch from exceeding the relief valve pressure setting.