Hydraulic Shock/Spikes – Slow Response

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In the last Application News I discussed shock in the hydraulic system caused by fluid flowing at high velocity and being decelerated/stopped abruptly. In this issue, I will discuss shock/spikes in the hydraulic system caused by slow response of the system components.

Two components that cause shock in a system are the slow response of a relief valve with a positive displacement pump, or the slow response of a variable volume pump during the transition from full-flow to no-flow. Pump response time is usually stated in the pump catalog as being in the 100 – 200 millisecond range. This is under ideal laboratory conditions and does not necessarily reflect actual response time.

Whether it is a system using a positive displacement pump and a large relief valve, or a large variable volume pump, the response time of the components can be between 350 and 500 milliseconds. A typical 60-gallon per minute pump can push an additional 58 cubic inches of fluid into the system. This is assuming it takes about 500 milliseconds to go from full-flow to no-flow. Since the pump is ramping down, we will take 50% of the flow over the time it takes to compensate. The additional fluid going into the system will show up as a spike, or increase, in pressure. This condition is more pronounced in systems where there is very little piping between the pump and the component that is closing off the flow of fluid. If there are hoses in the line, they will expand and suppress some of this shock.

Here is an example:

**inPHorm Program - Shock**
- 60 GPM Variable Volume Pump, operating at 2,000 PSI.
- 125°F Fluid Temp.
- 36” of 1.5” I.D. Sch. 80 piping between pump and valve closing off flow of fluid

If we use the inPHorm program to calculate the size of the accumulator to keep the pressure increase to 2100 PSI, we would require a 11.03-gallon accumulator. If we permit the pressure to increase to 2200 PSI, we would require a 5.71-gallon accumulator.

Remember, when we are using the Compensating for Shock Due to Component Response Time program, we are requiring the accumulator to take in the output of the pump with a very small differential in pressure. Precharge would be 90% of the relief valve setting.

The program above assumes the directional valve, or whatever is restricting the flow of fluid, is instantly shut off.