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# Industrial Accumulator 102

## Use of Accumulators for Shock Suppression

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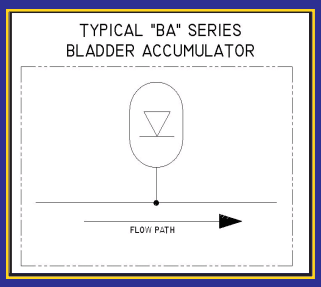
In a previous Application News Letter, the use of an accumulator for supplemental flow on a power unit was demonstrated. Another common application for an accumulator is for shock suppression. Often times a system can exhibit shock for various reasons:

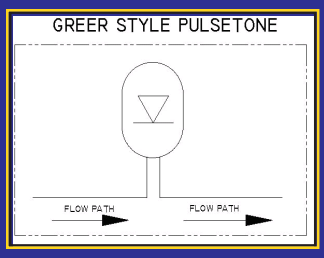
A) The application experiences a water hammer-type shock caused by fast valve closing or pump starts and stops. This regular shock travels through the system, causing damage to the system and affecting the quality of the end product.
B) The piping in the system excites a natural harmonic that resonates through out the system, again damaging the hydraulic system.
C) Application requirements:
   a. Closing valves quickly
   b. Cylinder bottoming out and relief, vent, or compensator valves don't respond quickly enough

Regardless of the source of the shock, or whether you are designing for it or it is an unexpected "visitor", a properly designed accumulator can reduce and in many cases eliminate the undesired results of the shock. While piston accumulators can be implemented in these systems, more commonly a bladder accumulator is chosen for its quick response.

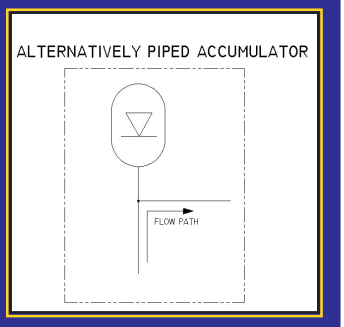
The 3 schematics demonstrate the most common orientations of plumbing an accumulator into the system. In the first schematic, a T-union is installed in the hydraulic line. The accumulator should be installed as close as reasonably possible on the perpendicular branch of the "T". A wide port on the fluid end of the accumulator will provide the best opportunity for the shock to be absorbed by the accumulator.




Schematic 1




Schematic 2




Schematic 3

Another method for absorbing shock is to force the oil path through the accumulator. Schematic 2 is representative of Parker's Greer Pulsetones that have a baffle in the hydraulic port; the baffle directs the oil into the shell of the bladder accumulator, thereby providing the best protection against shock.

Though the Pulsetone has superior shock suppression characteristics, sometimes there is not enough money in the budget for this component. Schematic 3 shows a third option for plumbing the accumulator into the system. It is generally thought that this type of installation will take an additional 5% of the shock out of the system.

When sizing for shock, the key factors are the mass and velocity of the fluid in the hydraulic line, and the pressure of the shock waves, as demonstrated in the following equation and Table of Variables:

$$V_1 = \frac{(12\omega AL)(V^2)(n-1)\left(\frac{P_2}{P_1}\right)^{1/n}}{2(g)(P_2)\left[\left(\frac{P_m}{P_2}\right)^{(n-1)/n} - 1\right]}$$

| Shock Variables | Symbol |
|---|---|
| System Pressure (psi) | $P_2$ |
| Shock Pressure (psi) | $P_m$ |
| Precharge (psi) | $P_1$ |
| Discharge Coefficient | n |
| Acceleration due to Gravity (ft/sec$^2$) | g |
| Specific Weight of Fluid (lbs/ft$^3$) | ω |
| Effective Flow Area of Pipe (ft$^2$) | A |
| Length of Pipe (ft) | L |
| Fluid Velocity (ft/sec) | V |
| Accumulator Volume (in$^3$) | $V_1$ |

When insufficient data is available to properly size an accumulator for shock, the following are good guidelines:

1. Use the largest port available.
2. Use a port that matches your line size
3. Use 60% of the max. operating pressure for the precharge pressure as a starting point.
4. Make an educated guess at what your shock pressure is, plug it into the equation. Repeat with double your initial shock pressure; this will help you understand how your accumulator size will grow with an increase in shock pressure. Varying your precharge pressure will change this too.
5. The compression ratio should not exceed 4:1 (operating pressure: precharge pressure)

Using these guidelines, you should be able to adequately size an accumulator for shock. Always call your local Parker Accumulator Application Engineer if you have any questions.

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