Precharge and Permeation - Part II

By Steve Hansen

In part one of Precharge and Permeation we discussed the importance of maintaining the correct precharge to ensure the longevity and effectiveness of a hydraulic accumulator. In part two we will discuss permeation, the most important issue that effects loss of precharge.

For the purposes of an accumulator, permeation as defined by dictionary.com is applicable: "The act of permeating, passing through, or spreading throughout. The pores or interstices of any substance."

In a pressurized accumulator, the nitrogen gas seeks to pass through whatever vessel is used to contain it. Steel shells used in piston, bladder, and diaphragm accumulators provide for an effective barrier to permeation. However, the seals, membranes, and bladder bags found in accumulators are not immune to the permeation of nitrogen.

The helium balloons we experienced as kids provided a good example of permeation. Within a couple days our balloons would not float up any more due to the helium having permeated the balloon membrane. It was a frustrating experience, as we had hoped they would last much longer.

While the permeation of nitrogen in accumulators is much slower by comparison, the overall effect is the same. What impacts permeation rates and how should we select an accumulator with permeation in mind? Temperature, contamination, and time are three key factors that affect the loss of permeation.

At normal system operating temperatures, precharge loss is relatively low and can be easily maintained. When accumulators are exposed to higher temperatures the rate of permeation increased dramatically. Referencing the permeation chart below we can see that when operating temperatures are kept less than 120 degrees F in diaphragm or bladder type accumulators the precharge loss after 1000 hours is around 50 PSI. If this same system operates at 160 degrees F the precharge loss could approach 200 PSI. This change in precharge may have a significant impact on system performance. At even higher temperatures the problem becomes more pronounced.

If temperature will be an issue in a given system a piston style accumulator may be a better choice than a bladder or diaphragm accumulator. Permeation does not occur through the aluminum piston and thus the only path for loss of nitrogen is through the piston seals. This area is so small that permeation is, for the most part, held in check.

Contamination becomes an enemy of precharge when piston seals become worn or piston bores are scored and create paths for the loss of precharge. When contamination is expected to be a concern a bladder or membrane style accumulator offers greater tolerance of contamination than a piston style accumulator.

Another option to consider when contamination is an issue is to install a KleenVent on the reservoir. As a reservoir isolator, the KleenVent is very effective in keeping contamination and more importantly, water out of hydraulic systems.

Time is also a factor in loss of precharge. While impacted by both, permeation will occur over time regardless of pressure or temperature. Regular maintenance checks should be made on hydraulic systems to ensure accumulator precharge is correct. Some systems may require a monthly check or duty cycle is extreme. Typically a quarterly or even annual check is sufficient to ensure that the accumulator is operating at an optimal level. In ideal settings, some accumulators are able to operate effectively for years without maintenance to the precharge. However, the ability to ignore maintenance for a hydraulic accumulator is not typical in most hydraulic systems.

Keep precharge and permeation in mind when selecting and maintaining accumulators. When correctly sized and maintained, accumulators will provide years of trouble free service and increase the longevity for other components of a hydraulic system.