For Optimum Operation of a Hydraulic Circuit
Accumulators Are an Essential Component

Accumulator Gases | The effects of Precharge Properties on Accumulators

When applying an accumulator in a hydraulic system, it is essential to understand the property of nitrogen. Since nitrogen will pretty much follow the ideal gas laws; at low pressure (equation demonstrating the relationship between temperature, pressure, and volume for gases); once these parameters are exceeded the gas will deviate from the ideal gas laws and follow the real gas laws.

Since the precharge in the accumulator is affected by the change in a gas's behavior, it is critical to understand a little about the properties of nitrogen.

We know the output of an accumulator or the useable volume of an accumulator between two distinct pressures is determined by the accumulator having the proper precharge at the operating temperature. If the precharge is too high, we know the accumulator will not take in the correct amount of fluid resulting in less fluid being discharged from the accumulator to do work between the minimum and maximum pressure. If the precharge is too low, we know the accumulator will take in more fluid, but there will be less fluid available to do the work between the minimum and maximum pressure.

Accumulators in A Circuit | Accumulators Can Perform A Variety of Functions in A Hydraulic System

- Maintain system pressure (pressure compensation, absorbing pressure spikes from pumps or other components – controlling pressure and flow rates in the hydraulic circuit)
- Supplement pump flow
- Absorb system shock (hydraulic spring/shock absorber)
- Store energy (saving energy without loss and redistributes when required therefore reducing installed power, (in the case of failure on the primary energy sources, accumulators provide sufficient stored energy to complete the operation at hand)
- Volume Control, by absorbing fluid volume variation that is introduced by temperature changes in a closed hydraulic circuit while maintaining a rated pressure
What is a Hydraulic Accumulator? | Storage of Hydraulic Energy

- Hydraulic accumulators are devices that store energy in the form of hydro-pneumatic (means of both water and air or other gas) under pressure.
- Accumulators join a gas which is usually nitrogen gas, in conjunction with hydraulic fluid. The hydraulic fluid has minimal power storage qualities, but the gas can be compressed to high pressures and low volumes.
- The energy is then stored in the compressed gas and released upon demand as needed.

What Are the Different Types of Hydraulic Accumulators?

**Bladder**
- General purpose available in a wide range of standard size
- Good response characteristics making bladder accumulators well suited for shock applications
- Large ports allowing for rapid fluid discharge which helps to ensure that the device is relatively insensitive to dirt and contamination
- Generally mounted vertically (low-cycle operations allow mounting on sides)
- A bladder acts as a gas spring – suppressing vibration and shock in the hydraulic system (lifting vehicles – forklifts) while maintaining real suspension of the load on the gas spring

**Diaphragm**
- Operates like a piston accumulator (uses the elastic diaphragm to separate the oil and gas volumes vs. piston which uses a rubber bladder
- Economical
- Compact
- Lightweight
- Offers relatively small flow and volume (typical to around 1 gallon)
- Handles high compression ratios
- Wide mounting flexibility
- Insensitive to contamination
- Respond quickly to changes in pressure
- Well suited for shock applications

**Piston**
- Generally recommended for large stored volume (up to 100 gallons or more)
- High-flow rates
- Pressure ration limited due to design
- Similar to a hydraulic cylinder, but without the rod
- Consists of a fluid section and a gas section (identical to other accumulators
- Movable piston separating fluid from gas section
- Built for rugged, heavy-duty applications
- Sensitive to contamination (damage to seals, but most readily repairable by replacing the piston seal)
How Do You Size Accumulators? | Sizing Is Based on Gas Charge of The Accumulator

We can assist you in determining the right accumulator volume for your application taking into consideration energy storage, thermal expansion, surge arrestor, anti-pulsation. The alteration in volume and pressure determines how much fluid can be stored and released.

Steps include:

- Understanding your application to select the proper accumulator size
- Explore critical concerns and system circuit aspects
- Determine how much usable volume
- Determine the appropriate pre-charge for the application

Boyles Law of Gasses:
That for a given mass, at a continuous temperature, the pressure times the volume is a constant the mathematical equation for Boyle’s law is:

\[ PV = k \]

P -> Pressure of the gas
V -> Volume of the gas
T -> Temperature of the gas
K -> Constant value of the temperature and volume of the system

\[ P_1 V_1 = P_2 V_2 \]

In Summary:

Accumulators store energy to be used to supplement pump flow, improve system responsiveness, during power failure serves as a back-up.

Accumulators may also compensate for leakage or thermal expansion, reducing vibration, pulsations, and system shock.

GS Global Resources can assist you in sizing the most efficient accumulator for your application. Download the sizing form from our website and e-mail it back to us sales@gsgr.com

References:

Milwaukee School of Engineering (MSOE)
The Ideal Gas Law: Crash Course Chemistry #12 [https://youtu.be/BxUS1K7xU30](https://youtu.be/BxUS1K7xU30)

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