Hydraulic Accumulator

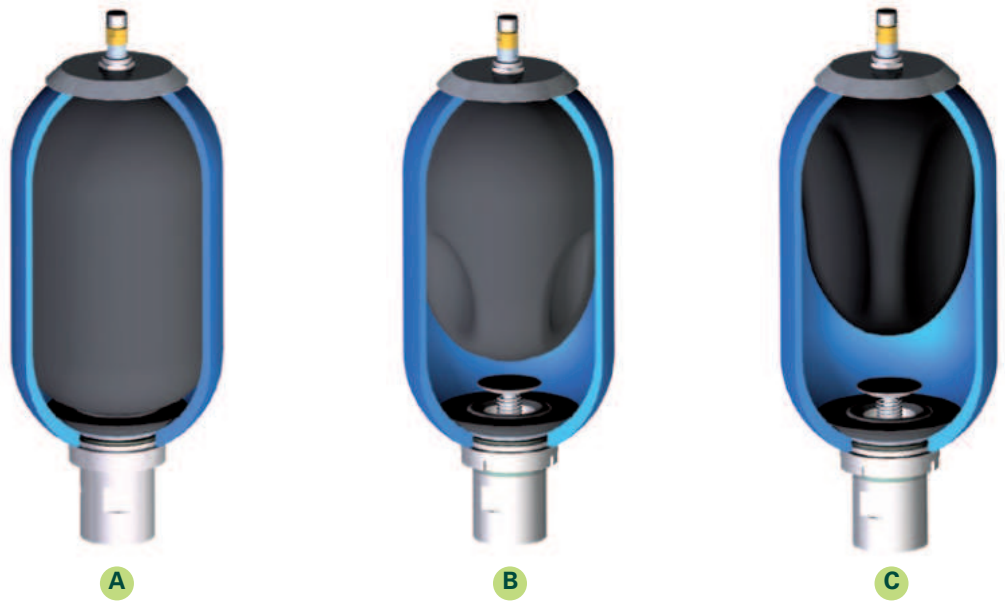
Fluids are practically incompressible and can therefore not be directly used for energy storage.

Hydraulic accumulators make storing fluids under pressure possible. Their operating principle is based on the Boyle-Mariotte's law (P x V = constant) and the compressibility difference between fluids and gases.

This allows:

- **Storage and, as required, release of the energy transmitted by the fluid.**
- **Maintaining a required level of pressure for a certain period of time.**
- **Hydraulic compensations of big masses.**
- **Absorbing excess energy (water hammers, etc.).**
- **Smoothening irregular pulsating fluid flows.**
- **Buffering shocks (vehicles, lifting systems, etc.).**
- **Pressure compensations in case of thermal loading.**

Hydraulic bladder accumulator operating principle



The bladder is filled with nitrogen through the gas valve and takes the shape of the accumulator shell **A**. By pumping hydraulic fluid into the accumulator, the gas contained in the bladder will be compressed. The gas volume is reduced and pressure increases. Hydraulic fluid accumulates in the unit **C**. Conversely, the accumulator will empty itself as soon as the hydraulic fluid pressure is lower than the gas pressure **B** .

The bladder normally deforms itself to a trefoil shape. This deformation is a practically inertia-free and frictionless deformation providing for a nearly 100% operation efficiency.

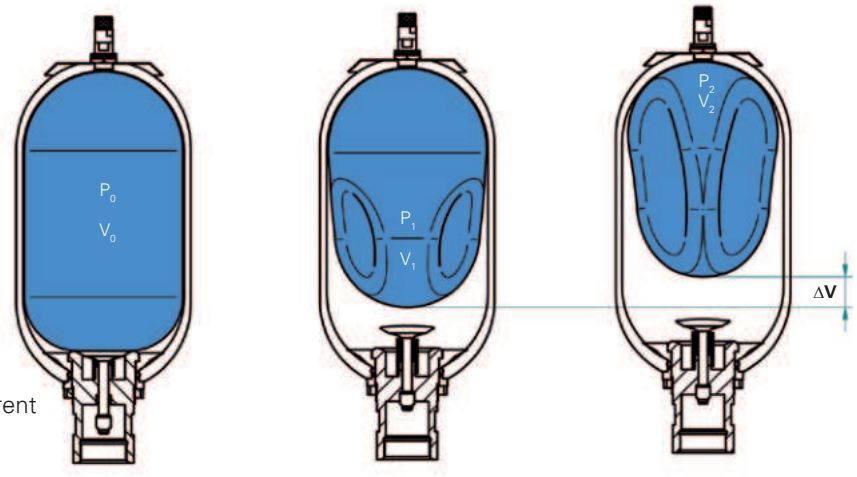
The three bladder basic positions:

A The bladder is in "precharge pressure position". This means that it is filled with nitrogen. The fluid port is closed.

B Position at minimum operating pressure. A small quantity of fluid remains between the bladder and the fluid port to prevent the bladder from striking the accumulator bottom when being emptied. $\mathbf{P}_0$ must always be lower than $\mathbf{P}_1$.

C Position at maximum operating pressure. The difference of volume $\Delta\mathbf{V}$ between the positions at maximum and minimum operating pressure corresponds to the accumulated fluid quantity.

$\mathbf{V}_0$ = Maximum accumulator capacity
$\mathbf{V}_1$ = Gas volume at $\mathbf{P}_1$
$\mathbf{V}_2$ = Gas volume at $\mathbf{P}_2$
$\Delta\mathbf{V}$ = Delivered and/or absorbed recovery volume between $\mathbf{P}_1$ and $\mathbf{P}_2$
$\mathbf{P}_0$ = Precharge pressure
$\mathbf{P}_1$ = Min. operating pressure
$\mathbf{P}_2$ = Max. operating pressure



Piston and diaphragm accumulators use the same operating principles with different constructional principles.

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