iNOSOL
innovative solutions

A001

01-2016

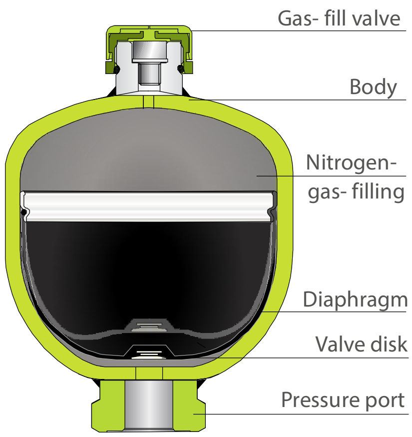
Pressure Accumulator

Diaphragm Accumulator, hydraulic, up to 500 bar

Advantages:

- ✓ **Different sizes available**
- ✓ **Solid design**
- ✓ **Discharge of hydraulic components under pressure variations and surges**
- ✓ **Supports energie reduction**
- ✓ **Reduces wear out of hydraulic components**

Description



Function:

The diaphragm is iminged with nitrogen gas. The integrated valve disk prevents damage of the diaphragm during the filling.

At minimum operating pressure a small amount of pressure oil must remain in the reservoir, to keep the diaphragm from closing the oil inlet by the pressure on the valve disk during emptying.

p0 therefore must be set always lower than **p1**.

The stored amount of liquid is corresponding to the volume change **ΔV** between minimum and maximum operating pressure.

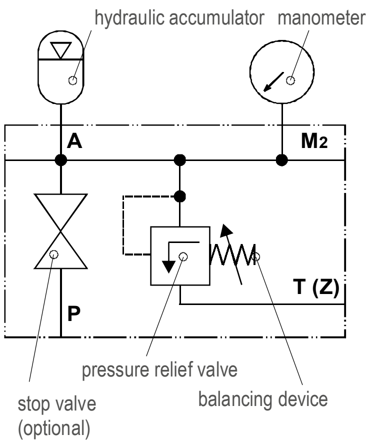
Standard gas filling: Nitrogen

Safety Information:

In Germany hydraulic accumulators are subjected to the TRB - Rules (Technical Regulations for Pressure Vessels). Therefore the following additional Equipment for the use of hydraulic accumulators is required:

- Manometer
- Balancing device
- Pressure relief valve
- Stop valve (optional)

Outside of Germany the national rules and regulations of the country apply to the use of pressure vessels.



Caution:

All work on the hydraulic accumulator may only be done by competent persons.

Applications:

Compensate system-internal leackage

In hydraulic clamping systems the pressure generators typically operate in shutdown mode. . A pressure switch controls the switching operations of the drive motor.

In case elements with leackage caused by design (e.g. controlled rotary distributors) are installed in the system, it results in frequent switching operations. The hydraulic accumulator reduces the On-Off switching cycles significantly. This saves energy and reduces the wear out of the material.

Compensate volume changes

In disengaged clamping systems, temperature differences can occur. This will inevitably result in significant changes of the clamping pressure (± 10 bar at ± 1° C).

With their volume memory function, hydraulic accumulators can be used as a source of pressure oil for emergency operation in case of failure of the oil supply.
The installation of an hydraulic accumulator in the system provides a volume compensation, thus preventing the undesirable pressure fluctuations.

Note:

By using hydraulic clamping systems, system internal leackage and volume changes (e.g. by temperature differences) must be compensated.
These tasks are performed by the hydraulic accumulator.
In intermittend applications the connected pressure generator fills the hydraulic accumulator during interruptions.
The short-term result is a high volume flow, which can be used to save drive power of the pressure generator, if necessary.

Contact

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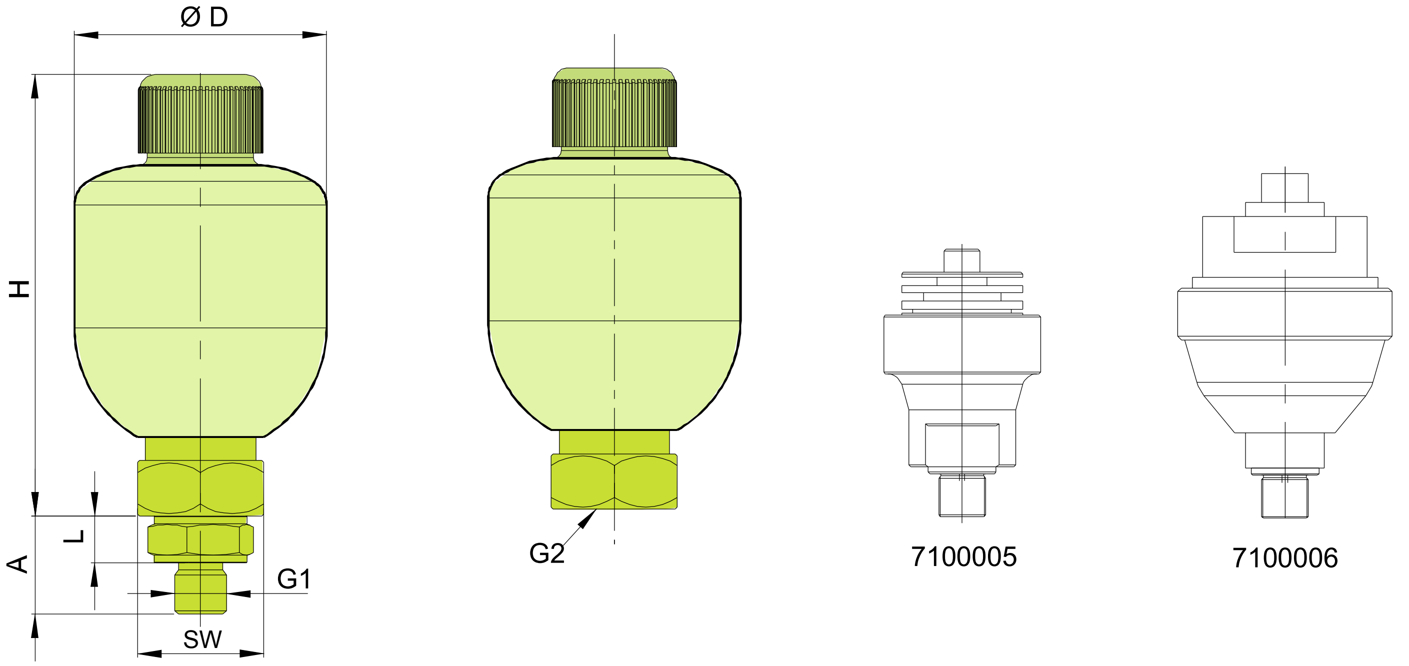
Details



Part number	Dimensions				(mm)			Surface
	G1	G2	D	H	L	SW	A	coating
7100005	1/4		44	62,5		22		galvanised
7100006	1/4		60	82,5		22		galvanised
MAEK-007	1/4	1/2	64	118	11	22	23	paint, black
MAEK-016	3/8	1/2	75	127	11	22	23	paint, black
MAEK-050	3/8	1/2	107	159	11	22	23	paint, black
MAEK-075	3/8	1/2	128,5	180	11	22	23	paint, black

Gas volume	Max. Pressure	Standard-Gas-	Temperature	Weight	p max / p min	Part number
liter	bar	preload pressure (bar)	from °C to °C	kg	Δp (bar) isotherm	
0,013	500	80	-10...+80	0,30	4:1	7100005
0,04	400	100	-10...+80	0,65	4:1	7100006
0,07	250	100	-10...+80	0,80	8:1	MAEK-007
0,16	250	120	-10...+80	1,00	6:1	MAEK-016
0,5	250	120	-10...+80	1,50	8:1	MAEK-050
0,75	350	130	-10...+80	4,00	8:1	MAEK-075

Different preloads and connectors on request!

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Parameters

Parameters and appreviations
for rough calculation

- p_0 = Precharge Pressure (bar)
- p_1 = min. operating pressure (bar)
- p_2 = max. operating pressure (bar)
- ΔV = effective volume (l) 1(W 2)
- T_1 = min. operating temperature (°C)
- T_2 = max. operating temperature (°C)
- t = charging or discharging time (sec)
- V_0 = effective gas volume of (l)
- V_1 = Gas volume at p_1 (l)
- V_2 = Gas volume at p_2 (l)
- n = Polytropic exponent
- p_m = Mean working pressure (bar)

The operations on the gas filling related to labor and/or heat exchange can be discribed with

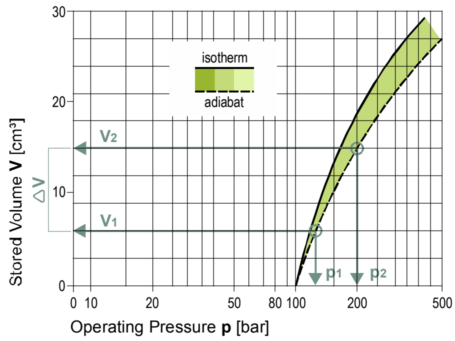
- isobars (constant pressure)
- isochor (constant volume)
- isotherm (constand temperature)
- adiabatic (heat sealed) or
- polytropic (between isotherm und adiabat)

changes of state.

In the rough calculation shown here a **isotherm** change of state is assumed.

$p \cdot V$ = constant   at T constant

Example



Calculation

For all accumulator calculations following absolute pressures should be used (**relativ + 1 bar**). The temperatures T_1 and T_2 in ° Kelvin (T + 273).

For energy reserve:
Formula-Calculation of the gas volume V_0:

$$V_0 = \frac{\Delta V * \frac{p_1}{p_0}}{1 - \left(\frac{p_1}{p_2}\right)^{\frac{1}{n}}}$$

Formula-Calculation of the effective volume V:

$$\Delta V = V_0 * p_0 \frac{1 - \left(\frac{p_1}{2}\right)^{\frac{1}{n}}}{p_1}$$

Calculation of the charging pressure p0 bei 20 °C

$$p_{0\ bei\ 20°C} = p_{0\ bei\ T_2} * \frac{273+20}{T_2}$$

This calculation steps show only a rough calculation for a hypothetical application.

As temperature, discharging time and situation of the gas filling change the calculation steps and accumulator size change as well.

Please note that by supplying pressure vessels in countries such as USA, Canada, China a.s.o. different regulations might apply.
This can include the type of filling gas.

In General:
At energy storage/ safety reserve/ weight balance

$P_0 = 0{,}8 \cdot p_1$ bei T2

Der Polytrophic expoment „n“ can be assumed with **1,2**

Calculation Example
Given:
max. operating pressure p_2 190 bar
min. operating pressure p_1 100 bar
dispensed effective volume (Δ) V= 1 l
max. operating temperature T_2 = 45 °C

Sought:
Acuumulator size, means required gas volume V_0

Solution:
a) Determination of the gas charging pressure bei p_0 maximum operating temperature

p_0 = 0,8 • 101 = 81 bar = 80 bar relativ

b) Determination of the gas volume V_0

$$V_0 = \frac{\Delta V * \frac{p_1}{p_0}}{1 - \left(\frac{p_1}{p_2}\right)^{\frac{1}{n}}} = \frac{1 * \frac{101}{80}}{1 - \left(\frac{101}{191}\right)^{\frac{1}{1,2}}} \quad 3{,}06\ l$$

c) Determination of the gas charging pressure p_0 bei 20 °C

$$p_{0\ bei\ 20°C} = 0{,}8 * p_1 * \frac{273+20}{T_2} = 0{,}8 * 101 * \frac{273+20}{318}$$

74 bar = 73 bar relativ

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