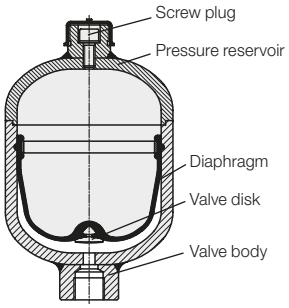
Hydraulic Accumulators

Nominal volume 13 – 750 cm³, max. operating pressure 250 – 500 bar

Advantages

- Sturdy diaphragm accumulator
- 5 sizes available
- Gas preload adaptable
- Energy-saving applications
- Mounting position: any



Application

Hydraulic accumulators are used in hydraulic power workholding applications as energy accumulator for compensation of internal leakages or to compensate the volume in the case of temperature changes.

Energy storage

With intermittent cycles the rating of the pump and thereby energy can be saved. During the breaks the pump refills the hydraulic accumulator. If required, a higher flow rate is available for a short time.

Compensation for internal leakage

In power workholding most of the pressure generators work in a cycling mode controlled by a pressure switch. If hydraulic devices with internal leakages are connected, e.g. spool valves or rotary valve couplings, this leads to frequent switching on and off of the electrical drive motor. The use of a small hydraulic accumulator considerably reduces the number of switching cycles and saves the material as well as energy.

Volume compensation in case of temperature changes

If hydraulic clamping systems will be separated from the pressure generator, there are considerable changes of the clamping pressure in the case of temperature variations.
(approximate value ±10 bar at ±1°C).
A small hydraulic accumulator mounted at a protected place on the fixture, causes a volume compensation and reduces pressure variations. In addition a small leakage will not immediately result in a pressure drop. A pressure gauge for pressure control should be installed in any case.

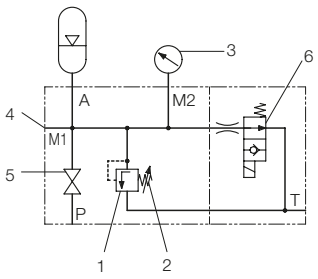
Description

Liquids are more or less incompressible and therefore are not in the position to store pressure energy. For hydraulic accumulators the compressibility of nitrogen is used to store liquids. A gas-tight diaphragm separates the liquid zone from the gas zone.
In the bottom of the diaphragm there is a valve disk that avoids a damage of the diaphragm if the hydraulic accumulator will be completely discharged. Nitrogen is filled in at the screw plug and provided with the required preload. For this purpose an appropriate filling and testing fixture is required.
The offered hydraulic accumulators correspond to the regulations of article 3 paragraph 3 of the directives for pressure devices 97/23/EG and are not allowed to bear the CE sign.

Additional safety devices

Hydraulic accumulators are subject to the valid national regulations and decrees at the installation location. In Germany, the "Technical Regulations for Pressure Reservoirs" (TRB) apply.
These regulations demand the following equipment:

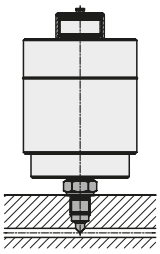
1. Pressure relief valve
2. Relief device
3. Pressure gauge
4. Connection of a test pressure gauge
5. Shut-off valve optional
6. Electromagnetically-operated relief device



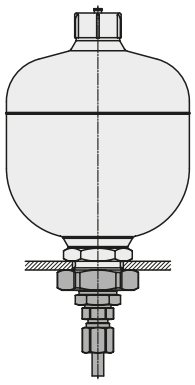
The application of individual components is specified on page 4.

Connection and fixation

Screw-in connection



Pipe thread

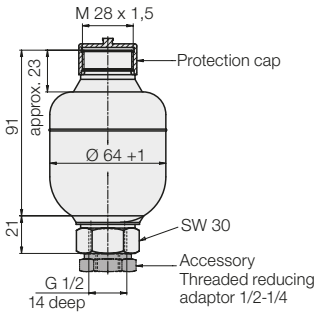


Legal requirements

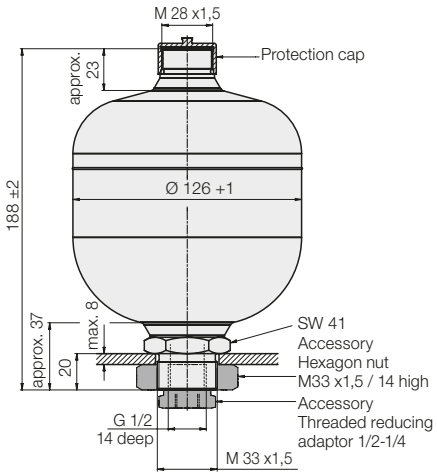
For hydraulic accumulators the applicable regulations at the place of installation have to be considered before start up and during operation.
The operator is exclusively responsible for the intended use and compliance of these regulations.
In Germany the Classification as per German Health and Safety at Work Regulations (BetrSichV) is valid as legal basis. For the offered accumulator size the following is valid:
All works at the hydraulic or pneumatic ports of the hydraulic accumulator must only be effected by trained experts.
An expert is not required for the first acceptance.

Max. operating pressure 250 bar
Dimensions • Technical characteristics

75 cm³



750 cm³



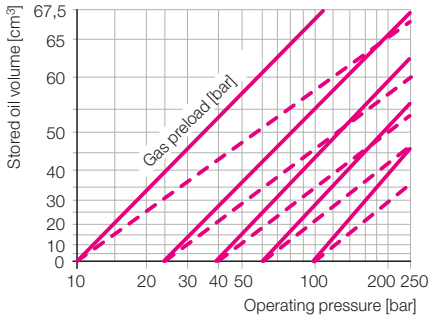
Nominal volume	**[cm³]**	**75**	**75**	**750**	**750**
Max. operating pressure	[bar]	250	250	250	250
Gas-preload pressure*	[bar]	40	100	40	100
Recommended range of operating pressure	[bar]	50-200	110-250	50-200	110-250
Stored oil volume at max.operating pressure and 22°C	[cm³]	62	45	625	450
Weight	[kg]	0.7	0.7	2.9	2.9
Part no.		**9601-311**	**9601-511**	**9604-310**	**9604-510**
Accessories					
Thread reducing adaptor 1/2-1/4		**3613-015**	**3613-015**	**3613-015**	**3613-015**
Hexagon nut M 33 x 1.5 / 14 high				**3300-010**	**3300-010**
Pressure relief valve G1/2 sealed**		**2952-527**	**2952-527**	**2952-527**	**2952-527**
Reaction pressure	[bar]	260	260	260	260

* Other gas-preload pressures on request
** Connecting dimensions see data sheet C 2.952

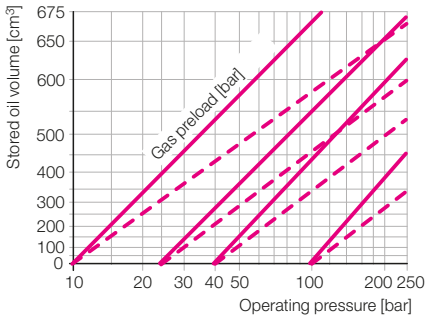
Adm. operating temperature [°C]	-10... +80
Design	Diaphragm accumulator
Hydraulic fluid	Hydraulic oil as per DIN 51524
Filling gas	Nitrogen (at least 99.8%)
Mounting position	any (preferably vertical)

Pressure volume curve — Isotherms - - - Adiabats

75 cm³



750 cm³



Technical explanations

1. Nominal volume
The nominal volume is the effective gas volume of the hydraulic accumulator. The maximum storable oil volume is approx. 10% smaller.

2. Maximum operating pressure
The maximum operating pressure must not be exceeded in any operating mode.
For this purpose a suitable safety valve is required for pressure limitation (see Safety devices page 4).

3. Gas preload
The gas preload is the nitrogen pressure at a room temperature of 22°C, without oil filling. The hydraulic accumulator can only take hydraulic oil after exceeding this pressure.

4. Recommended range of operating pressure
In this range the hydraulic accumulator works with the best degree of efficiency with optimum life of the diaphragm.

5. Definitions
V_0 = Nominal volume = max. gas volume
p_0 = Gas preload
V_1 = Gas volume at p_1
p_1 = min. operating pressure ≥ 1.1 x p_0
V_2 = Gas volume at p_2
p_2 = max. operating pressure ≤ 8 x p_0
for 9606-10X ≤ 3...4 x p_0
and 9606-401

6. Stored oil volume
Starting from the maximum operating pressure until the complete discharge of the hydraulic accumulator the stored oil volume is $\Delta V_{Oil} = V_0 - V_2$

7. Pressure-volume diagram
The compression and expansion processes in hydraulic accumulators are subject to the laws of polytropic state change of the gas.
The temperature and the time dependent course is of decisive importance.

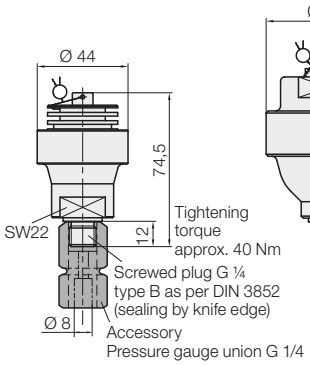
a) Isotherms
Charge and discharge are effected very slowly, so that there is sufficient time for a complete temperature exchange. In the diagrams the isoterms are presented as continuous line.

Application :
compensation of leakage oil or volume in the case of temperature changes (see use)

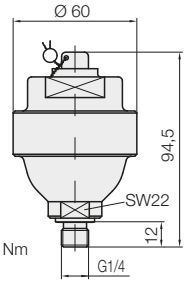
b) Adiabats
Charge or discharge is effected very quickly. The nitrogen is considerably heated or cooled. A quick temperature balance with the environment is not possible. In the diagram the adiabats are presented as interrupted line.

Application :
Energy storage (see use)

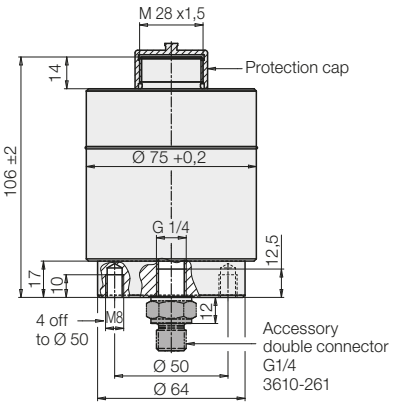
13 cm³



40 cm³



75 cm³



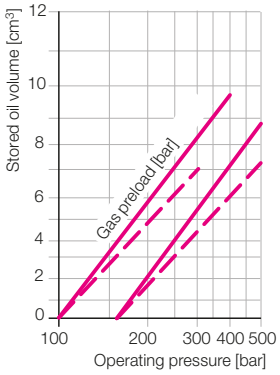
Nominal volume	[cm³]	13	13	40	75
Max. operating pressure	[bar]	400/300*	500	400/300*	500
Gas-preload pressure**	[bar]	100	160	100	100
Recommended range of operating pressure	[bar]	110-400/300*	175-500	110-400/300*	110-500
Stored oil volume at max. operating pressure and 22°C	[cm³]	9,75/7*	8.8	29/21*	59
Weight	[kg]	0.3	0.3	0.65	2.4
Part no.		**9606-102**	**9606-109**	**9606-401**	**9605-611**
Accessory (see data sheet F 9.300)					
Pressure gauge union G 1/4 - Ø8		**9208-040**	**9208-040**	**9208-040**	
Double connector G 1/4					**3610-261**
Tube male stud coupling D 8S ED					**9208-132**
Pressure relief valve G1/2 sealed***		**2952-528**	**2952-529**	**2952-528**	**2952-529**
Reaction pressure	[bar]	315	520	315	520

* isothermic /adiabatic
** Other gas-preload pressures on request
*** Connecting dimensions see data sheet C 2.952

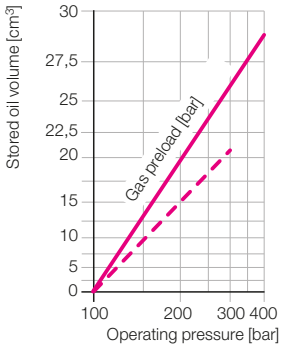
Adm. operating temperature [°C]	–10 … +80
Design	Diaphragm accumulator
Hydraulic fluid	Hydraulic oil as per DIN 51524
Filling gas	Nitrogen (at least 99.8%)
Mounting position	any (preferably vertical)

Pressure volume curve — Isotherms — Adiabats

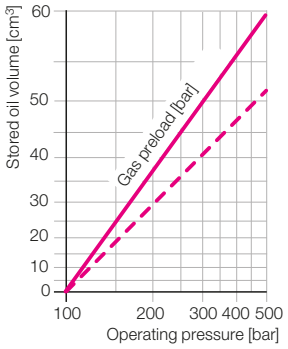
13 cm³



40 cm³



75 cm³



c) Example (see example page 4)

Compensation of leakages with rotary valve couplings

Max. leakage	approx. 5 cm³/s
Operating pressure	200 bar
Nominal volume of accumulator	750 cm³
Gas preload	100 bar

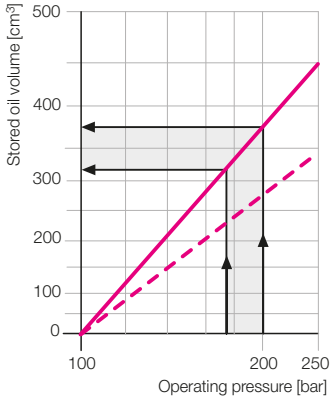
The power unit switches off at 200 bar and on at 175 bar in cycling mode. How many seconds does a switching cycle last?

Solution:
For the leakage compensation the isothermic pressure-volume curve can be assumed:

p1 =	200 bar	➛➛➛	V1 =	375 cm³
p2 =	175 bar	➛➛➛	V2 =	320 cm³
Δp =	25 bar		ΔV =	55 cm³

$$\text{Switching time} = \frac{\Delta V}{\text{Leakage rate/s}}$$

$$= \frac{55\ \text{cm}^3}{5\ \text{cm}^3/\text{s}} = 11\ \text{s}$$



8. Hydraulic accumulators in power workholding

In hydraulic power workholding hydraulic accumulators are mostly used for the compensation of leakages or of the volume in the case of temperature variations. Charge of the accumulator is made very quickly, that means adiabatically, but the discharge is relatively slow, that means isothermically.

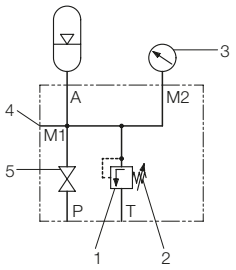
If the power unit works in a cycling mode, after the clamping process there will be several reswitchings until the pressure is constant.

Reason: The quick adiabatic pressure built-up heats the nitrogen. If it cools again through the accumulator body, the pressure in the system drops and oil has to be resupplied one or two times. At the end as much oil is supplied into the hydraulic accumulator as in case of a mere isothermic compression.

Important note:

Do not uncouple coupling systems with coupling unit immediately after clamping, but wait approx. 15 seconds until the clamping pressure is constant.

Description of safety devices



1. Pressure relief valve

(Safety valve)

The pressure relief valve shall protect the hydraulic accumulator against a pressure increase by more than 10 % of the maximum operating pressure.

Adjustment has to be effected with the maximum flow rate of the power unit. The reaction pressure of the pressure relief valve should be a little bit higher than the nominal pressure of the hydraulic accumulator.

The valve spindle of the pressure relief valve has to be secured against adjustment in the direction of higher pressure by means of distance plates and/or lead-sealing.

Important notes:

The pressure relief valve of the power unit must not be adjusted above the maximum operating pressure of the hydraulic accumulator. In the case of "small accumulators" with a nominal volume below 100 cm³ pressure safeguard can be realised by the pressure relief valve at the power unit, when the adjusting spindle is secured against exceeding the maximum operating pressure.

If "small accumulators" are located on workpiece pallets, that will be uncoupled from the power unit, a pressure relief valve has to be provided on each pallet.

2. Relief device

Important note:

Before realising maintenance works at the hydraulic system or the fixture the hydraulic accumulator should be completely discharged. There are two possibilities: To screw completely out the valve spindle of the pressure relief valve in the direction of low pressure or to open an installed shut-off valve (see example).

3. Pressure gauge

The pressure gauge shall indicate the actual pressure in the hydraulic accumulator. For this purpose a direct supply line has to be mounted. The pressure gauge at the power unit is not suitable for that purpose. The maximum operating pressure of the hydraulic accumulator shall be indicated by a marking on the pressure gauge scale. Alternatively also a labelled plate or tag can be fixed.

4. Connection of a test pressure gauge

For regular pressure tests a test pressure gauge can be connected.

5. Shut-off valve

By means of the shut-off valve the hydraulic accumulator can be separated from the power unit and the fixture in order to realise adjusting and maintenance works without danger.

Maintenance

Diaphragm accumulators are in fact maintenance free. However to allow trouble-free function and a long life the following checks have to be realised:

- Gas preload
- Safety devices
- Pipe connections
- Fixing of the accumulator

Gas preload

Delivered condition

The hydraulic accumulators are delivered with the desired gas preload and are marked correspondingly. On request also other preload pressures are available.

Check preload pressure

The preload pressure has to be checked

- after installation
- one week after installation
- 8 weeks after installation

If no filling loss is observed, yearly checks are sufficient. If no test and filling device is available, the filling pressure can also be checked at the hydraulic side:

1. Separate the hydraulically-filled accumulator by means of the shut-off valve from the system.
2. Open slowly the relief device for discharge and observe the pressure loss at the pressure gauge.
3. At the moment of complete discharge the pressure drops suddenly. This pressure is the filling pressure of the hydraulic accumulator.

Change preload pressure

This is only possible with an appropriate test and filling device. Please contact us.

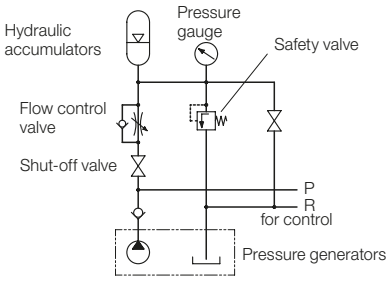
Service life

The service life of diaphragm accumulators depends on the width of pressure variations and the number of load changes. Similar to high-pressure hoses, you can assume a life of 6 years with conventional use.

Flow control

A hydraulic accumulator is in the position to supply a high flow rate within very short time. Since this is not required or desired for the most applications, the flow rate should be throttled to save the accumulator diaphragm.

A flow control valve has to be installed so that the outflowing hydraulic oil will be throttled, but a quick charge of the accumulator will be guaranteed in opposite direction (see hydraulic circuit diagram).



Example

Power unit for a double-acting clamping circuit with pressure reducing valve and hydraulic accumulator for compensation of the leakage.