Hydraulic miniature accumulators type AC

Product documentation

Operating pressure p_{max}:	500 bar
Nominal volume $V_{0\ max}$:	13 or 40 cm^3
Gas filling pressure $p_{0\ max}$:	250 bar

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1 Overview of hydraulic miniature accumulators type AC

Hydraulic accumulators are a type of pressure vessel. They are used primarily for hydraulic damping, as energy stores and for pressure and flow rate equalisation.

The miniature hydraulic accumulator type AC is a diaphragm accumulator. Its relatively small accumulation volume is used mainly to compensate for volume changes caused by temperature fluctuation, as backup for potential oil losses from leakage or for oscillation damping.

Different installation positions and mounting positions are available. Because they are so small, miniature hydraulic accumulators type AC are not subject Pressure Equipment Directive 2014/68/EU to article 4 (3). Various different fittings make it simple to integrate the hydraulic accumulator type AC into a hydraulic system.

Hydraulic miniature accumulators type AC

Features and advantages

- Compact design
- Option of integration with the HAWE modular system
- Operating pressures up to 500 bar

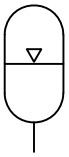
Applications

- Machine tools
- Mobile hydraulics
- Accumulator systems
- Test benches

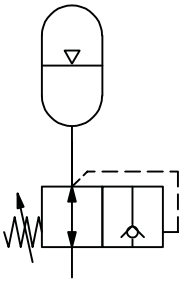
2 Available versions

Circuit symbol

AC



ACS



Ordering examples

AC 13-1/4 ACS 13-1/4	/50 /70	/130	-K 1/4

2.4 "Extension"

2.3 "Shut-off valve pressure setting"

2.2 "Gas pre-load pressure"

2.1 "Basic type, nominal volume and port size"

2.1 Basic type, nominal volume and port size

Type	Nominal volume $V_{0\ max}$ (cm³)	permissible overpressure $p_{4\ max}$ (bar)	Operating pressure ratio	
			$p_{1\ max}$ adiabatic	$p_{2\ max}$ isothermal
AC 13-1/4/...	13	500	3:1	4:1
ACS 13-1/4/.../...	13	500	3:1	4:1
AC 40-1/4/...	40	400	3:1	4:1

NOTICE

Use of accumulator with shut-off valve type ACS for applications with pressures $p_{oil\ 2} > 4\ p_0$.

- see Chapter 6.1, "Layout instructions"
- see Chapter 6.3, "Other variants"

2.2 Gas pre-load pressure

Type	Gas pre-load pressure $p_{0\ max}$ (bar)
AC 13	250
AC 40	250

NOTICE

possible values: 0 bar or 5 to 250 bar

Gas pre-load pressures < 20 bar may result in higher wear.

Information on gas pre-load pressure p_0 see Chapter 6.1, "Layout instructions"

2.3 Shut-off valve pressure setting

Type	Adjustment range for shut-off valve from ... to (bar)
ACS 13	▪ 20 ... 100 ▪ 80 ... 200 ▪ 180 ... 300

2.4 Extension

Coding	Description
without coding	without extension
K 1/4	short extension, 31 mm
L 1/4	long extension, 66 mm

3 Parameters

3.1 General data

Designation	Micro diaphragm accumulator (spherical accumulator)
Material	▪ Housing: steel, galvanised ▪ Diaphragm: NBR
Surface protection	Zinc electroplating with transparent passivation
Installation position	any
Attachment	▪ Screwed into threaded holes ▪ Tapped journal G 1/4 A (ISO 228-1) with sealing edge
Sealing	Sealing as standard with adhesive seal (without separate type code)
Tightening torque	see Chapter 4, "Dimensions"
Gas filling	Nitrogen, grade 4.0 or 5.0
Ambient temperature	-20 ... +60 °C
Hydraulic fluid	Hydraulic fluid, according to DIN 51 524 Parts 1 to 3; ISO VG 10 to 68 according to DIN ISO 3448 Viscosity range: 4 - 1500 mm²/s Optimal operating range: approx. 10 - 500 mm²/s Also suitable for biologically degradable hydraulic fluids type HEPG (polyalkylene glycol) and HEES (synthetic ester) at operating temperatures up to approx. +70°C.
Pressure	see Chapter 2.1, "Basic type, nominal volume and port size" ▪ p_0 (bar): desired gas filling pressure, embossed in accumulator housing ▪ $p_{0\ max}$ = 250 bar; $p_{0\ min}$ = 5 bar ▪ $p_{oil\ 1}$ (bar): lower operating pressure (oil side), $p_{oil\ 1\ min}$ = 1.1 p_0 ▪ $p_{oil\ 2}$ (bar): upper operating pressure (oil side), $p_{oil\ 2\ max}$ = 4 p_0 (isothermal), $p_{oil\ 2\ max}$ = 3 p_0 (adiabatic) see Chapter 6.1, "Layout instructions"
Bursting pressure	▪ AC(S) 13: approx. 3.5x max. overpressure p_4 ▪ AC 40: approx. 4x max. overpressure p_4
Refill option	yes; required filling device available upon request, see Chapter 5.3.1, "Installation and commissioning"

3.2 Weight

Miniature hydraulic accumulator	**Type**	
	AC 13	= 0.3 kg
	ACS 13	= 0.3 kg
	AC 40	= 0.65 kg
Extension	**Coding**	
	K 1/4	= + 0.06 kg
	L 1/4	= + 0.1 kg

3.3 Characteristic lines

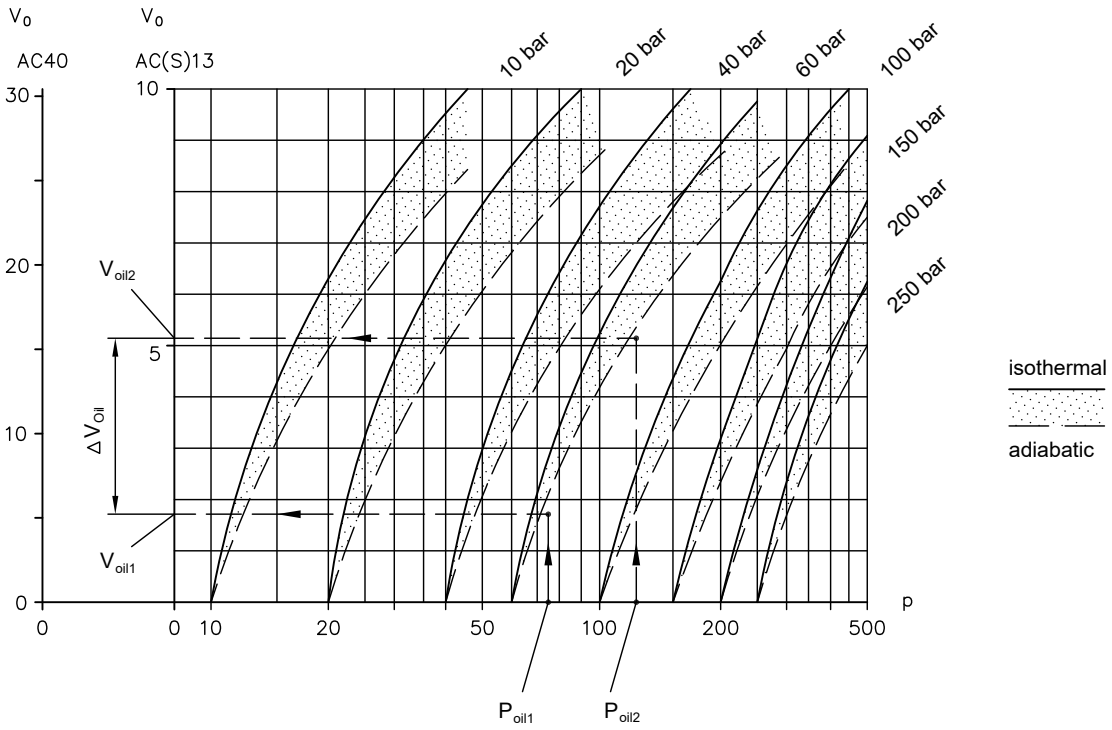
NOTICE

The characteristic lines are theoretical reference limit values.

At a given gas filling pressure p_0, the volume available for removal can be calculated from the operating points $p_{oil\ 2}$ and $p_{oil\ 1}$: $V_{oil} = V_{oil\ 2} - V_{oil\ 1}$

The real values depend, among other things, on the application:

- Used for oil leakage compensation → closer to isothermal characteristic line
- Faster load alternation → closer to adiabatic characteristic line



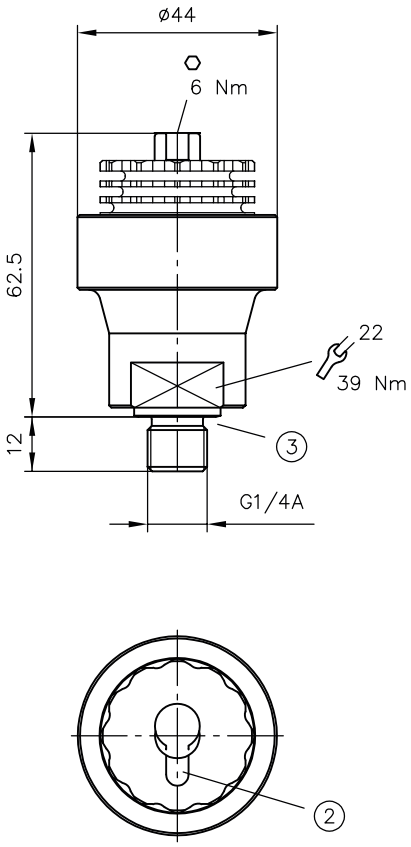
p gas filling pressure (bar); V_0 nominal volume (cm³)

4 Dimensions

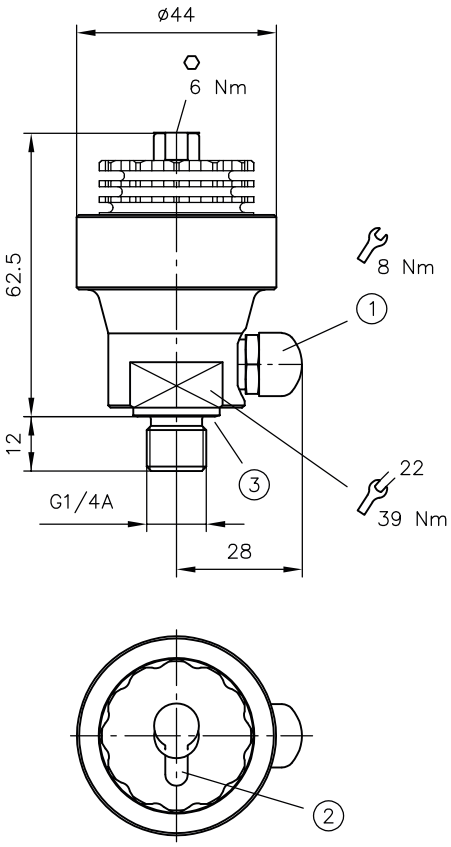
All dimensions in mm, subject to change.

4.1 Miniature hydraulic accumulator

AC 13

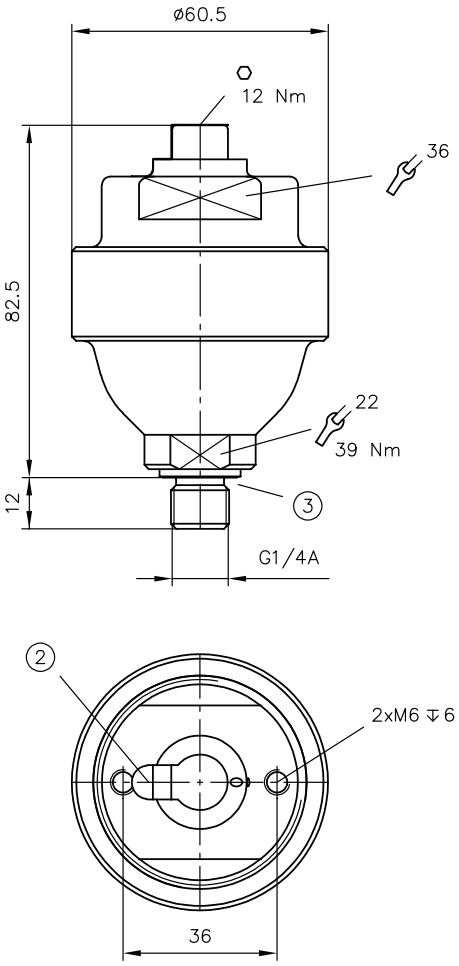


ACS 13

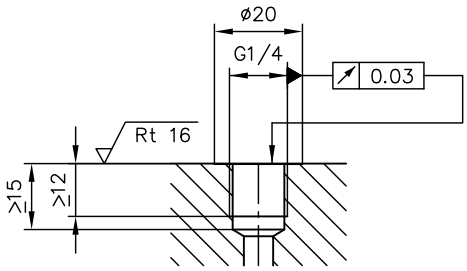


1 Shut-off valve
2 Sealing
3 Sealing edge

AC 40

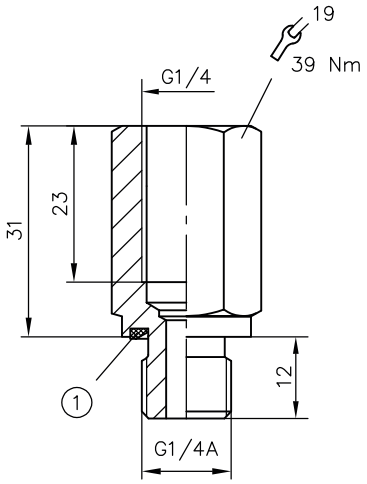


Mounting hole



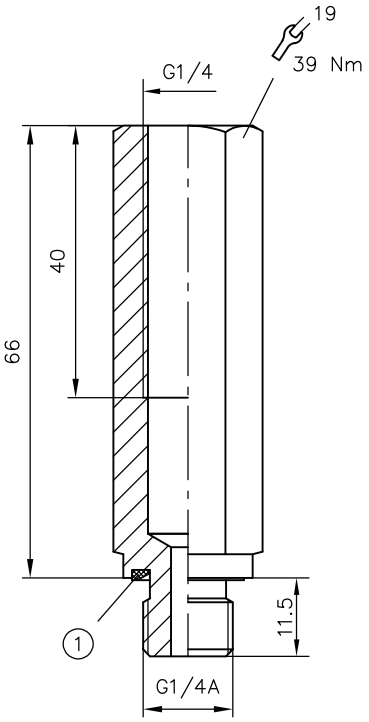
4.2 Extension

K 1/4



1 Fitting seal G 1/4 NBR 85 Sh A

L 1/4



1 Fitting seal G 1/4 NBR 85 Sh A

NOTICE

Mounting hole for K 1/4 and L 1/4, including tightening torque see Chapter 4.1, "Miniature hydraulic accumulator"

5 Installation, operation and maintenance information

Observe the document B 5488 “General operating instructions for assembly, commissioning, and maintenance.”

5.1 General notes

Operation is only allowed within the permissible values. The hydraulic accumulator must only be installed, maintained and repaired by authorised and trained personnel; these tasks are governed by national regulations. In Germany, through the Betriebssicherheitsverordnung (BetrSichV) Industrial Safety Regulation In the EU through the EU Directive 2009/104/EC.

The gas pre-load pressure must be checked at regular intervals.

INFORMATION

Before beginning a repair, relieve the system of hydraulic pressure. A corresponding warning sign (HAWE order number 7788 022 (4708 4258-00)) must be attached in an easily visible place near the hydraulic accumulator.

No modifications of any kind (mechanical, welding or soldering work) may be made to the accumulator.

5.1.1 Safety instructions

Further information on the technical version of accumulator systems is provided by DIN EN ISO 4413. To summarise, there must be a facility to release the accumulator pressure on the fluid side when servicing is carried out (drain valve and pressure gauge for monitoring purposes).

Even when using miniature hydraulic accumulators, it is still recommended to apply a warning notice with instructions to relieve fluid pressure before beginning and work on the hydraulic system (e.g. repairs, changing valves). No work must be performed on the hydraulic system while the fluid in the miniature hydraulic accumulator is under pressure.

A corresponding notice should be attached to the hydraulic system in an easily visible place. Equivalent instructions should also be added to the system’s operating manual or associated schematic (DIN 24 346 section 7.4.7).

Options for relieving the pressure circuit

- via drain screw in one of the directional valve banks’ end plates, if present, e.g. end plate coding 2 in D 7470 B/1
- multiple actuation of directional seated valve connected to accumulator. This directional seated valve must feature absolute negative overlap. Attention needs to be paid to whether any potentially generated consumer pressure causes any effects.

5.1.2 Legal provisions

Hydraulic accumulators are pressure vessels within the meaning of the European Pressure Equipment Directive 2014/68/EU. For hydraulic accumulators, the regulations that apply at the installation location must be adhered to before commissioning and during operation. The operator holds sole responsibility for compliance with the existing regulations. The supplied documents must be kept in a safe place; they will be needed for recurring inspections.

5.1.3 Transportation and storage

CAUTION

Risk of injury due to incorrect transportation

Risk of minor injury.

- Comply with the relevant regulations on transportation and safety.
- Wear protective equipment.

INFORMATION

Accumulators must be stored in a cool, dry place and protected from direct sunlight.

Dirt must be prevented from entering the accumulator.

If the accumulator is stored over a longer period, it is advisable to reduce the gas pre-load pressure to approx. 10 bar to prevent deformation of the sealing element or separator.

5.2 Intended use

This product is intended exclusively for hydraulic applications (fluid technology).

The user must observe the safety measures and warnings in this document.

Essential requirements for the product to function correctly and safely:

- ► All information in this documentation must be observed. This applies in particular to all safety measures and warnings.
- ► The product must only be assembled and put into operation by specialist personnel.
- ► The product must only be operated within the specified technical parameters described in detail in this document.
- ► All components must be suitable for the operating conditions when using an assembly.
- ► The operating instructions for the components, assemblies and the specific complete system must also always be observed.

If the product can no longer be operated safely:

1. Remove the product from operation and mark it accordingly.
   ✓ It is then not permitted to continue using or operating the product.

5.3 Assembly information

The product must only be installed in the complete system with standard and compliant connection components (screw fittings, hoses, pipes, fixtures etc.).

The product must be shut down correctly prior to disassembly (in particular in combination with hydraulic accumulators).

DANGER

Sudden movement of the hydraulic drives when disassembled incorrectly

Risk of serious injury or death

- ► Depressurise the hydraulic system.
- ► Perform safety measures in preparation for maintenance.

5.3.1 Installation and commissioning

Installation

WARNING

Risk of injury due to stored pressure escaping in an uncontrolled manner.

Risk of serious injury or death.

- ► Relieve the pressure in the hydraulic system prior to all maintenance and disassembly work.

Installing the accumulator

1. Fit the accumulator to the bracket supplied for this purpose, if possible route the gas connection for the system upwards.
2. Fit the required shut-off, drain and safety valves between the accumulator and the hydraulic system. The easiest way to do this is probably using a 'safety block' that contains all the above components.

Primary filling

DANGER

The product will explode if used or filled incorrectly.

Serious injury or death.

- The accumulator of the product must be suitable for the maximum operating pressure, filling pressure and temperature range of the operating conditions.
- Fill hydraulic accumulators exclusively with N_2 (nitrogen).
- Only use suitable filling and testing devices.

Primary filling of the accumulator

1. Ensure that the accumulator is suitable for the operating conditions with regard to max. operating pressure, filling pressure and temperature range.

filling device for diaphragm accumulators

INFORMATION

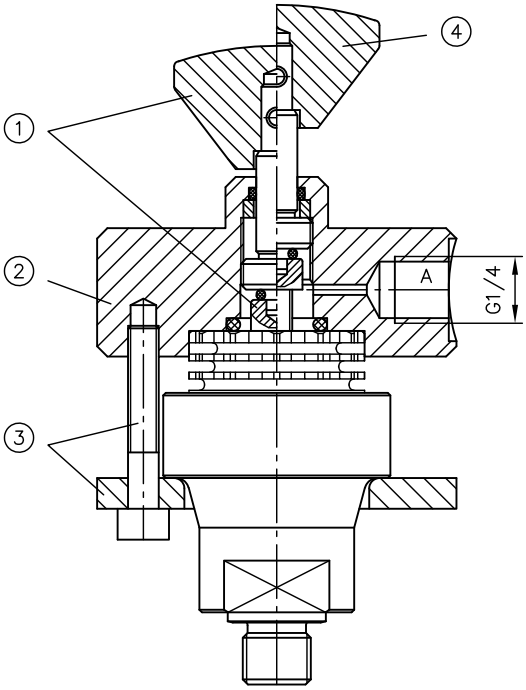
Order numbers for the filling device, see Chapter 6.2.1, "Filling device"

The filling device is intended for refilling and changing the gas filling pressure. Since diaphragm accumulators are pressure vessels and subject to the European Pressure Equipment Directive (see there for exceptions), it must be ensured that the safety required therein, in particular the prevention of overpressure, is achieved. Since when filling is being performed from a nitrogen bottle with 200 bar or 300 bar bottle filling pressure, that pressure can be significantly higher than one of the following values,

- permissible operating gauge pressure of the diaphragm accumulator
- permissible gas filling pressure of the diaphragm accumulator
- permissible gauge range of respective pressure gauge

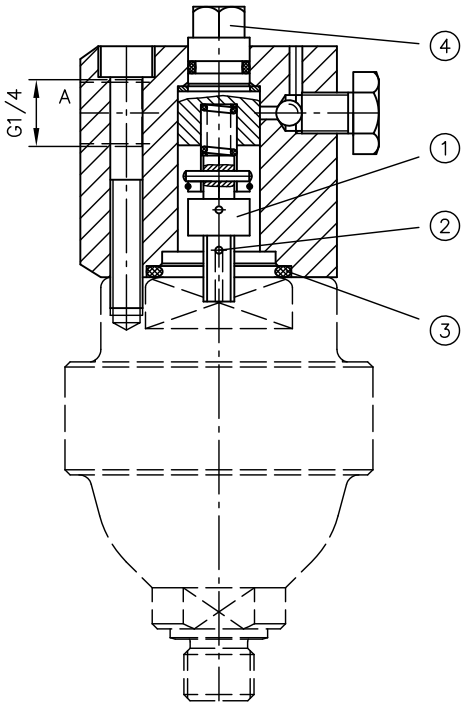
measures must be taken against overpressure. It is therefore advisable to entrust testing and filling tasks only to specialist staff, and under no circumstances to use any sort of adapter to connect the filling device directly to the nitrogen bottle, but instead to use a bottle pressure reducer. Hoses with G 1/4 and G 1/2 connection nuts are required for connection to such a bottle pressure DIN EN 560 reducer.
Use only purified grade 4.0 or 5.0 nitrogen!

Filling device for AC 13, ACS 13



1 Accumulator bleed screw
2 Housing
3 Tighten lock ring and bolts
4 Unscrew wing bolt anti-clockwise

Filling device for AC 40



1 Accumulator bleed screw
2 Bleed hole
3 O-ring 23.47x2.62 NBR 90 Shore
4 Spindle

Filling instructions

DANGER

The product will explode if used or filled incorrectly.

Serious injury or death.

- The accumulator of the product must be suitable for the maximum operating pressure, filling pressure and temperature range of the operating conditions.
- Fill hydraulic accumulators exclusively with N_2 (nitrogen).
- Only use suitable filling and testing devices.

AC 13, ACS 13

Draining

1. Screw spindle in all the way into the housing **2** to the wing bolt's stop and guide the hex end into the accumulator's bleed screw.
2. Hold the accumulator and fixture together with your hand and – if necessary – turn the housing **2** clockwise until it lies in contact with the accumulator.
3. Tighten lock ring and screws **3**.
4. Unscrew the wing bolt anti-clockwise = gas pressure relieves through A.

Filling

1. Connect a nitrogen bottle with pressure-reducing valve to A and set the desired gas filling pressure in the pressure-reducing valve (monitor the pressure gauge!).
2. Screw in the wing bolt clockwise until the accumulator's bleed screw makes contact.
3. Remove the device.
4. Tighten the screw!

AC 40

Draining

1. Unscrew the accumulator's bleed screw **1**, after about two turns gas starts bleeding through the vent hole **2** on the side.

Filling

1. Lay the O-ring **3** into the counterhole and screw in the accumulator's bleed screw. Screw it in only so far that the vent hole on the side remains clear. Screw the filling device to the accumulator.
2. Connect a nitrogen bottle with pressure-reducing valve to A and set the desired gas filling pressure in the pressure-reducing valve (monitor the pressure gauge!).
3. Screw in the spindle **4** clockwise with a size 10 spanner until the accumulator's bleed screw makes contact.
4. Remove the device, tighten the screw!

5.4 Operating instructions

Observe product configuration and pressure/flow rate.

The statements and technical parameters in this document must be strictly observed.
The instructions for the complete technical system must also always be followed.

NOTICE

- ► Read the documentation carefully before usage.
- ► The documentation must be accessible to the operating and maintenance staff at all times.
- ► Keep documentation up to date after every addition or update.

CAUTION

Overloading components due to incorrect pressure settings.
Risk of minor injury. Parts may burst or fly off, and uncontrolled leakage of hydraulic fluid.

- Pay attention to the maximum operating pressure of the pump, valves and fittings.
- Always monitor the pressure gauge when setting and changing the pressure.

Purity and filtering of the hydraulic fluid

Fine contamination can significantly impair the function of the product. Contamination can cause irreparable damage.

Examples of fine contamination include:

- Swarf
- Rubber particles from hoses and seals
- Dirt due to assembly and maintenance
- Mechanical debris
- Chemical ageing of the hydraulic fluid

NOTICE

New hydraulic fluid from the manufacturer may not have the required purity.
Damage to the product is possible.

- ► Filter new hydraulic fluid to a high quality when filling.
- ► Do not mix hydraulic fluids. Always use hydraulic fluid that is from the same manufacturer, of the same type, and with the same viscosity properties.

For smooth operation, pay attention to the cleanliness level of the hydraulic fluid (cleanliness level see Chapter 3, "Parameters").

Additionally applicable document: D 5488/1 oil recommendations

5.5 Maintenance information

Check regularly (at least once a year) by visual inspection whether the hydraulic connections are damaged. If external leakages are found, shut down and repair the system.

Clean the surface of the device regularly (at least once a year) (dust deposits and dirt).

6 Other information

6.1 Layout instructions

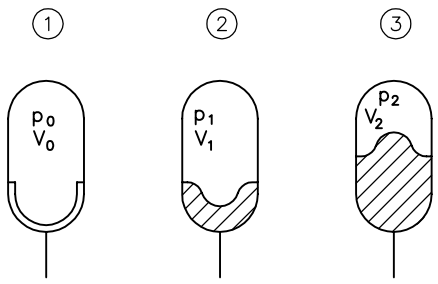
General layout instructions

Max. permissible operating pressure

The max. permissible operating pressure (p_{max}) is the maximum pressure that may be applied to the accumulator.

State variables

- p_0: Gas filling pressure
- p_1: min. operating pressure
- p_2: max. operating pressure
- V_0: accumulator's effective volume
- V_1: Gas capacity at p_1
- V_2: Gas capacity at p_2
- ΔV: delivered or received usable oil volume between p_1 and p_2



1 Accumulator empty
The nitrogen-loaded diaphragm assumes the accumulator's inner contour. The valve disc seals the fluid port, preventing damage to the diaphragm.

2 Accumulator at lower operating pressure
Attention, a small quantity of fluid should always remain in the accumulator to prevent damage to the diaphragm ($p_0 < p_1$).

3 Accumulator at upper operating pressure
Volume change ΔV between position at lower and at upper operating pressure corresponds to the usable fluid volume: $\Delta V = V_1 - V_2$

Gas pre-filling pressure p_0 (reference values)

- When acting as a pressure reservoir around 90 % of the lower operating pressure
- When acting as pulse damping around 60 % of upper operating pressure
- Taking account of the influence of temperature

$$p_{1,T1} = p_{0,T0} \cdot \frac{(T_1 + 273)}{(T_0 + 273)}$$

e.g. filling pressure p_0 at 90 bar with ambient temperature T_0 of 20 °C

- With the ambient temperature changing to T_1 = 40 °C you get $p_{1\,min}$ = 96.14 bar
- With the ambient temperature changing to T_1 = -10 °C you get $p_{1\,min}$ = 80.78 bar

State change

The compression and expansion processes in a diaphragm accumulator are governed by the laws of polytropic changes of gas state. These are divided into:

- Isothermal change during slow processes (polytropic exponent n = 1), e.g. when used for oil leakage compensation)
- Adiabatic change during rapid processes (polytropic exponent n = 1.4, applies to nitrogen), e.g. when used as a damping element

Calculating V_0

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

(reference value: V_0 = 1.5 ... 3 x ΔV)

Use of pressure-limiting valve

The miniature hydraulic accumulators described are not subject to Pressure Equipment Directive 2014/68/EU article 4 (3).

For pressure safety, the pressure-limiting valve employed for the hydraulic system is sufficient. A separate, specially component-approved safety valve for the accumulator itself is not necessary. If the miniature accumulator is located in a section of the hydraulic system that may, during the operating procedure (or in the event of an operating error), be subjected to pressure amplification that could exceed the max. overpressure of p_4, this section requires a simple pressure-limiting valve set to less than or equal to p_4 .

Use of accumulator with shut-off valve type ACS

Sample application:
One accumulator acts as a damper in the low pressure range (low gas pre-load pressure), another accumulator acts as a damper in a higher pressure range (high gas pre-load pressure).

The accumulator with shut-off valve, type ACS, is used for damping in the low-pressure range. Set the shut-off valve to a shut-off pressure of $\leqq 4\ p_0$. In the case of adiabatic load (constant load alternation), set the shut-off valve to a shut-off pressure of $\leqq 3\ p_0$.

Application examples

Accumulators are used for:

- compensating for any internal leakage that might occur
  - For example as a reservoir to cover any oil lost to leaking for small-scale systems operating in standby mode, e.g. in clamping circuits (delaying downstream switching intervals controlled by pressure switches, for example)
- boosting pump delivery flow
  - Example 1: Pressure oil supply for emergency activation if pump-side pressure oil supply fails. Preferably AC 40 because of available accumulator volume.
  - Example 2: Assisting changeover processes in purely hydraulic, pressure-controlled idle circulation valves (see D 7529).
- compensating for pressure fluctuations due to temperature changes
  - For example for neutralising volume changes in blocked-off oil chambers caused by changes in the ambient temperature (e.g. in long-term testing using small, static test presses)
- damping pulsations in the hydraulic system
  - For example to affect and increase the delayed action of pressure compensators or other function elements operated by pressure differences. This might serve, for example, to prevent or rapidly attenuate excessive control amplitudes in low-frequency slewing or bobbing movements performed by components in hydro-mechanical systems (e.g. crane booms, hydraulic motors on long pipelines).

6.2 Accessories, spare and individual parts

For reference to spare parts and fastening clips see HAWE Hydraulik interactive contact map.

6.2.1 Filling device

Filling device for type	Order coding
AC 13 ACS 13	SK 7571-F 13
AC 40	SK 7571-F 40

6.2.2 Extension

Coding	Order coding
K 1/4	6920 210 a
L 1/4	6920 210 b

With fitting seal G 1/4 NBR

6.3 Other variants

document / Dokument	*description* / Beschreibung	*features, benefits, comments* / Eigenschaften, Vorteile, Bemerkungen
SK 7571 000 A	– *AC 13-1/4 with seal ring: EO-Lastic* – *Order code: AC 13 - 1/4 SR - ...* – AC 13-1/4 mit Dichtring: EO-Lastic – Bestellbezeichnung: AC 13 - 1/4 SR - ...	– *Can be easiliy assembled and disassembled several times* – *Replace AC 13-1/4 with AC 13-1/4 SR only after consultation.* – Mehrfache De- und Montage gut möglich – Austausch von AC 13-1/4 gegen AC 13-1/4 SR nur nach Rücksprache.

References

Additional versions

- Valve bank (nominal size 6) type BA: D 7788
- Diaphragm accumulator type AC: D 7969
- Piston type accumulators, type HPS: D 7969 HPS

HAWE Hydraulik SE
Einsteinring 17 | 85609 Aschheim/Munich | P.O. Box 11 55 | 85605 Aschheim | Germany
Phone +49 89 379100-1000 | info@hawe.de | www.hawe.com

hawe.com/contact

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