Miniature accumulator 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

D 7571
03-2021-1.0 en

HAWE HYDRAULIK

Printing date / document generated on: 19.03.2021

Contents

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

Hydraulic miniature accumulators type AC

Features and benefits:

- Compact design
- Operating pressures up to 500 bar
- Robust design

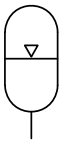
Intended applications:

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

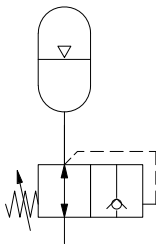
2 Available versions, main data

Circuit symbol:

AC



ACS



Ordering examples:

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

Extension "Table 4"

Shut-off valve pressure setting "Table 3"

Gas filling pressure "Table 2"

Basic type, nominal volume and port size "Table 1"

Table 1 Basic type, nominal volume and port size

Basic type	Nominal volume V_0 (cm³)	permissible overpressure $p_{4\ max}$ (bar)	Operating pressure ratio	
			$p_{2\ max}$ isothermal	$p_{1\ max}$ adiabatic
AC 13 - 1/4 -...	13	500	4:1	3:1
ACS 13 - 1/4 -.../...	13	500	4:1	3:1
AC 40 - 1/4 -...	40	400	4:1	3:1

NOTE

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"

Table 2 Gas pre-load pressure

Basic type	Max. gas pre-load pressure p_0 (bar)
AC 13	250
AC 40	250

NOTE
possible values: 0 bar or 20 to 250 bar

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

Table 3 Shut-off valve pressure setting

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

Table 4 Extension

Coding	Description
No designation	w/o extension
K 1/4	short extension, 31 mm
L 1/4	long extension, 66.5 mm

3 Parameters

3.1 General

General information

Designation	Micro diaphragm accumulator (spherical accumulator)
Surface protection	Zinc electroplating with transparent passivation
Mounting position	As desired
Attachment	Screwed into threaded holes Tapped journals G 1/4 A ISO 228-1 with sealing edge Tightening torque See Chapter 4, "Dimensions"
Gas filling	Nitrogen, grade 4.0 or 5.0
Ambient temperature	-20 to +60°C
Hydraulic fluid	Hydraulic oil: according to Parts 1 to 3; ISO VG 10 to 68 acc. to DIN ISO 3448 Viscosity range: min. approx. 4; max. approx. 1500 mm^2/s Optimal operating range: approx. 10 to 500 mm^2/s Also suitable for biologically degradable pressure fluids type HEPG (polyalkylene glycol) and HEES (synthetic ester) at operating temperatures up to approx. +70°C.
Operating pressures	See "Table 1" p_0 (bar) gas filling pressure (desired), engraved in accumulator housing $p_{0\ max}$ = 250 bar; $p_{0\ min}$ = 5 bar $p_{oil\ 1}$ (bar) lower operating pressure (oil side), $p_{oil\ 1\ min}$, $1.1p_0$ $p_{oil\ 2}$ (bar) upper operating pressure (oil side), $p_{oil\ 2\ max}$, 4 p_0 (isothermal), 3 p_0 (adiabatic)
Bursting pressure	approx. 4x max. overpressure p_4
Can be topped up	yes; required filling device available upon request (See Chapter 5.3.1, "Installation and commissioning")

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

Characteristic lines

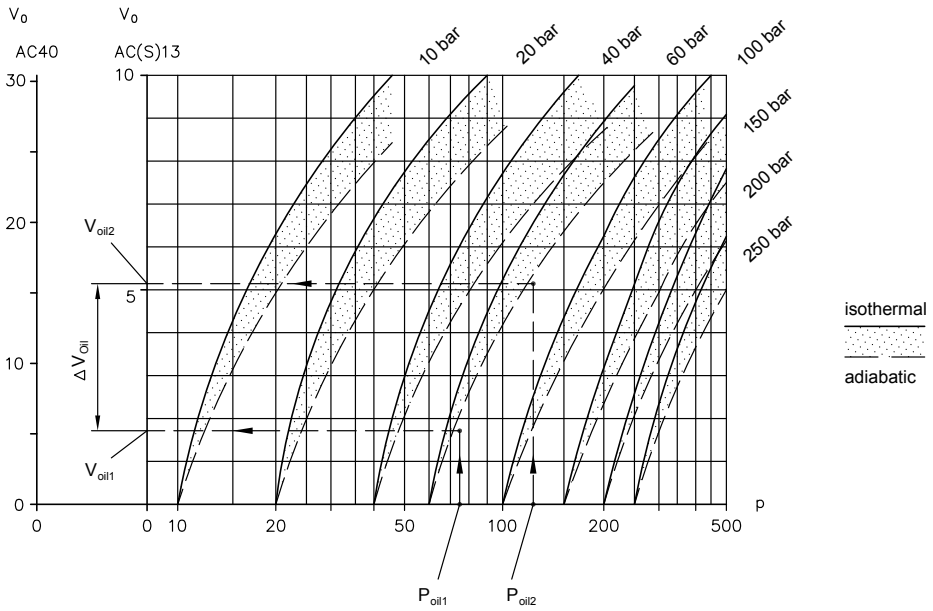
NOTE

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

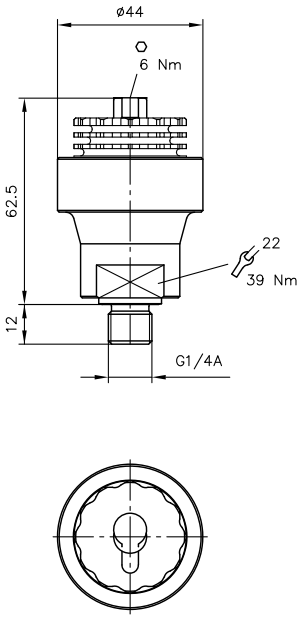


4 Dimensions

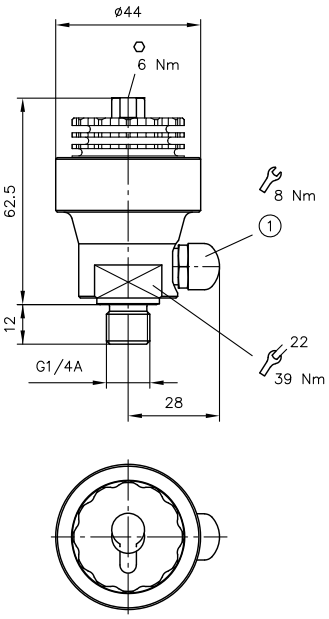
All dimensions in mm, subject to change.

4.1 Miniature hydraulic accumulator

AC 13

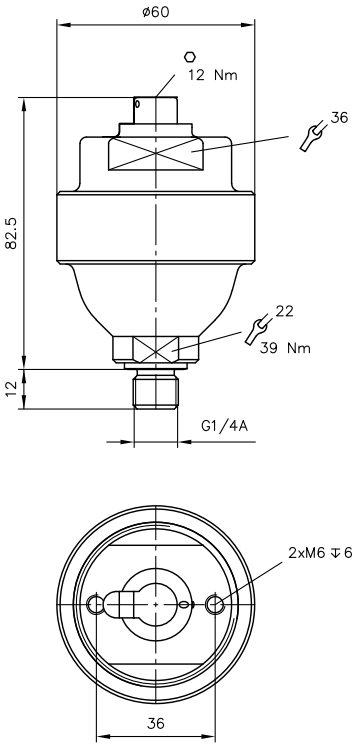


ACS 13

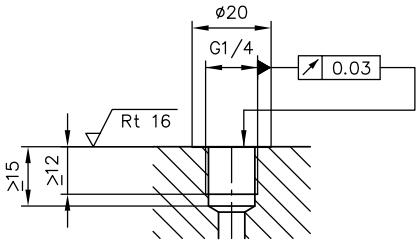


1 Shut-off valve

AC 40

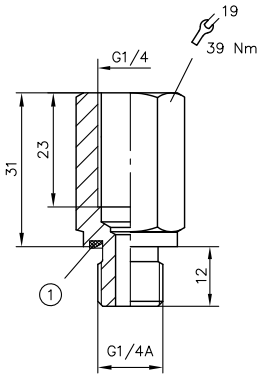


Mounting hole



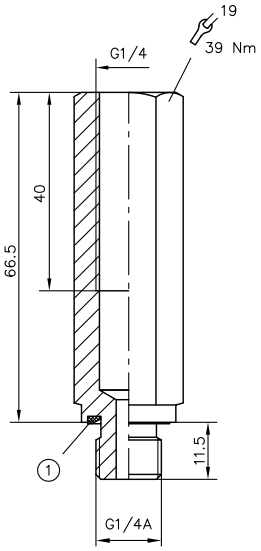
4.2 Extension

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

NOTE

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

5 Assembly, operation and maintenance recommendations

5.1 General notes

5.1.1 Safety instructions

Further information on the technical design 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 bank's 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 classified as pressure vessels under 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 regulations on transportation and safety.
- Wear protective equipment.

NOTE

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 restrict 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 use in hydraulic applications (fluid technology).

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

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 qualified personnel.
- The product must only be operated within the specified technical parameters. The technical parameters are described in detail in this documentation.
- All components must be suitable for the operating conditions in the event of application in an assembly.
- The operating and maintenance manual of 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 dismounting (in particular in combination with hydraulic accumulators).

DANGER

Risk to life caused by sudden movement of the hydraulic drives when dismantled 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.

- Prior to all maintenance work, release the pressure in the hydraulic system.

1. Fit the accumulator to the bracket intended for this purpose, if possible route the gas side directing 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 cap.

When installing, use only the spanner flats on the underside.

Primary filling

DANGER

Risk to life due to hydraulic accumulators potentially exploding if they are not filled correctly!

Risk of serious injury or death.

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

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

Filling device

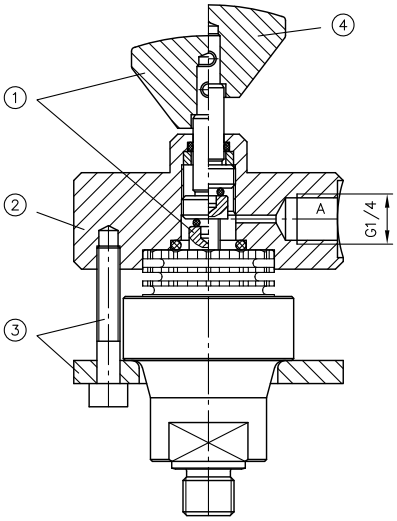
The filling device is used for topping up and adjusting the gas filling pressure.
Since diaphragm accumulators are hydraulic accumulators and subject to the European Pressure Equipment Directive (see there for exceptions), it must be ensured that the safety required therein, in particular to prevent 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.

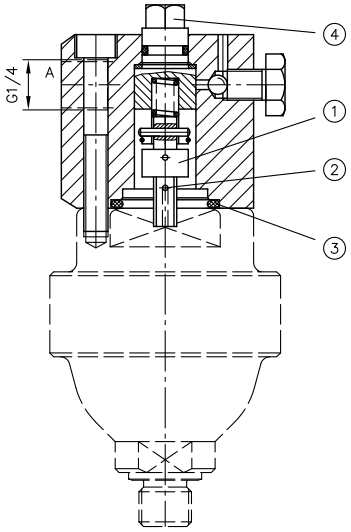
It is therefore advisable to entrust testing and filling tasks only to specialist staff, and under no circumstances to use any sort of adapter to connect the filling device directly to the nitrogen bottle, but instead to use a bottle pressure reducer.
Hoses with G 1/4 and G 1/2 connection nuts are required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

Filling device for AC(S) 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

NOTE
Order numbers for filling device See Chapter 6.2.1, "Filling device"

Filling instructions

DANGER

Risk to life due to hydraulic accumulators potentially exploding if they are not filled correctly!

Risk of serious injury or death.

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

AC(S) 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 device 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 bolts **3**.
4. Unscrew the wing bolt anti-clockwise = gas pressure relieves through A.

Filling

5. 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!).
6. Screw in the wing bolt clockwise until the accumulator's bleed screw makes contact.
7. Remove the device.
8. Tighten the screw!

AC 40

Draining

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

Filling

Lay the O-ring **3** into the counterhole and screw in the accumulator's bleed screw. Screw it in only so far that the bleed hole on the side remains clear. Screw the filling device to the accumulator. 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!).
Screw in the spindle **4** clockwise with a size 10 spanner until the accumulator's bleed screw makes contact.
Remove the device, tighten the screw!

5.4 Operating instructions

Purity and filtering of the hydraulic fluid

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

Examples of fine contamination include:

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

NOTE
New hydraulic fluid from the manufacturer does not necessarily have the required level of purity.
The hydraulic fluid must be filtered during filling.

Pay attention to the cleanliness level of the hydraulic fluid to maintain faultless operation.
(Also see cleanliness level in Chapter 3, "Parameters").

Additionally applicable document: D 5488/1 Oil recommendations

5.5 Maintenance information

Conduct a visual inspection at regular intervals, but at least once per year, to check if the hydraulic connections are damaged. If external leakages are found, shut down and repair the system.

Clean the device surface of dust deposits and dirt at regular intervals, but at least once per year.

6 Other information

6.1 Layout instructions

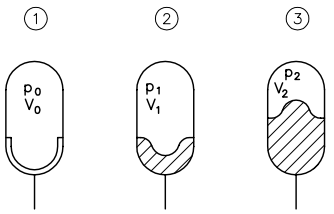
a) General layout instructions

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: $V\Delta = V_1 - V_2$

Gas pre-filling pressure p_0 (reference values)

- When acting as pressure reservoir around 90% of lower operating pressure
- When acting as a pulse damper around 60% of upper operating pressure
- Consideration of temperature influence

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

e.g. filling pressure p_0 at 90 bar with ambient temperature T_0 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 changes

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 in 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)

b) Use of pressure-limiting valve

The miniature hydraulic accumulators described here are exempted from the Pressure Equipment Directive 2014/68/EU as per 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 operation (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.

c) 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 $\leqq 3\ p_0$. Characteristic lines See Chapter 3, "Parameters"

d) Application examples

Accumulators are used to:

- compensate for potential internal leaking
  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 capacity.
  Example 2: Assisting changeover processes in purely hydraulic, pressure-controlled idle circulation valves (see D 7529).
- compensate pressure fluctuations caused by shifting temperatures
  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)
- pulse damping in hydraulic systems
  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 parts and separate components

6.2.1 Filling device

Filling device for type	Order coding
AC(S) 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

Further information

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

D 7571 - 03-2021-1.0

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