Piston accumulators
High pressure

1. DESCRIPTION

1.1. FUNCTION

While fluids are practically incompressible, this does not apply to gases. Hydraulic accumulators use these basic laws of physics to store hydraulic energy. Nitrogen is normally used as the compressible medium.

The various types of hydraulic accumulator are categorised on the basis of the separation element that keeps the gas section separate from the fluid section in the pressure vessel. In the case of the piston accumulator, this is a piston made from aluminium or steel with a sealing system that is compatible with the application.

The fluid side of the piston accumulator is connected to the hydraulic circuit so that the piston accumulator draws in fluid when the system pressure increases and the trapped gas is compressed. When the system pressure drops, the compressed gas expands and forces the stored fluid back out into the hydraulic circuit.

HYDAC piston accumulators are available in various designs, see catalogue sections:

- Piston accumulators Standard design
  No. 3.301

- Piston accumulators SK280
  No. 3.303

1.2. DESIGN

HYDAC piston accumulators consist of the following key individual components:

- Cylinder with a very finely machined internal surface
- Gas side end cap and oil side end cap, both sealed with O-rings
- Steel or aluminium piston
- High-pressure sealing system adapted to the particular field of application

The piston floats on guide rings which prevent metal-to-metal contact between the piston and the accumulator wall.
Suitable materials are available for low temperature applications.

2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

The cylinder and the two end caps are manufactured in carbon steel as standard. For use with certain aggressive or corrosive fluids, the parts coming into contact with the fluid can be nickel plated for protection, or made entirely from corrosion-resistant material. When supplied piston accumulators are suitable for short-term storage. Piston accumulators suitable for long-term storage are available on request.

2.1.2 Pistons with sealing system

Precise information about the intended operating conditions is required in order to select the most appropriate sealing system for the field of application.
Important criteria for this selection are, for example, the:

- Design pressure
- Actual pressure differential
- Switching frequency or switching cycle
- Piston velocity
- Operating temperature
- Operating fluid
- Cleanliness of fluid (filtration rating)
- Maintenance requirements

For high-pressure piston accumulators, an advanced piston design 2 is used which has been modified for applications up to 1000 bar.

2.1.3 Maximum temperature range of elastomer materials

The permitted working temperature of a piston accumulator is dependent on the application limits of the metal materials and the piston seal. The operating medium must also be taken into account. The following table shows the main **elastomer materials with their maximum possible temperature ranges** with examples of operating fluids.

Materials	Material code [1]	Max. possible temperature range [2]	Possible operating fluids, others on request	
			Resistant to	Not resistant to
NBR Acrylonitrile butadiene rubber	2	-20 °C ... + 80 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the groups HFA, HFB, HFC – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Fuels
	5	-40 °C ... + 80 °C		
FKM Fluorine rubber	6	-15 °C … +160 °C	– Mineral oil (HL, HLP) – Hydraulic fluids from the group HFD – Synthetic esters (HEES) – Fuels – Aromatic hydrocarbons – Inorganic acids	– Amines and ketones – Ammonia – Skydrol and HyJet IV – Steam

[1] The material code (MC) is described in more detail in the model code, see section 3.

[2] The specified temperature range relates to the particular elastomer material, not to the operating range of the hydraulic accumulator, see section 4.1.1

2.2. INSTALLATION POSITION

HYDAC piston accumulators operate in any position. Vertical installation is preferable with the gas side at the top, to prevent contaminant particles from the fluid settling on the piston seals.

2.3. TYPE OF INSTALLATION

Information on secure installation and mounting elements can be found in the following catalogue section:

- Mounting elements for hydraulic accumulators No. 3.502

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. HYDRAULIC FLUID

Hydraulic accumulators must only be operated with operating fluids with a minimum cleanliness class of:

- NAS 1638 Class 6 or
- ISO 4406 Class 17/15/12

2.6. CERTIFICATES

Hydraulic accumulators that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering. HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.
Others on request

2.7. FURTHER INFORMATION

- Operating instructions for piston accumulators No. 3.301.BA

The operating instructions must be observed!
All work on HYDAC piston accumulators must only be carried out by suitably trained staff. Incorrect installation or handling can lead to serious accidents.

- Assembly and repair instructions piston accumulators No. 3.301.M For repairs to be performed on hydraulic accumulators, we provide corresponding assembly and repair instructions.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

Not all combinations are possible. Order example.
For further information, please contact HYDAC.

SK690 – 1 / 2212 U – 690 ADE – VB – 08 UP2 – 1 – 300

Series

Nominal volume [l]

Material and piston code (MC)
Dependent on operating fluid
Standard design = 2212 for mineral oil
Others on request

Piston design
High pressure piston 2

Piston material
2 = carbon steel
3 = stainless steel 1)

Material of cylinder and end cap
1 = carbon steel
2 = stainless steel 1)

Material of seals including piston seals
2 = NBR 2) / PTFE
6 = FKM / PTFE

Certification code
U = European Pressure Equipment Directive (PED)
For others, see section 2.6.

Permitted operating pressure [bar]

Fluid port
Type of connection (see Table 1) Standard or specification of
the type of connection (see Table 2)
Size of connection (see Table 3)

Gas side connection or gas valve
Type of connection (see Table 1)
Standard or specification of the type of connection (see Table 2)
Size of connection (see Table 3)

Piston diameter
08 = 80 mm
12 = 125 mm
15 = 150 mm
18 = 180 mm

Additional equipment 3)
For detailed technical data, see flyer: "Monitoring equipment for hydraulic accumulators", No. 3.506
M = magnetic flap indication
UP..= piston position switch (e.g. UP2 = 2 position switches)

Safety equipment 3)
1 = burst disc (please give nominal pressure and temperature)

Pre-charge pressure p_0 [bar] at 20 °C, must be stated clearly, if required!

1) Dependent on type and pressure rating
2) Observe temperature ranges, see section 2.1.3
3) If required, please state at time of ordering

Table 1, Connection type

Code letter	Description
A	Threaded connection (internal)
K	Customer-specific connection
V	Gas valve port
S	Special connection on request

Table 2, Threaded connection: standard or specification

Code letter	Description
A	Thread to ISO 228 (BSP)
B	Thread to DIN 13 or ISO 965/1 (metric)
C	Thread to ANSI B 1.1 (UN..-2B, seal SAE J 514)
D	Thread to ANSI B1.20.3 (NPTF)

Table 3, Threaded connection: sizes

Type listed in Table 2	Code letter, size						
	A	B	C	D	E	F	G
A	G 1/8	G 1/4	G 3/8	G 1/2	G 3/4	G 1	G 1 1/4
B	M10x1	M12x1.5	M14x1.5	M16x1.5	M18x1.5	M22x1.5	M27x2
C	5/16-24UNF	3/8-24UNF	7/16-20UNF	1/2-20UNF	9/16-18UNF	3/4-16UNF	7/8-14UNF
D	1/16-27 NPTF	1/8-27 NPTF	1/4-18 NPTF	3/8-18 NPTF	1/2-14 NPTF	3/4-14 NPTF	1-11 1/2 NPTF

Table 4, Connection size for preferred high pressure connections (e.g. Maximator)

	Code letter, size						
	KCQ	KCR	KCT	KUR	KUY	KWB	KWP
1. Connection	13/16-16UNF (9MF)	13/16-16UNF (9MF)	9/16-18UNF (6MF)	9/16-18UNF (6MF)	1 3/8-12UNF (16MF)	9/16-18UNF (6MF)	3/4-16UNF (6HF)
2. Connection	13/16-16UNF (9MF)	-	-	9/16-18UNF (6MF)	-	G 3/4-ISO228	-

Other connections on request

Table 5, Gas valve port

Code letter	Description
B	Gas valve end connection M28x1.5/M8 (max. pre-charge pressure 800 bar with FPU-2)
M	Gas valve, male, for high pressure port 9/16-18UNF (6MF) (no limit for pre-charge pressure)

4. STANDARD ITEMS

4.1. TECHNICAL DATA

4.1.1 Permitted operating temperature

As standard, a piston accumulator can be operated in the following temperature range:

-20 °C ... +50 °C

Other operating temperatures on request.

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The table in section 4.2. shows the permitted operating pressure in accordance with the European Pressure Equipment Directive.

4.1.3 Nominal volume

HYDAC piston accumulators are available with set nominal volumes, as described in the table in section 4.2.

4.1.4 Effective volume

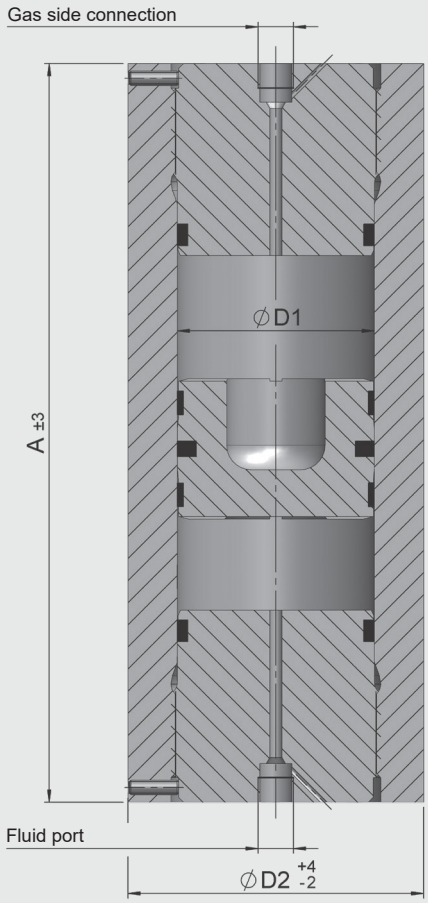
Volume (fluid side) between operating pressures p_2 and p_1.

4.1.5 Limits for gas pre-charge pressure

For more information, see catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

4.2. TABLES AND DRAWINGS



Nominal volume	Series	Perm. operating pressure (PED)	Ø D1	Ø D2 Carbon steel	Ø D2 Stainless steel	A	Approx. weight Carbon steel	Approx. weight Stainless steel
[l]		[bar]	[mm]	[mm]	[mm]	[mm]	[kg]	[kg]
0.5 - 10	690	690	80	107	110	280 - 2170	15 - 74	16 - 83
	800	800						
	1000	1000		120	119	310 - 2200	23 - 117	22 - 113
1 - 20	690	690	125	160	160	295 - 1845	37 - 133	37 - 133
	800	800		162			38 - 140	
	1000	1000		172	164	295 - 1840	44 - 178	40 - 148
5 - 30	690	690	150	190	200	535 - 1950	75 - 194	88 - 241
	800	800		185		535 - 1990	80 - 182	87 - 240
	1000	1000		200	250	575 - 1990	100 - 253	179 - 529
5 - 50	690	690	180	246	220	480 - 2250	136 - 443	94 - 269
	800	800			224			100 - 293
	1000	1000			280	555 - 2325	168 - 475	229 - 732

Notice:

The specified values are maximum values and must not be considered as referring to a permanent load. The tolerable pressure ratio is influenced by the geometry, temperature, fluid and flow rate as well as any gas losses due to physical properties.

5. NOTE

The information in this brochure relates to the operating conditions and fields of application described. For applications and/or operating conditions not described, please contact the relevant technical department.
Subject to technical modifications.