Diaphragm Accumulators



1. DESCRIPTION

1.1. FUNCTION

Fluids are practically incompressible and cannot therefore store pressure energy.

The compressibility of a gas is utilised in hydraulic accumulators for storing fluids. HYDAC diaphragm accumulators are based on this principle, using nitrogen as the compressible medium.

Diaphragm accumulators consist of a fluid section and a gas section with the diaphragm acting as a gas-tight separation element.

The fluid section is connected to the hydraulic circuit so that the diaphragm accumulator draws in fluid when the pressure increases and the gas is compressed. When the pressure drops, the compressed gas expands and forces the stored fluid into the circuit.

Set into the base of the diaphragm is a valve poppet. This shuts off the hydraulic outlet when the accumulator is completely empty and thus prevents damage to the diaphragm.

Note:
HYDAC diaphragm accumulators when fitted with a HYDAC safety and shut-off block comply with the regulations of the European Pressure Equipment Directive (PED) and the German Industrial Safety Regulations (Betr.Sich.V.).

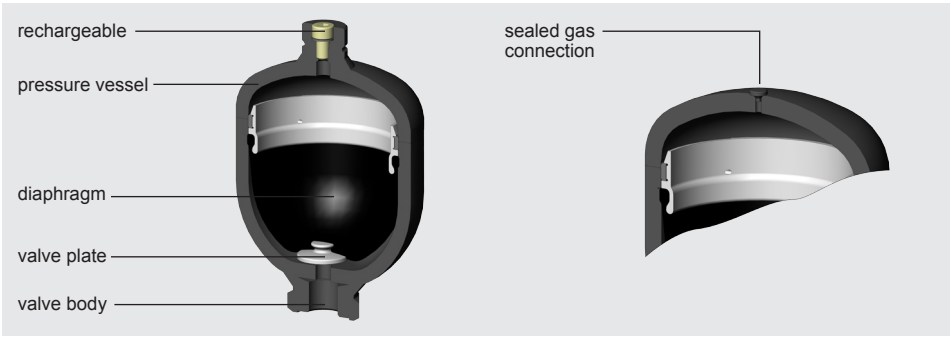
See catalogue section:

- Safety and Shut-off Block SAF/DSV No. 3.551

1.2. DESIGN

HYDAC diaphragm accumulators are available in two versions.

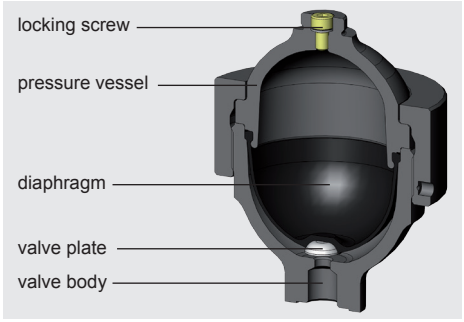
1.2.1 **Weld type**



This consists of:

- Welded pressure vessel, rechargeable on the gas side or, alternatively, completely sealed. Fluid connection available in various types.
- Flexible diaphragm to separate the fluid and gas sections.
- Valve poppet set into the base of the diaphragm.

1.2.2 **Screw type**



This consists of:

- Forged upper section with gas charging connection.
- Forged lower section with fluid connection.
- Exchangeable flexible diaphragm to separate the gas and fluid.
- Vulcanized valve poppet set into the base of the diaphragm.
- Lock nut to hold the upper and lower sections of the accumulator together.

1.2.3 **Diaphragm material**

The diaphragm material must be selected in accordance with the particular operating fluid or operating temperature, see section 1.5.
If discharge conditions are unfavourable (high p_2/p_0 pressure ratio, rapid discharge speed), the gas may cool to below the permitted temperature. This can cause cold cracking. The gas temperature can be calculated using the HYDAC Accumulator Simulation Program **ASP**.

1.2.4 **Corrosion protection**

For use with chemically aggressive fluids the accumulator can be supplied with corrosion protection, such as plastic coating or a galvanic or chemical surface protection. If this is insufficient, then almost all types can be supplied in stainless steel.

1.3. INSTALLATION POSITION

Optional. However, if there is a risk of contamination collecting, a vertical position is preferable (fluid connection at the bottom).

1.4. TYPE OF INSTALLATION

Accumulators up to 2 l can be screwed directly inline.

Where strong vibrations are expected, the accumulator must be secured to prevent it working loose. For weld type accumulators we recommend HYDAC support clamps. For screw type accumulators with lock nut, a suitable support console can be ordered.

For additional male thread on the hydraulic connection for screwing into mounting holes, see table 3.1.

See catalogue section:

- Supports for Hydraulic Accumulators No. 3.502

1.5. GENERAL

1.5.1 **Permitted operating pressure**
see tables 3.1. and 3.2.

The permitted operating pressure can differ from the nominal pressure for foreign test certificates.

1.5.2 **Nominal volume**
see tables 3.1. and 3.2.

1.5.3 **Effective gas volume**
corresponds to the nominal volume of the diaphragm accumulator.

1.5.4 **Effective fluid volume**
Volume of fluid which is available between the operating pressures p_2 and p_1.

1.5.5 **Gas charging**
All accumulators are supplied with a protective pre-charge.
Higher gas pre-charge pressures are available on request (gas charging screw or sealed gas connection).

Hydraulic accumulators must only be charged with nitrogen.
Never use other gases.
Risk of explosion!

In principle, the accumulator may only be charged with nitrogen class 4.0, filtered to <3 µm.

If other gases are to be used, please contact HYDAC for advice.

1.5.6 **Limits for gas pre-charge pressure**

$p_0 \leq 0.9 \bullet p_1$

For diaphragm accumulators with PTFE diaphragms, the following applies:
$p_{0tmax} \leq 200$ bar

for further information, see catalogue section:

- HYDAC Accumulator Technology No. 3.000

1.5.7 **Permitted pressure ratio**
Ratio of maximum operating pressure p_2 to gas pre-charge pressure p_0.

1.5.8 **Max. flow rate of the operating fluid**
In order to achieve the max. flow rate given in the tables, a residual fluid volume of approx. 10 % of the effective gas volume must remain in the accumulator.

The maximum fluid flow rate was determined under specific typical conditions and is not applicable in all operating conditions.

1.5.9 **Working temperature and operating fluid**
The permitted working temperature of a diaphragm accumulator is dependent on the application limits of the metal materials and the diaphragm. Outside this temperature range, special materials must be used. The operating fluid must also be taken into account. The following table displays a selection of elastomer materials with temperature range and a rough overview of resistant and non-resistant fluids, on a case-by-case basis, information must be requested regarding the resistance and the resistance must be tested specifically:

Materials		Material code [1]	Temperature range	Overview of the fluids [2]	
				Resistant to	Not resistant to
NBR	Acrylonitrile butadiene rubber	2	-15 °C ... + 80 °C	● Mineral oil (HL, HLP) ● Flame-resistant fluids from the groups HFA, HFB, HFC ● Synthetic ester (HEES) ● Water ● Sea water	● Aromatic hydrocarbons ● Chlorinated hydrocarbons (HFD-S) ● Amines and ketones ● Hydraulic fluids of type HFD-R ● Fuels
		5	-50 °C ... + 50 °C		
ECO	Ethylene oxide epichlorohydrin rubber	3	-40 °C ... +120 °C	● Mineral oil (HL, HLP) ● Flame-resistant fluids from the HFB group ● Synthetic ester (HEES) ● Water ● Sea water	● Aromatic hydrocarbons ● Chlorinated hydrocarbons (HFD-S) ● Amines and ketones ● Hydraulic fluids of type HFD-R ● Flame-resistant fluids from the groups HFA and HFC ● Fuels
IIR	Butyl rubber	4	-50 °C ... +120 °C	● Hydraulic fluids of type HFD-R ● Flame-resistant fluids from the group HFC ● Water	● Mineral oils and mineral greases ● Synthetic ester (HEES) ● Aliphatic, chlorinated and aromatic hydrocarbons ● Fuels
FKM	Fluorine rubber	6	-10 °C ... +150 °C	● Mineral oil (HL, HLP) ● Hydraulic fluids of type HFD, ● Synthetic ester (HEES) ● Fuels ● Aromatic hydrocarbons ● Inorganic acids	● Amines and ketones ● Ammonia ● Skydrol and HyJet IV ● Steam

[1] see section 2.1. Model code, material code, diaphragm

[2] others available on request

1.5.10 **Certificate codes**
Hydraulic accumulators which are installed in countries outside Germany are supplied with the test certificates required in that country. The country of installation must be stated at the time of ordering.
HYDAC pressure vessels can be supplied with virtually any test certificate.
Please note that the permitted operating pressure can differ from the nominal pressure.
The following table contains a few examples of the codes used in the model code for different countries of installation:

Country	Certificate code (AKZ)
EU member states	U
Australia	F [1]
Belarus	A6
Canada	S1 [1]
China	A9
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic)	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

On no account must any welding, soldering or mechanical work be carried out on the accumulator shell. After the hydraulic line has been connected it must be completely vented. Work on systems with hydraulic accumulators (repairs, connecting pressure gauges etc.) must only be carried out once the fluid pressure has been released.
The operating instruction must be followed!
No. 3.100.BA

Note:
Application examples, accumulator sizing and extracts from approvals regulations on hydraulic accumulators can be found in the catalogue section:

- HYDAC Accumulator Technology No. 3.000

2. TECHNICAL SPECIFICATIONS

2.1. MODEL CODE

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

SBO210 – 2 E1 / 112 U – 210 AK 050

Series

Nominal volume [l]

Type

Weld type:
E1 = rechargeable M28x1.5
E2 = sealed gas connection, with gas pre-charge as requested [1]
E3 = rechargeable, gas valve M16x1.5 / M14x1.5

Screw type
A6 = rechargeable M28x1.5, exchangeable diaphragm
A3 = gas valve M16x1.5 / M14x1.5, exchangeable diaphragm

Material code
dependent on operating medium
standard model = 112 for mineral oils

Fluid connection
1 = carbon steel
3 = stainless steel [2]
4 = carbon steel with protective coating [3]
6 = low-temperature steel
7 = other materials

Accumulator shell
0 = plastic coating
1 = carbon steel
2 = carbon steel with protective coating [3] [4]
4 = stainless steel [2]
6 = low-temperature steel
7 = other materials

Diaphragm
2 = NBR [5]
3 = ECO
4 = IIR
5 = NBR [5]
6 = FKM
7 = other materials (e.g. PTFE, EPDM, ...)

Certification code
U = European Pressure Equipment Directive (PED)

Permitted operating pressure [bar]

Fluid connection form
Standard connection = AK or AB
e.g. form AK = G 3/4
for SBO210-2 see section 3.

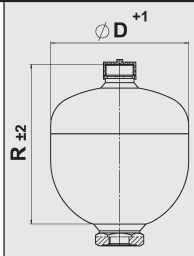
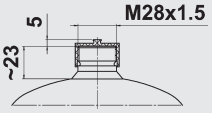
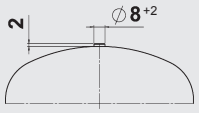
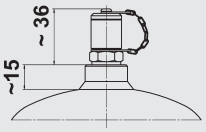
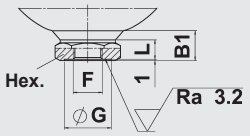
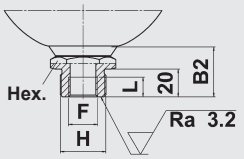
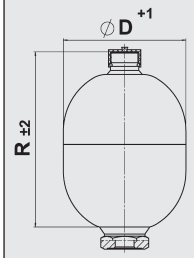
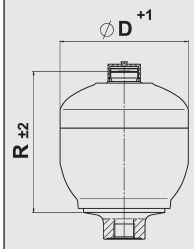
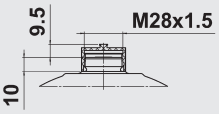
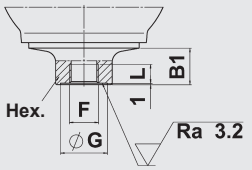
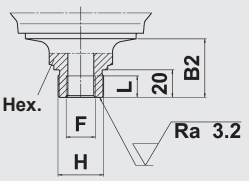
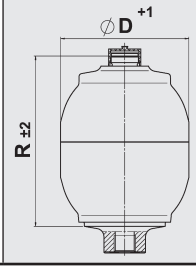
Pre-charge pressure p_0 [bar] at 20 °C, must be stated clearly, if required! [1]

[1] only for E1 or E2 design, when ordered as standard
[2] dependent on type and pressure level
[3] only for screw-type design
[4] only for parts that come into contact with fluid
[5] Observe temperature ranges – see section 1.5.

3. TECHNICAL DATA

3.1. WELD TYPE
– non-exchangeable diaphragms –

3.1.1 Drawings

Fig.	Design	Gas side connection			Fluid side connection*	
		E1	E2	E3	AK	AB
1						
2			–			
3			on request			
4			–			

* = alternative fluid connections on request

3.1.2 **Dimensions**

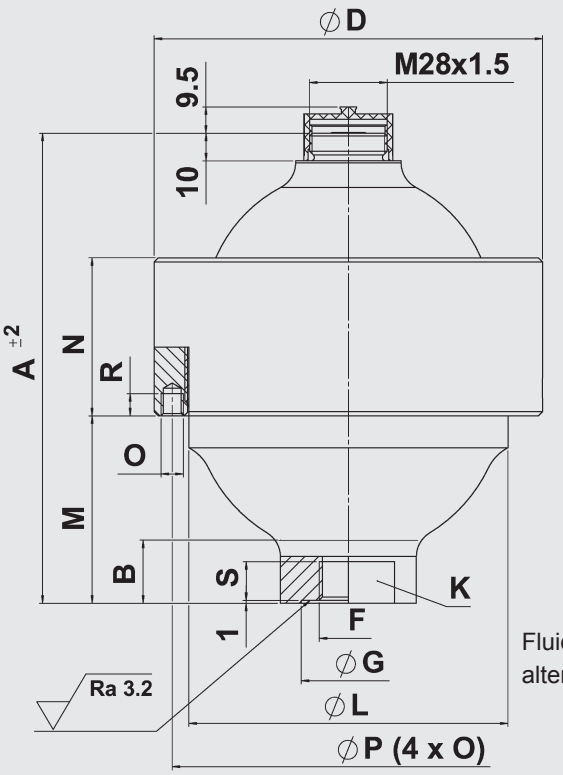
Nom. vol. [1] [l]	Perm. press. ratio $p_2 : p_0$	Series	Certificate code U / Permitt. oper. pressure [bar] Carbon steel	Stainless steel	R [mm]	ØD [mm]	Weight [kg]	Q [2] [l/min]	Standard fluid connection – Form AK: F ISO 228	ØG [mm]	L [mm]	B1 [mm]	Hex. SW	Form AB: F ISO 228	H DIN 13	L [mm]	B2 [mm]	Hex. SW	Fig.
0.075	8 : 1	250	250	–	91	64	0.7	38	G 1/2	–	14	21	30	not available					1
0.16	8 : 1	210	210	180	103	74	0.8	38	G 1/2	–	14	21	30	not available					1
		300	300	–	108	78	1.1												
0.32	8 : 1	210	210	160	116	93	1.3	95	G 1/2	–	14	21	30	not available					1
		300	300	–	120	96	1.8												
0.5	8 : 1	160	160	–	130	102	1.3	95	G 1/2	–	14	21	30	G 1/2	M33x1.5	14	37	41	1
		210	210	–	133	105	1.7												
0.6	8 : 1	330	330	–	151	115	3.3	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
		350	350	–	130	121	3.5						50					50	3
0.7	8 : 1	100	100	–	151	106	1.8	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
0.75	8 : 1	140	140	–	142	116	1.8	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
		210	210	140	147	121	2.8												
		250	250	–	152	126	3.6									15	42		
		330	330	–	140	126	4					26							3
1	8 : 1	200	200	–	159	136	3.6	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
	4 : 1	250	250	–	192	126	4.4												2
		330	330	–	169		4.8					26				15	42		4
1.4	8 : 1	140	140	–	173	145	3.9	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
		210	210	–	178	150	5.4												
		250	250	–	185	153	5.9									15			
		330	330	–	172	155	7.6					33					42		3
2	8 : 1	100	100	100	190	160	4	150	G 3/4	44	16	28	46	G 3/4	M45x1.5	16	33	46	1
		210	210	–	198	167	6.6												
	4 : 1	250	250	–	232	153	7.4												2
	8 : 1	330	330	–	181	172	9.2					43					42		3
2.8	4 : 1	210	210	–	250	167	8.2	150	G 3/4	44	16	28	46	G 3/4	M45x1.5	16	33	46	2
		250	250	–	250	170	9.5												
		330	330	–	237	172	11					43					42		4
	6 : 1				231							44							3
3.5	4 : 1	250	210	–	306	170	11.2	150	G 3/4	44	16	28	46	G 3/4	M45x1.5	16	33	46	2
		330	330	–	274	172	13.8					44					42		4
4	4 : 1	50	–	50	294	158	5	150	G 3/4	44	16	44	46	G 3/4	M45x1.5	16	33	46	2
		250	–	180	306	170	11.2												

[1] others on request
[2] max. flow rate of operating fluid

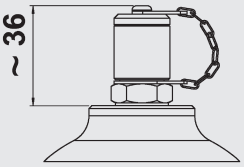
3.2. SCREW TYPE
– exchangeable diaphragm –

3.2.1 **Drawings**

Type A6



Type A3



Fluid port AK
alternative fluid connections on request

Figure 5

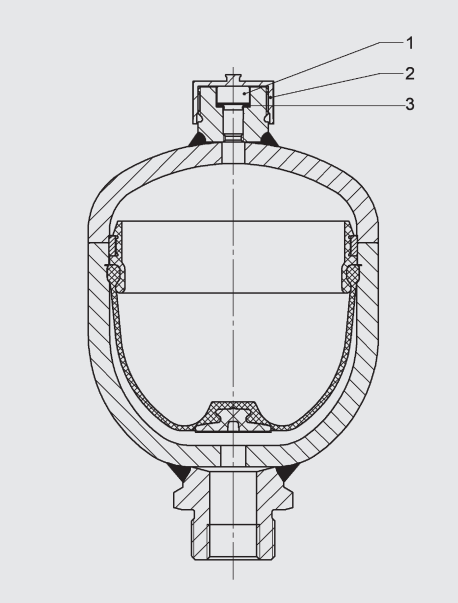
3.2.2 **Dimensions**

Nom. vol. [1] [l]	Perm. press. ratio $p_2 : p_0$	Series	Certificate code U / Permitt. oper. pressure [bar] Carbon steel	Stainless steel	Weight [kg]	A [mm]	B [mm]	ØD [mm]	ØL [mm]	M [mm]	N [mm]	O	ØP [mm]	R [mm]	Q [2] [l/min]	**Standard fluid connection Form AK** F ISO 228	S [mm]	ØG [mm]	K SW	Figure
0.1	10 : 1	500	500	–	1.9	110	30	95	–	53	35	–	–	–	95	G 1/2	14	–	36	
0.25	10 : 1	500	500	–	3.9	129	20	115	92	56	56	–	–	–	95	G 1/2	14	–	36	
			–	350	4.9			125			60									
		750	–	750	9	136	11	153	114	57.5	63	M6	140	12				27		
0.6	10 : 1	450	450	250	5.7	170	19	140	115	68	57	–	–	–	95	G 1/2	14	34	41	5
1.3	10 : 1	400	400	–	11.2	212	28	199	160	97	65	M8	180	10	150	G 3/4	16	44	50	
2	10 : 1	250	250	180	11.4	227	17	201	168	101	64	M8	188	10	150	G 3/4	16	44	50	
2.8	10 : 1	400	400	–	22	257	30	252	207	106	80	M8	230	10	150	G 3/4	16	44	50	
4	10 : 1	400	400	–	34	284	30	287	236	127.5	90	M8	265	10	150	G 3/4	16	44	50	

[1] others on request
[2] max. flow rate of operating fluid

4. SPARE PARTS

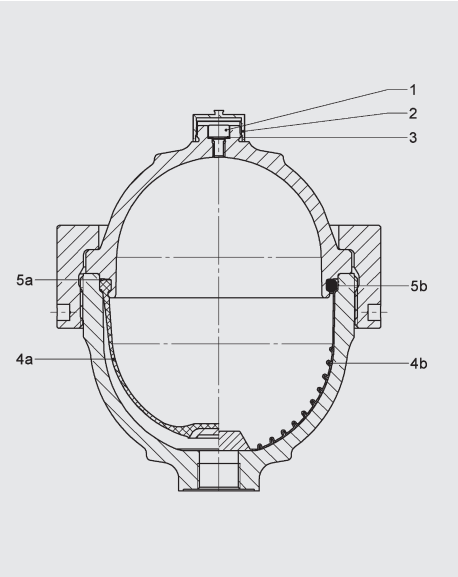
4.1. WELD TYPE
– non-exchangeable diaphragms –



Description	Quantity	Item
Spare parts set for gas side consisting of:		
Locking screw	20	1
Protective cap	20	2
Seal ring	20	3

Nominal volume [l]	Part no.				
	NBR	ECO	FKM	IIR	PTFE
Spare parts set for gas side					
0.075 - 4	3262845	-	-	-	-

4.2. SCREW TYPE
– exchangeable diaphragm –



Description	Quantity	Item
Spare parts set for gas side consisting of:		
Locking screw	20	1
Protective cap	20	2
Seal ring	20	3
Spare parts kit for elastomer diaphragm consisting of:		
Locking screw	1	1
Seal ring	1	3
Elastomer diaphragm	1	4a
Back-up ring	1	5a
Spare parts kit for PTFE diaphragm consisting of:		
Locking screw	1	1
Seal ring	1	3
PTFE diaphragm	1	4b
O-ring	1	5b

Nominal volume [l]	Part no.				
	NBR	ECO	FKM	IIR	PTFE
Spare parts set for gas side					
0.1 - 4	3262845	-	-	-	-
Spare parts kit					
0.1	3042668	3182526	-	-	-
0.25	3042709	3042712	3042714	3042713	3504798
0.6	3042710	3042715	3042717	3042716	3550388
1.3	3042681	3042682	3042684	-	3446897
2	3042711	3042719	3042721	3042720	3464205
2.8	3042700	3042701	3042704	3042702	-
4	3042705	3042706	3042708	3042707	-

When replacing seals and/ or diaphragms, please read the Instructions for Assembly and Repair (No. 3.100.M).

4. NOTE

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

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