Bladder accumulators
Standard design

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 a bladder accumulator, the separation element is a closed elastomer bladder.

The fluid side of the bladder accumulator is connected to the hydraulic circuit so that the bladder 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 bladder accumulators are available in various designs – see catalogue sections:

- Bladder accumulators Low pressure
  No. 3.202

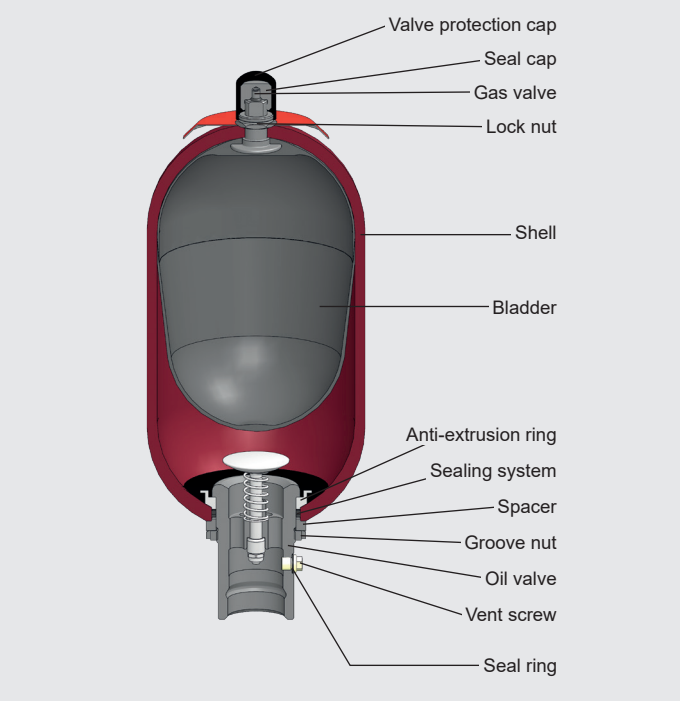
- Bladder accumulators High pressure
  No. 3.203

Bladder accumulators can also be used as dampers, for example - see catalogue section:

- Hydraulic dampers
  No. 3.701

1.2. DESIGN

- **SB330/400/500/550**
  HYDAC standard bladder accumulators consist of the pressure vessel, the flexible bladder with gas valve and the hydraulic connection with check valve. The pressure vessels are seamless and manufactured from high-tensile steel.

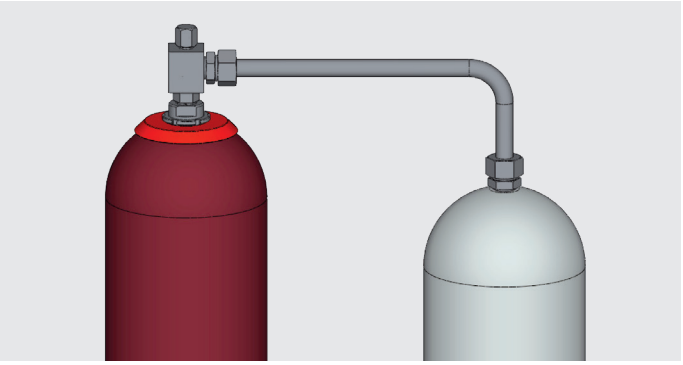


- **SB330N**
  The flow-optimised design of the standard oil valve enables the maximum possible operating fluid flow rate to increase to 25 l/s with this accumulator type.
- **SB330H (High Flow)**
  HYDAC high flow bladder accumulators type SB330 are high performance accumulators with a flow rate of up to 30 l/s. The fluid port is enlarged to allow higher flow rates.
- **SB600**
  For higher pressures, with the ASME U Stamp, HYDAC provides the series SB600 with approval S (p_{max} 345 bar / 5000 psi).

- **Bladder accumulator SB330B**
  HYDAC bladder accumulators SB330B are designed to allow the bladder to be removed from above (top repairable). This has the advantage that the bladder accumulator does not need to be removed from the hydraulic system for inspection and repair work.

- **Bladder accumulator back-up version**
  To extend the gas volume of a hydraulic accumulator, HYDAC supplies back-up versions (version 1 in this case).

  For more information, see catalogue section:
  - Hydraulic accumulators with back-up nitrogen bottles No. 3.553



2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

The accumulator shells are made from carbon steel as standard.
For operation with chemically aggressive media, the accumulator shell can be supplied with corrosion protection (such as chemical nickel-plating). If this is insufficient, then stainless steel hydraulic accumulators must be used.

2.1.2 Bladder

The bladder material must be selected in accordance with the particular operating medium or operating temperature, see section 2.1.3.
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**.

2.1.3 Maximum temperature range of elastomer materials

The permitted working temperature of a bladder accumulator is dependent on the applications limits of the metal materials and the bladder. 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	-15 °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	-50 °C ... + 50 °C		
		9	-30 °C ... + 80 °C		
ECO	Ethylene oxide epichlorohydrin rubber	3	-30 °C ... +120 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the HFB group – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the groups HFA and HFC – Fuels
IIR	Butyl rubber	4	-50 °C ... +100 °C	– Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the group HFC – Water	– Mineral oils and mineral greases – Synthetic esters (HEES) – Aliphatic, chlorinated and aromatic hydrocarbons – Fuels
FKM	Fluorine rubber	6	-10 °C ... +150 °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 bladder accumulators can be installed vertically, horizontally and at a slant. When installing vertically or at a slant, the oil valve must be at the bottom.
For certain applications listed below, particular positions are preferable:

- Energy storage: vertical
- Pulsation damping: any position from horizontal to vertical
- Maintaining constant pressure: any position from horizontal to vertical
- Volume compensation: vertical

If the installation position is horizontal or at a slant, the effective fluid volume and the maximum permitted flow rate of the operating fluid are reduced.

2.3. TYPE OF INSTALLATION

By using an adapter, HYDAC hydraulic accumulators with a volume of up to 1 l can be installed directly inline.

For strong vibrations and volumes above 1 litre, we recommend HYDAC mounting elements – see catalogue section:

- Mounting elements for hydraulic accumulators
  No. 3.502
- ACCUSET SB
  No. 3.503

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. 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

2.6. FURTHER INFORMATION

- Operating instructions for bladder accumulators
  No. 3.201.BA

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

- Assembly and repair instructions bladder accumulators
  No. 3.201.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.

SB330 (H) – 32 A 1 / 112 U – 330 A 050

Series

Type code
No details = standard
H = high flow
N = flow-optimised valve, fluid side
A = shock absorber [1)]
P = pulsation damper [2)]
B = bladder top-repairable
E = bladder with foam filling
DA = bladder integrity system, industry version (others on request)
L = light-weight
Combinations must be agreed with HYDAC.

Nominal volume [l]

Fluid port
A = standard connection, thread with internal seal face
F = flange connection
C = valve mounting with screws on underside
E = sealing surfaces on front interface (e.g. for thread M50x1.5 – valve)
G = external thread
S = special connection, to customer specification

Gas side connection
1 = standard design (see section 4.1.8)
2 = back-up version[3)]
3 = gas valve 7/8-14UNF with M8 internal thread
4 = gas valve 7/8-14UNF with gas valve connection 5/8-18UNF
5 = gas valve M50x1.5 in accumulators smaller than 50 l
6 = 7/8-14UNF gas valve
7 = M28x1.5 gas valve
8 = M16x1.5 gas valve (with M14x1.5 bore in gas valve)
9 = special gas valve, to customer specification

Material code (MC)
Dependent on operating medium
Standard design= 112 for mineral oils
Others on request

Fluid port
1 = carbon steel
2 = high tensile steel
3 = stainless steel [4)]
6 = low temperature steel

Accumulator shell
0 = plastic coated (internally)
1 = carbon steel
2 = chemically nickel-plated (internal coating)
4 = stainless steel [4)]
6 = low temperature steel

Accumulator bladder [5)]
2 = NBR [6)]
3 = ECO
4 = IIR
5 = NBR [6)]
6 = FKM
7 = other
9 = NBR [6)]

Certification code
U = European Pressure Equipment Directive (PED)
For others, see section 2.5.

Permitted operating pressure [bar]

Connection, fluid side
Thread, codes for fluid port: A, C, E, G
A = thread to ISO228 (BSP)
B = thread to DIN13 or ISO965/1 (metric)
C = thread to ANSI B1.1 (UN..-2B seal in acc. with SAE J 514)
D = thread to ANSI B1.20.1 (NPT)
S = special thread, to customer specification

Flange, codes for fluid port: F
A = EN 1092-1 welding neck flange
B = flange ASME B16.5
C = SAE flange 3000 psi
D = SAE flange 6000 psi
S = special flange, to customer specification

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

[1)] See catalogue section Bladder accumulators Low pressure, No. 3.202
[2)] See catalogue section Hydraulic dampers, No. 3.701
[3)] See catalogue section Hydraulic accumulators with back-up nitrogen bottles, No. 3.553
[5)] When ordering a spare bladder, please state diameter of the smaller shell port
[4)] Dependent on type and pressure rating
[6)] Observe temperature ranges of the accumulator bladder, see section 2.1.3.

4. STANDARD ITEMS

The bladder accumulators and spare parts described below are manufactured in carbon steel with an NBR accumulator bladder (MC = 112).

The table provides the most important data and dimensions for the following series:
SB330/400/500/550/600, SB330H, SB330N

The part numbers provided refer to bladder accumulators in accordance with PED (CC = U) and ASME (CC = S).
Designs that differ from the standard types described below can be requested from HYDAC.

4.1. TECHNICAL DATA

4.1.1 Permitted operating temperature

As standard, the part numbers listed in the table may be operated in the following temperature range:

-10 °C ... +80 °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 pressures for the listed certification codes.

4.1.3 Nominal volume

HYDAC bladder accumulators are available with set nominal volumes, see table in section 4.2.

4.1.4 Effective gas volume

The effective gas volume is based on nominal dimensions. It differs slightly from the nominal volume and must be used when calculating the effective fluid volume see table in section 4.2.

4.1.5 Effective volume

Volume of fluid which is available between the operating pressures p_2 and p_1.

4.1.6 Maximum flow rate of the operating fluid

In order to achieve the max. flow rate given in the tables, the accumulator must be installed vertically.
It must be ensured that a residual fluid volume of approx. 10 % of the effective gas volume remains in the accumulator.
The maximum fluid flow rate was determined under specific conditions and is not applicable in all operating conditions.

4.1.7 Limits for gas pre-charge pressure

$p_0 \leq 0.9 \bullet p_1$
with a permitted pressure ratio of:
$p_2 : p_0 \leq 4:1$

p_2 = max. operating pressure
p_0 = pre-charge pressure

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.

For more information, see catalogue section:

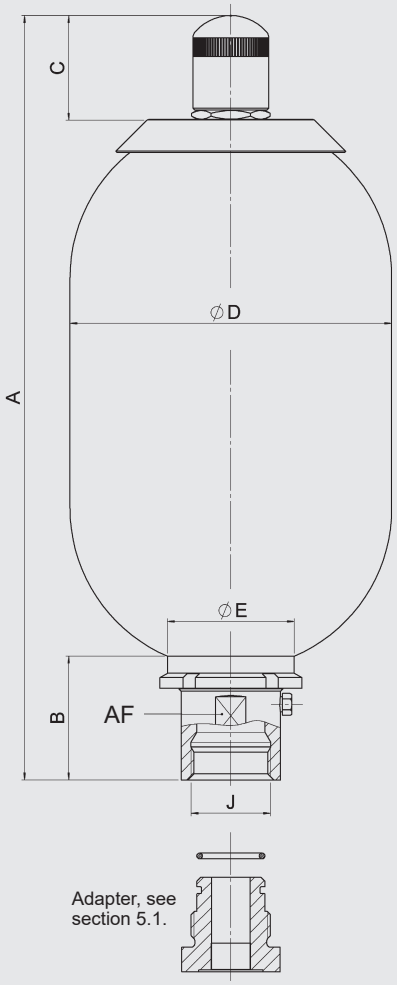
- HYDAC Accumulator Technology
  No. 3.000

4.1.8 Gas side connection

Series	Volume [l]	Gas valve design
SB330 / SB400	< 1	5/8-18UNF
	< 50	7/8-14UNF
	≥ 50	M50x1.5 / 7/8-14UNF
SB500 / SB600	10 ... 50	M50x1.5 / 7/8-14UNF
SB550	1 ... 5	7/8-14UNF

Other pressure ratings on request

4.2. TABLES AND DRAWINGS



Nominal volume	Series	Max. operating pressure				Eff. gas volume	A max.	B	C	Ø D max.	J Thread	Ø E	AF	Q max. [2]	Weight
		CC U		CC S											
[l]		[bar]	Part no. [1]	[bar]	Part no. [1]	[l]	[mm]	[mm]	[mm]	[mm]	ISO 228	[mm]	[mm]	[l/s]	[kg]
0.5	SB400	400	3047163	–	–	0.5	270	57	33.5	96	G 3/4	50	32	4	4
1	SB330	330	3047162	–	–	1	316	57	56	115	G 3/4	50	32	4	7
	SB550 [4]	550	3110531	–	–		343	67		123	G 1	67	45	6	10
2.5	SB330	330	3047165	–	–	2.4	528	64	56	115	G 1 1/4	67	50	10	11
	SB550 [4]	550	3068916	–	–	2.5	550	67		123	G 1		45	6	14
4	SB330	330	3047166	–	–	3.7	412	65	56	170	G 1 1/4	67	50	10	15
	SB400 [4]	400	3107905	–	–										
5	SB550 [4]	550	3090654	–	–	4.9	876	64	56	123	G 1	67	45	6	27
6	SB330	330	3047168	–	–	5.7	534	65	56	170	G 1 1/4	67	50	10	18
10 [3]	SB330	330	3047170	–	–	9.3	810	65	56	170	G 1 1/4	67	50	10	31
10	SB330	330	3047172	262	3141237	9.3	582	101	56	229	G 2	100	70	15	33
	SB330N		3156632	–	–									25	34
	SB330H		3079081	–	–	9	617	136			G 2 1/2	125	90	30	38
	SB400 [4]	400	3107393	290	–	9.3	578	101		234	G 2	100	70	15	41
	SB500 [4]	500	3130252	–	–	8.8	598		69	241					46
	SB600	–	–	345	332265										
13	SB330	330	3047173	–	–	12	695	101	56	229	G 2	100	70	15	46
	SB330N		–	–	–									25	47
	SB330H		–	–	–		730	136			G 2 1/2	125	90	30	45
20	SB330	330	3047174	262	3117153	18.4	895	101	56	229	G 2	100	70	15	49
	SB330N		3162982	–	–									25	
	SB330H		3092659	–	–	17.5	930	136			G 2 1/2	125	90	30	62
	SB400 [4]	400	3115007	290	–	18.4	895	101		234	G 2	100	70	15	71
	SB500 [4]	500	3118156	–	–	17	913		69	241			75		77
	SB600	–	–	345	332266										
24	SB330	330	3047175	–	–	23.6	1060	101	56	229	G 2	100	70	15	72
	SB330N		–	–	–									25	73
	SB330H		–	–	–	24	1095	136			G 2 1/2	125	90	30	76
32	SB330	330	3047176	262	3117154	33.9	1410	101	56	229	G 2	100	70	15	80
	SB330N		3220899	–	–									25	81
	SB330H		3059515	–	–	32.5	1445	136			G 2 1/2	125	90	30	98
	SB400 [4]	400	3125141	290	–	33.9	1410	101		234	G 2	100	70	15	104
	SB500 [4]	500	3760577	–	–	33.5	1423		69	241			75		112
	SB600	–	–	345	332267										
50	SB330	330	3047177	262	362904	47.5	1933	101	69	229	G 2	100	70	15	114
	SB330N		3185604	–	–									25	115
	SB330H		3089605	–	–		1968	136			G 2 1/2	125	90	30	128
	SB400 [4]	400	3114662	290	–		1933	101		234	G 2	100	70	15	137
	SB500 [4]	500	3130253	–	–	48.3				241			75		167
	SB600	–	–	345	332268										
60	SB330	330	3341217	–	–	60	1210	138	69	360	G 2 1/2	125	90	30	160
80	SB330	330	–	–	–	85	1460	138	69	360	G 2 1/2	125	90	30	200
100	SB330	330	3098489	–	–	105	1710	138	69	360	G 2 1/2	125	90	30	234
130	SB330	330	–	–	–	133	2030	138	69	360	G 2 1/2	125	90	30	283
160	SB330	330	–	–	–	170	2059	137	69	410	G 2 1/2	125	90	30	345
200	SB330	330	–	–	–	201	2359	137	69	410	G 2 1/2	125	90	30	403

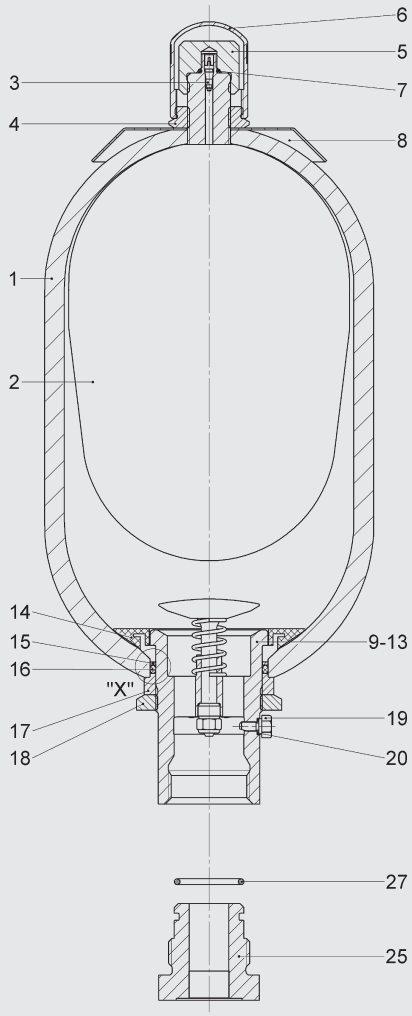
[1] If not specified, please request

[2] Under optimum conditions

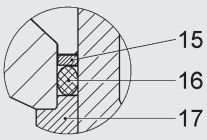
[3] Slimline version, for confined installation spaces

[4] Material code (MC) = 212 for AC U, see section 3.

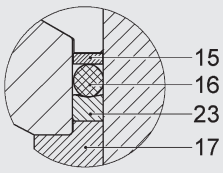
4.3. SPARE PARTS



Detail "X"
SB330/400 – 0.5 ... 6 l
SB330 – 10 l slimline version



SB330/400/500/600 – 10 ... 50 l
SB330 - 60 ... 200 l
SB330H/N – 10 ... 50 l
SB550 – 1 ... 5 l



Description	Item
Bladder assembly [1] consisting of:	
Bladder	2
Gas valve insert [2]	3
Lock nut	4
Seal cap	5
Protective cap	6
O-ring	7
Seal kit consisting of:	
O-ring	7
Washer	15
O-ring	16
Vent screw	19
Support ring	23 [3]
O-ring	27 [3]
Repair kit [1] consisting of:	
Bladder assembly (see above)	
Seal kit (see above)	
Oil valve assembly consisting of:	
Valve	9-13
Anti-extrusion ring [2]	14
Washer	15
O-ring	16
Spacer	17
Groove nut	18
Vent screw	19
Support ring	23 [3]

[1] When ordering, please state diameter of the smaller shell port
[2] Available separately
[3] Not for all accumulator types
Accumulator shell (item 1) and company label (item 8) not available as spare part
Vent screw (item 19) for NBR/carbon steel: Seal ring (item 20) included
Adapter (item 25) incl. O-ring (item 27) available as an accessory, section 5.1.

SB330/400, standard gas valve

Nominal volume [l]	Bladder assembly	Seal kit	Repair kit	Oil valve assembly	Anti-extrusion ring	Gas valve insert
0.5	365263	353606	2128169 [1]	2102355	2105411	632865
1	237624		2106261			
2.5	236171	353609	2106200	236045	2105431	
4	236046		2106204	238523	2105451	
5	240917		2106208	236045	2105431	
6	2112097		2112100	238523	2105451	
10 [2]	2127255 [3]		3117512 [3]			
10	236088	353621	2106212	352572	2105491	
13	376249		2106216			
20	236089		2106220			
24	376253		2106224			
32	235335		2106228			
50	235290		2106252			
60	3364274	3102043 [3]	3117513	3273734	3102326	
80	3364312		3117514			
100	3127313		3117515			
130	3201384		3117516			
160	3184769		3117517			
200	3461300		3117558			

Others on request

[1] Only for SB400

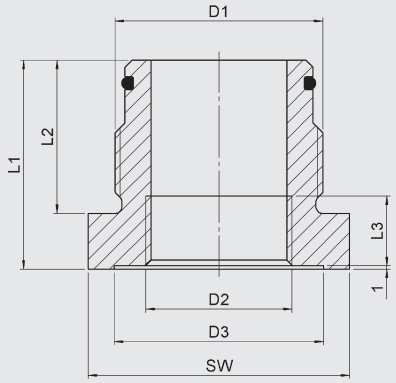
[2] Slimline version, for confined installation spaces

[3] Only for SB330

5. ACCESSORIES

5.1. ADAPTERS FOR STANDARD BLADDER ACCUMULATORS (FLUID SIDE)

To connect the bladder accumulator to threaded pipe fittings. These are available separately



D1 Accum.conn.* ISO 228-BSP	D2 ISO 228-BSP	D3 [mm]	L1 [mm]	L2 [mm]	L3 [mm]	AF [mm]	O-ring [mm]	Part no. NBR/carbon steel
G 3/4	G 3/8	28	55	28	12	32	17x3	2104346
	G 1/2		60		14	36		2104348
G 1 1/4	G 3/8	28	50	37	12	46	30x3	2116345
	G 1/2	34			14			2105232
	G 3/4	44			16			2104384
	G 1	50	67		18	65		2110124
G 2	G 1/2	34	60	44	14	65	48x3.15	2104853
	G 3/4	44			16			2104849
	G 1	50			18			2124831
	G 1 1/4	60			20			2107113
	G 1 1/2	68	80		22	70		2105905
G 2 1/2	G 1 1/4	60	66	50	20	80	62x4	2127406
	G 1 1/2	68			22			3243831
	G 2	96	88		27	100		2113403

* Others on request

5.2. ADAPTERS (GAS SIDE)

The adapters shown below are available for standard connections on bladder accumulators and must be specified separately in the order.

Fundamentally, the permitted operating pressure for the specified assembly numbers must not exceed 400 bar.
The upper limit of the pressure gauge must be observed, however.

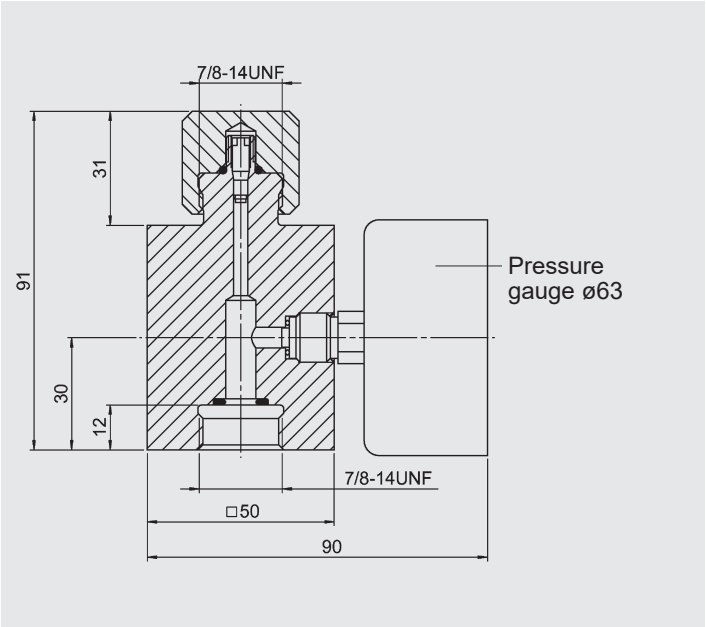
5.2.1 Adapter for safety devices

Adapter for connecting safety devices, such as burst discs or temperature fuses, see catalogue section:

- Safety equipment for hydraulic accumulators No. 3.552

5.2.2 Pressure gauge model

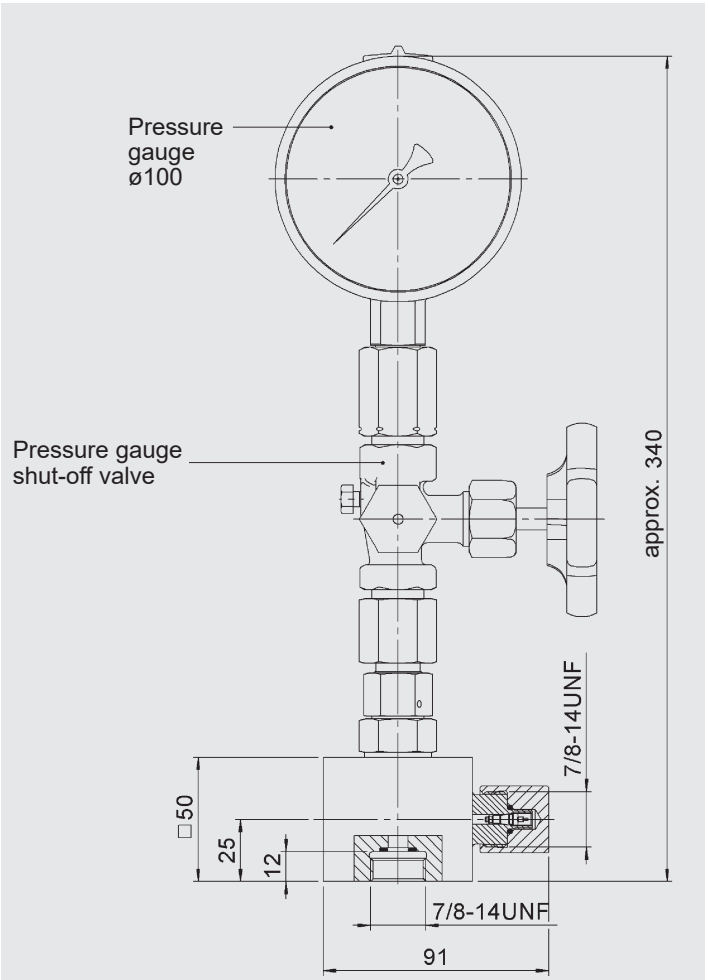
Gas-side connection on the bladder accumulator for permanent monitoring of the pre-charge pressure.



Gauge indication range	Pressure gauge Part no.	Adapter assembly Part no.
–	–	366621
0 - 10 bar	614420	2108416
0 - 60 bar	606886	3093386
0 - 100 bar	606887	2104778
0 - 160 bar	606888	3032348
0 - 250 bar	606889	2100217
0 - 400 bar	606890	2102117

5.2.3 Pressure gauge model with shut-off valve

Gas side connection on the bladder accumulator for permanent monitoring of the pre-charge pressure with shut-off option.

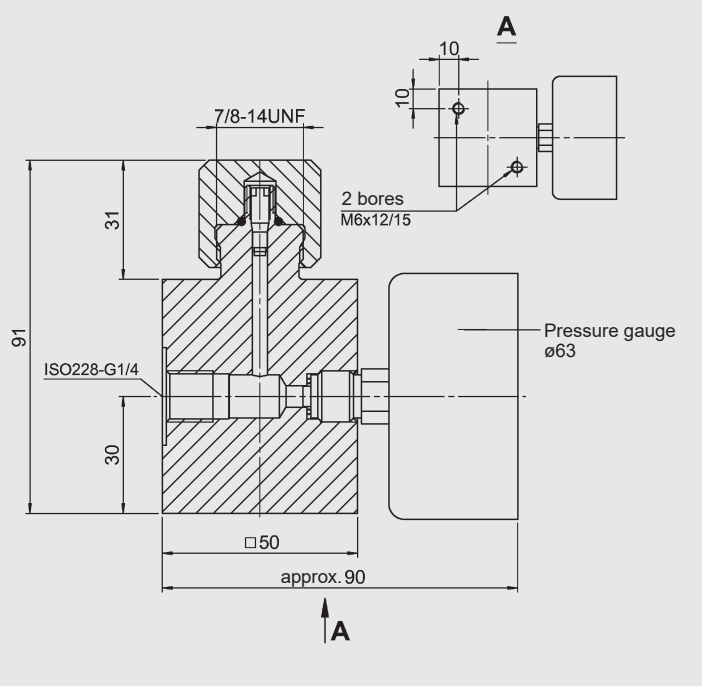


Gauge indication range	Pressure gauge Part no.	Adapter assembly Part no.
–	–	2103381
0 - 25 bar	617928	3784725
0 - 60 bar	606771	2110059
0 - 100 bar	606772	3139314
0 - 160 bar	606773	3202970
0 - 250 bar	606774	3194154
0 - 400 bar	606775	2103226

5.2.4 Remote monitoring of the pre-charge pressure

To monitor the pre-charge pressure in hydraulic accumulators remotely, gas-side adapters with a pressure gauge and mounting bores are available.

In order to connect these adapters directly to the hydraulic accumulator using appropriate pipework, accumulator connectors are also available for connection at the top (see figure 1) or for connection at the side (see figure 2).



Gauge indication range	Pressure gauge Part no.	Adapter assembly Part no.
–	–	3037666
0 - 10 bar	614420	3095818
0 - 60 bar	606886	3095819
0 - 100 bar	606887	3095820
0 - 160 bar	606888	3095821
0 - 250 bar	606889	3095822
0 - 400 bar	606890	3095823

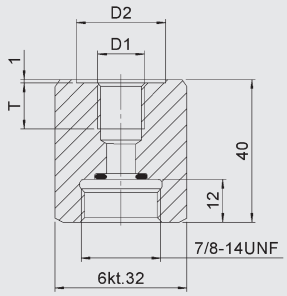


Fig 1

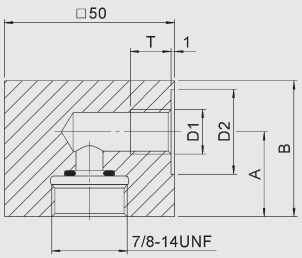


Fig 2

D1 Threaded connection	D2 [mm]	T [mm]	A [mm]	B [mm]	Adapter assembly Part no.	Fig.
ISO228 - G 1/4	25	14	-	-	2109481	1
			25	40	2102042	2
ISO228 - G 3/8	28		-	-	2109483	1
			25	40	366607	2
ISO228 - G 1/2	34	16	-	-	2110636	1
			31	55	366608	2

5.3. TRANSPORT EQUIPMENT FOR BLADDER ACCUMULATORS

Various types of transport equipment are available for transporting standard bladder accumulators.
The weights of the bladder accumulators are given in section 4.2.

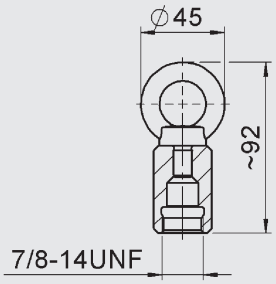


Fig. 1

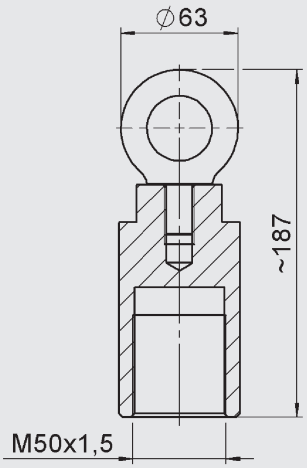


Fig. 2

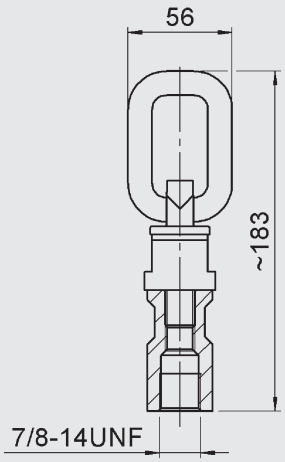


Fig. 3

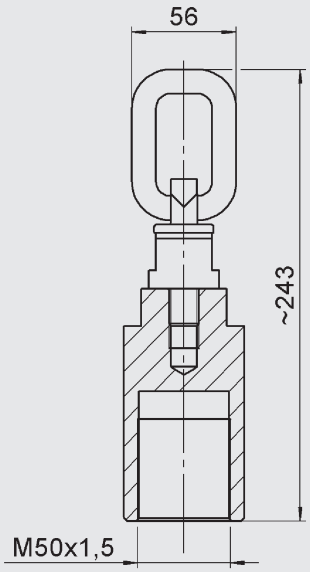


Fig. 4

Material	Part no.	Gas side connection	max. [kg]	Special feature	Fig.
Carbon steel	4356969	7/8-14UNF	350	–	1
	4356971	M50x1.5	350	–	2
	4152199	7/8-14UNF	1120	swivel-type	3
	4356954	M50x1.5	1120	swivel-type	4

Others on request

6. 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.

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Piston accumulators
Standard design

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.

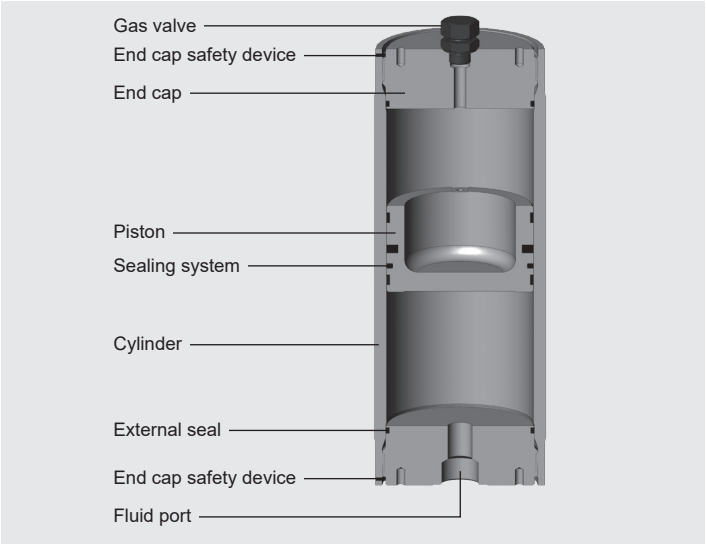
The fluid side of the piston accumulator is connected to the hydraulic circuit so that the piston accumulator draws in fluid when the system pressure increases and the trapped gas is compressed. When the system pressure drops, the compressed gas expands and forces the stored fluid back out into the hydraulic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

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

- Piston accumulators SK280
  No. 3.303

- Piston accumulators High pressure
  No. 3.302

1.2. DESIGN

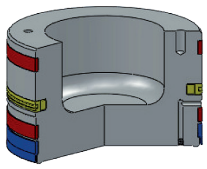
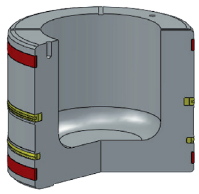
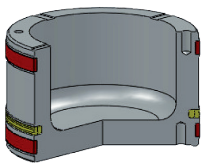
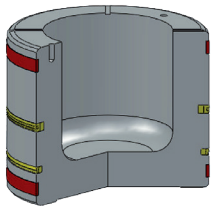


HYDAC piston accumulators consist of the following key individual components:

- 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
- 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.

1.2.1 Piston design

Design		Application	Contamination level of fluid	Comment
	1	– For general accumulator operation with without special requirements Application limitations: max. piston velocity: 0.5 m/s	Optimised for applications with a high level of contamination	
	2	– Low-friction design – For high piston speeds – Depending on fluid, slow movements without stick-slip effect Application limitations: Max. piston velocity: 3.5 m/s	Filtration: NAS 1638 - Class 6 ISO 4406 - Class 17/15/12	
	3	– Low-friction design – Simple-to-fit seals – Depending on fluid, slow movements without stick-slip effect Application limitation: Max. piston velocity: 0.8 m/s		1 guide ring for pistons with Ø ≤ 150 mm 2 guide rings for pistons with Ø ≥ 180 mm
	4	– Low-friction design with emergency safety features – Depending on fluid, slow movements without stick-slip effect – Very low oil transfer to the gas side Application limitations: Max. piston velocity: 5 m/s		

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 a 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

The sealing systems differ according to the type of piston used, each of which has its own type and arrangement of seals. Various elastomers are available as a sealing material, depending on the operating conditions, see section 2.1.3

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		
PUR	Polyurethane	8	Standard application -30 °C ... + 80 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the HFA group	– Water and water-glycol mixture HFC – Alkalis – Acids
			Special application -40 °C ... +100 °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. For hydraulic accumulators with certain piston position indicators, vertical installation is essential.

2.3. TYPE OF INSTALLATION

For strong vibrations and volumes above 1 litre, we recommend the use of two HYDAC mounting clamps, or more as appropriate, ideally in the end cap area. See 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. EFFECT OF SEALING FRICTION

The permitted piston velocity depends on the sealing friction. Higher piston velocities are possible where there is less sealing friction.
HYDAC piston accumulators of piston design 2 allow velocities of up to 3.5 m/s.

2.8. PERMITTED VELOCITIES

Gas velocity

The flow velocities in the gas side connection and pipe system should be limited to 30 m/s when using piston accumulators of the back-up type. Gas velocities of over 50 m/s should be avoided at all costs.

Oil velocity

In order to limit the pressure losses when the operating fluid is displaced, the flow velocity should not exceed 10 m/s in the fitting cross-section.

2.9. FUNCTION TESTS AND FATIGUE TESTS

Function tests and fatigue tests are carried out to ensure continuous improvement of our piston accumulators.
By subjecting the accumulators to endurance tests under realistic as well as extreme working conditions, important data can be obtained about the long-term behaviour of the component. In the case of piston accumulators, important information on gas density and the service life of seals is gained from such tests.
Vital data for use in accumulator sizing is gained by altering the working pressure and switching cycles.

2.10. 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.

SK350 – 20 / 2212 U – 350 AAG – VA – 18 A – 1 – 050

Series

Nominal volume [l]

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

Piston design (see section 1.2.1)

Piston material
1 = aluminium
2 = carbon steel
3 = stainless steel [1)]

Material of cylinder and end cap
1 = carbon steel
2 = carbon steel with surface protection
3 = stainless steel [1)]
6 = carbon steel (low temperature)

Material of sealing system, including piston seal
2 = NBR [2)] / PTFE compound
5 = NBR [2)] / PTFE compound
6 = FKM / PTFE compound
8 = NBR [2)] / PUR
9 = special qualities

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 Tables 2 + 3)
Size of connection (see Tables 4 + 5)

Gas-side connection or gas valve
Type of connection (see Table 1)
Standard or specification of the type of connection (see Tables 2 + 3)
(no letter required for connection type V)
Size of connection (see Table 4, 5 + 6)

Piston diameter

04 =	40 mm	20 =	200 mm
05 =	50 mm	25 =	250 mm
06 =	60 mm	31 =	310 mm
08 =	80 mm	35 =	355 mm
10 =	100 mm	49 =	490 mm
12 =	125 mm	54 =	540 mm
15 =	150 mm	61 =	610 mm
18 =	180 mm		

Additional equipment [3)]
Detailed technical data on request,
see flyer “Monitoring equipment for hydraulic accumulators”, No. 3.506

A = electrical limit switch – 35 mm stroke
B = electrical limit switch – 200 mm stroke
C = electrical limit switch – 500 mm stroke
E.. = other electrical limit switch, fixed or adjustable
K = protruding piston rod
L = linear position measurement system
LA = laser linear position measurement system
M = magnetic flap indication
S = cable tension measurement system
UP.. = piston position switch (e.g. UP2 = 2 position switches)
W = limit switch with linear position measurement system

Safety equipment [3)]
1 = burst disc (please give nominal pressure and temperature)
2 = gas safety valve
3 = temperature fuse

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 thread)
B	Threaded connection (external thread)
F	Flange connection
H	Protruding flange
K, S	Combination connection / special connection
V	Gas valve type

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 B1.1 (UN..-2B, seal SAE J 514)
D	Thread to ANSI B1.20.3 (NPTF)

Table 3, Flange connection: standard or specification

Code letter	Description
A	Flanges to DIN standards (pressure rating + standard)
B	Flanges to ANSI B 16.5
C	SAE flange 3000 psi
D	SAE flange 6000 psi
E	High pressure block flange (Bosch-Rexroth) PN320
F	High pressure block flange (AVIT, HAVIT) PN320

Table 4, Threaded version: connection sizes

Type listed in Table 2	Code letter, size										
	A	B	C	D	E	F	G	H	J	K	L
A	G 1/8	G 1/4	G 3/8	G 1/2	G 3/4	G 1	G 1 1/4	G 1 1/2	G 2	G 2 1/2	G 3
B	M10x1	M12x1.5	M14x1.5	M16x1.5	M18x1.5	M22x1.5	M27x2	M33x2	M42x2	M48x2	M60x2
C	5/16-24UNF	3/8-24UNF	7/16-20UNF	1/2-20UNF	9/16-18UNF	3/4-16UNF	7/8-14UNF	1 1/16-12UNF	1 3/16-12UNF	1 5/16-12UNF	1 5/8-12UNF
D	1/16-NPTF	1/8-NPTF	1/4-NPTF	3/8-NPTF	1/2-NPTF	3/4-NPTF	1-11 1/2 NPTF	1 1/4-11 1/2 NPTF	1 1/2-11 1/2 NPTF	2-11 1/2 NPTF	2 1/2 - NPTF

Table 5, Flange version: connection sizes

Type listed in Table 3	Code letter, size										
	A	B	C	D	E	F	G	H	J	K	L
A	DN15	DN25	DN40	DN50	DN65	DN80	DN100	DN125	DN150	DN200	–
B	1/2" - 1500 psi	1" - 1500 psi	1 1/2" - 1500 psi	2" - 1500 psi	2 1/2" - 1500 psi	3" - 1500 psi	1/2" - 2500 psi	1" - 2500 psi	1 1/2" - 2500 psi	2" - 2500 psi	2 1/2" - 2500 psi
C	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"
D									–	–	–
E	DN32	DN40	DN50	DN65	DN80	DN100	DN125	DN150	–	DN25	–
F											

Table 6, Gas valve models

Code letter	Description
A	Gas valve G 3/4 male, with M28x1.5/M8
B	Gas valve in end cap M28x1.5/M8
C	Gas valve 1/2"-20UNF, male, with M16x2 (ISO 10945)
D	Gas valve M14x1.5, male, with male M16x1.5 (Minimess)
E	Gas valve G 3/4 male, with 7/8-14UNF-VG8
F	Gas valve in end cap M42x1.5/M12

4. STANDARD ITEMS

4.1. TECHNICAL DATA

The piston accumulators and spare parts described below are manufactured in carbon steel with a design 2 piston (aluminium or carbon steel, depending on the version) and a sealing system made from NBR/PTFE (MC = 2212 / 2112).

The table provides the most important data and dimensions for the following series: SK210/350

The part numbers provided refer to piston accumulators in accordance with PED (CC = U).
Designs that differ from the standard types described below can be requested from HYDAC.

4.1.1 Permissible operating temperature

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

-10 °C ... +80 °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 gas volume

The effective gas volume differs slightly from the nominal volume and forms the basis of the calculated effective fluid volume.

The gas volume V is larger than the nominal volume by the amounts shown below.

Piston Ø D1	Piston design			
	1	2	3	4
[mm]	Δ[l]			
50	–	–	0.014	–
60	–	0.04	0.04	0.04
80	–	0.04	0.08	0.04
100	0.06	0.06	0.26	0.06
125	–	0.17	0.5	0.17
150	–	0.65	0.78	0.65
180	1.21	1.21	1.21	1.21
200	–	1	1.6	1
250	3.03	3.03	3.58	3.03
310	–	6.22	–	6.22
355	4.51	4.51	–	4.51
490	–	12.71	–	12.71

4.1.5 Effective volume

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

4.1.6 Limits for gas pre-charge pressure

For more information, see catalogue section:

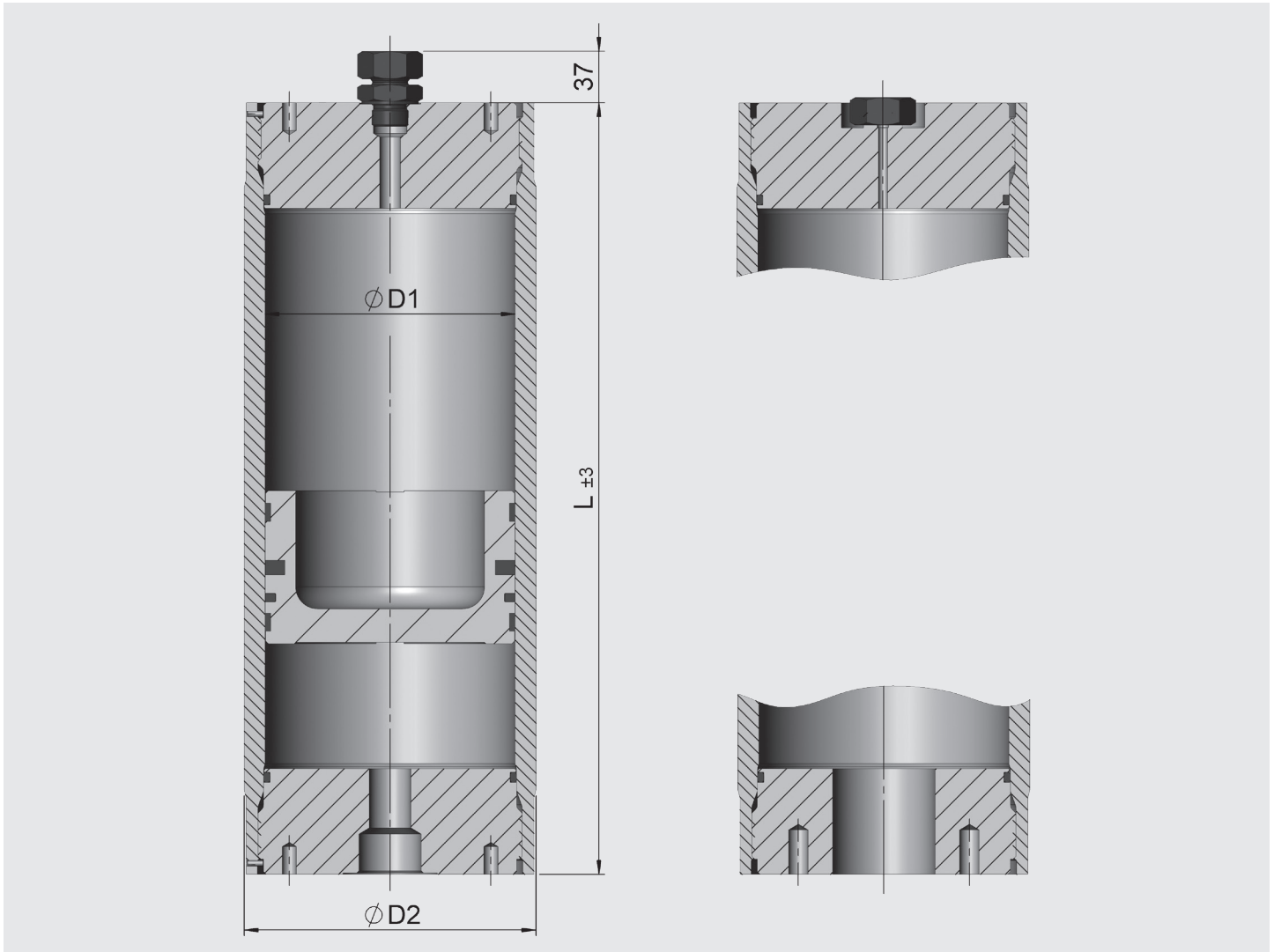
- HYDAC Accumulator Technology
  No. 3.000

4.2. TABLES AND DRAWINGS

Nom. volume V min. - max. [l]	Series	Perm. operating pressure (PED) [bar]	Ø D1 [mm]	Ø D2 [mm]	Length calculation [1] L = a + (b • V) a [mm]	b [mm/l]	Weight [2] min. - max. [kg]
0.2 – 5	SK350	350	60	80	126	353.7	6 – 35
0.5 – 10	SK350	350	80	100	157	198.9	11 – 48
0.5 – 15	SK350	350	100	125	184	127.3	19 – 85
1 – 50	SK350	350	125	160	185	81.5	32 – 280
2.5 – 70	SK210	210	150	180	210	56.6	47 – 280
	SK350	350			234		52 – 285
2.5 – 100	SK210	210	180	210	262	39.3	70 – 346
	SK350	350		220			79 – 458
2.5 – 200	SK210	210	200	235	290	31.8	100 – 690
	SK350	350					
10 – 200	SK210	210	250	286	408	20.4	173 – 731
	SK350	350		300			204 – 999
25 – 400	SK350	350	310	350	462	13.2	390 – 1110
25 – 750	SK210	210	355	404	534	10.1	472 – 2154
	SK350	350		434			594 – 3413
200 – 1300	SK210	210	490	570	700	5.3	1589 – 4492
	SK350	350					1641 – 4696
300 – 3300	SK210	210	610	691	856	3.42	2500 – 11000
	SK350	350		710	950		

[1] The lengths calculated are normally rounded up or down in 5 mm increments

[2] Intermediate weights can be calculated approximately depending on the length/diameter required



Nominal volume [l]	Series	Perm. operating pressure (PED) [bar]	Part no. [1]	Ø D1 [mm]	Ø D2 ±3 [mm]	L [mm]	Gas side connection [3]	Fluid side connection ISO 228	Weight [kg]
10	SK350	350	3946133	150	180	800	Gas valve VB	G 3/4	76
			3946157				G 3/4		
			3946158				Gas valve VA		77
20	SK350	350	3946159	150	180	1365	Gas valve VB	G 3/4	111
			3946161				G 3/4		
			3946164				Gas valve VA		112
	SK210	210	3946260	180	210	1050	G 3/4	G 3/4	119
			3946262					G 1 1/2	120
			3586466				Gas valve VA	G 3/4	
			3123789					G 1 1/2	118
32	SK350	350	3946195	150	180	2045	Gas valve VB	G 3/4	152
			3946196				G 3/4		
			3946198				Gas valve VA		153
			3946330	180	220	1520	G 3/4	G 3/4	193
			3112126					G 1 1/2	189
			3946331				Gas valve VA	G 3/4	194
			3123473					G 1 1/2	190
	SK210	210	3946297	180	210	1520	G 3/4	G 3/4	153
			3152988					G 1 1/2	
			3946298				Gas valve VA	G 3/4	
			3123470					G 1 1/2	150
	SK350	350	3946383 [2]	200	235	1310	G 3/4	G 3/4	174
			3946396 [2]				Gas valve VA		175
50	SK350	350	3946332	180	220	2225	G 3/4	G 3/4	262
			3213717					G 1 1/2	250
			3946333				Gas valve VA	G 3/4	262
			3123505					G 1 1/2	251
	SK210	210	3946301	180	210	2225	G 3/4	G 3/4	203
			3823656					G 1 1/2	
			3946302				Gas valve VA	G 3/4	
			3280844					G 1 1/2	201
	SK350	350	3946399 [2]	200	235	1880	G 3/4	G 3/4	228
			3946402 [2]				Gas valve VA		229
			3221083 [2]	250	300	1425	G 3/4	G 1 1/2	339
			3946442 [2]				Gas valve VA		341
75	SK350	350	3946403 [2]	200	235	2675	G 3/4	G 3/4	302
			3946438 [2]				Gas valve VA		303
100	SK350	350	3484504 [2]	250	300	2445	G 3/4	G 1 1/2	512
			3946475 [2]				Gas valve VA		514

[1] Preferred models, others on request

[2] Material and piston code (MC) = 2112, see section 3.

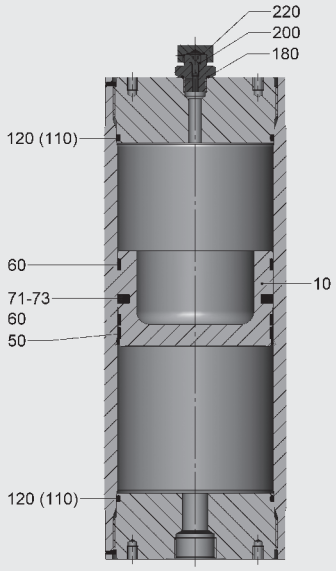
[3] Gas side connection, see section 3.

Notice:

Dimensions, particularly lengths, are approximate and dependent on various factors (e.g. piston design, approval).
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.

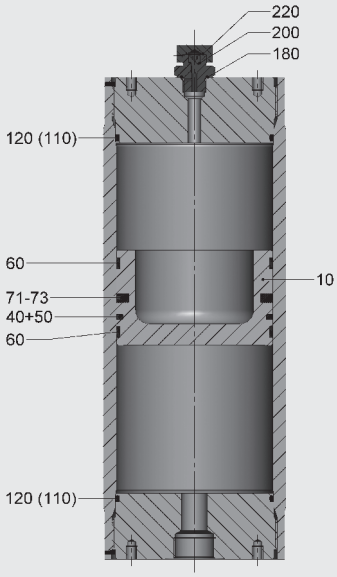
4.2.1 Spare parts

Piston design 1



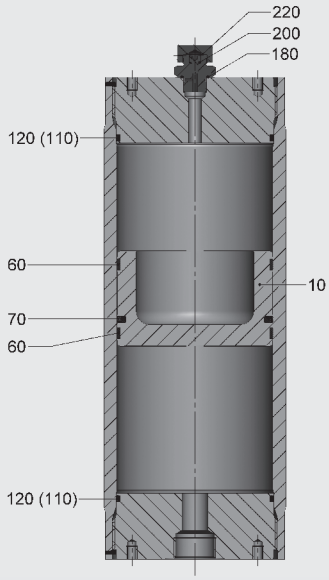
Description	Qty.	Item
Piston assembly [2] consisting of:		
Piston	1	10
Seal ring	1	50
Guide ring	2	60
Centre seal	1	71-73
Seal kit consisting of:		
Seal ring	1	50
Guide ring	2	60
Centre seal	1	71-73
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

Piston design 2



Description	Qty.	Item
Piston assembly [2] consisting of:		
Piston	1	10
Seal ring	1	40+50
Guide ring	2	60
Centre seal	1	71-73
Seal kit consisting of:		
Seal ring	1	40+50
Guide ring	2	60
Centre seal	1	71-73
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

Piston design 3



Description	Qty.	Item
Piston assembly [2] consisting of:		
Piston	1	10
Guide ring [1]	1/2	60
Seal ring	1	70
Seal kit consisting of:		
Guide ring [1]	1/2	60
Seal ring	1	70
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

Pressure-bearing parts cannot be supplied as spares.

(…) for SK690 and standard SK, internal diameters 310 mm and above

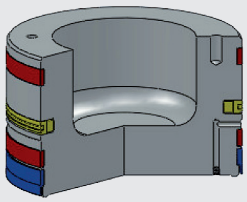
[1] The bottom guide ring for internal diameters 180 mm and above

[2] Items (110), 120, 180, 200 and 220 are enclosed unassembled

Spare parts for piston design 4 are available on request.

4.2.2 Piston and seal kit

Piston design 1



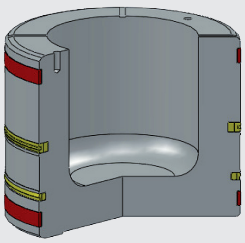
Piston assembly

Piston Ø [mm]	NBR / PTFE Part no.	FKM / PTFE Part no.
60	–	–
80	–	–
100	3128922	3128926
125	–	–
150	–	–
180	3141888	3182493
200	–	–
250	3128924	3128938
310	–	–
355	3128925	3128939
490	–	–

Seal kit

Piston Ø [mm]	NBR / PTFE Part no.	FKM / PTFE Part no.
60	–	–
80	–	–
100	3128940	3128944
125	–	–
150	–	–
180	3128941	3128945
200	–	–
250	3128942	3128946
310	–	–
355	3128943	3128947
490	–	–

Piston design 2



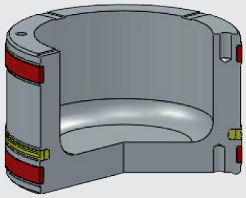
Piston assembly

Piston Ø [mm]	NBR / PTFE Part no.	FKM / PTFE Part no.
60	3183495	–
80	3183496	3183497
100	3175476	3183117
125	3016232	3016253
150	3016228	3016229
180	2118451	2112535
200	3110811	3016215
250	353980	353981
310	3016195	3016197
355	356382	354079
490	3128989	3128990

Seal kit

Piston Ø [mm]	NBR / PTFE Part no.	FKM / PTFE Part no.
60	3090507	–
80	3041573	3015745
100	363268	363269
125	3116665	3016234
150	3016235	3016237
180	363270	363271
200	3110810	3016242
250	363266	363267
310	3016200	3016201
355	363272	363273
490	3104100	3128991

Piston design 3



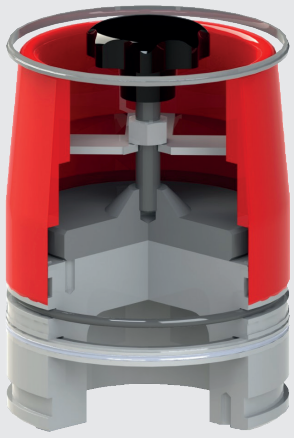
Piston assembly

Piston Ø [mm]	NBR / PUR Part no.
60	3009372
80	2119931
100	2115547
125	3016150
150	3016231
180	3046277
200	3016218
250	3016171
310	–
355	4323005
490	4323006

Seal kit

Piston Ø [mm]	NBR / PUR Part no.
60	3016210
80	3013230
100	2123414
125	2128104
150	3007546
180	2123415
200	3113127
250	3016213
310	4374872
355	3726888
490	3894300

4.2.3 Assembly sleeves



Special assembly sleeves are needed to assemble the piston and seals, see:

- Assembly and repair instructions for piston accumulators No. 3.301.M

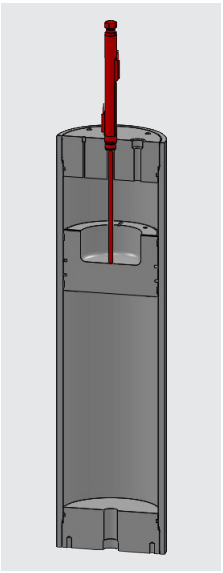
5. ACCESSORIES

5.1. PISTON POSITION INDICATORS

Examples of piston monitoring devices.
Further options for determining the piston position and detailed technical data available on request. See also flyer:

- Monitoring equipment for hydraulic accumulators No. 3.506

5.1.1 Electrical limit switch



What is measured?
Max. or set fill level of the piston accumulator

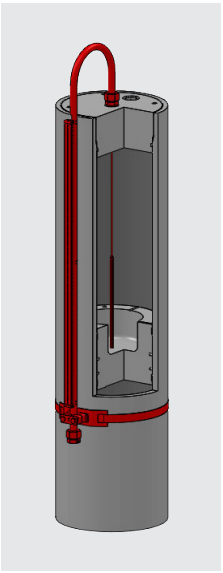
How are measurements taken?
As point measurements

Where to measure?
Gas side

Identification in the model code:
A, B, C, ..., depending on stroke

Product information:
No. 10000769094

5.1.2 Magnetic flap indication



What is measured?
Piston position via a magnet fastened to the cable that moves coloured flaps that can be read from the outside

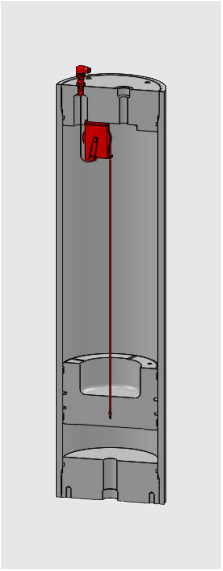
How are measurements taken?
Continuously

Where to measure?
Gas side

Identification in the model code:
M

Product information:
No. 10000769200

5.1.3 Cable tension measurement system



What is measured?
Piston position via a cable fastened to the piston

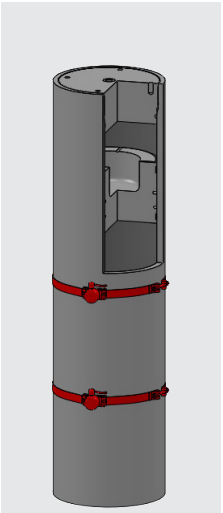
How are measurements taken?
Continuously

Where to measure?
Gas side

Identification in the model code:
S

Product information:
No. 10000641374

5.1.4 Piston position switch



What is measured?
Piston position via ultrasonic measurement

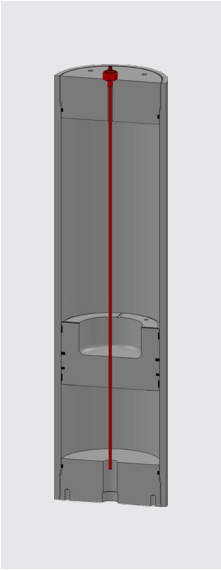
How are measurements taken?
As point measurements

Where to measure?
Fluid side

Identification in the model code:
UP...

Product information:
No. 10000769179

5.1.5 Linear position measurement system



What is measured?

Piston position via elapsed time measurement

How are measurements taken?

Continuously

Where to measure?

Gas side

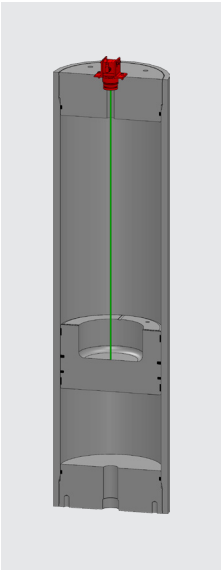
Identification in the model code:

L

Product information:

No. 10000810655

5.1.6 Laser linear position measurement system



What is measured?

Piston position via laser elapsed time measurement

How are measurements taken?

Continuously

Where to measure?

Gas side

Identification in the model code:

LA

Product information:

No. 10000810664

6. 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.

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