HYDAC INTERNATIONAL

Hydraulic dampers

1. DESCRIPTION

1.1. FUNCTION

The pressure fluctuations occurring in hydraulic systems can be cyclical or one-off problems due to:

- flow rate fluctuations from displacement pumps
- actuation of shut-off and control valves with short opening and closing times
- switching on and off of pumps
- sudden linking of spaces with different pressure levels.

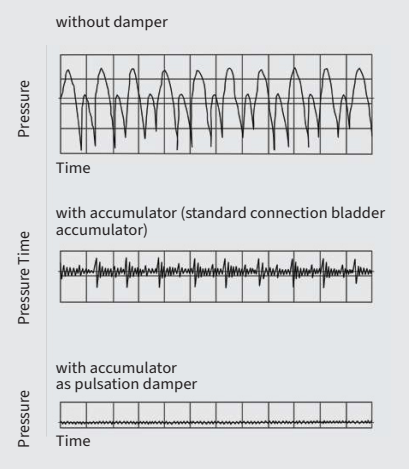
HYDAC hydraulic dampers are particularly suitable for damping such pressure fluctuations.

Selecting the most suitable hydraulic damper for each system ensures that

- vibrations caused by pipes, valves, couplings etc. are minimised and subsequent pipe and valve damage is prevented
- measuring instruments are protected and their performance is no longer impaired
- the noise level in hydraulic systems is reduced
- the performance of machine tools is improved
- interconnection of several pumps in one line is possible
- a pump rpm and feed pressure increase is possible
- the maintenance and servicing costs can be reduced
- the service life of the system is increased.

2. APPLICATION

2.1. PULSATION DAMPING TYPE SB...P / SBO...P



2.1.1 General
The HYDAC pulsation damper

- prevents pipe breaks caused by material fatigue, pipe oscillations and irregular flow rates,
- protects valves, control devices and other instruments,
- improves noise level damping.

2.1.2 Applications
The pulsation damper is particularly suitable for hydraulic systems, displacement pumps, sensitive measurement and control instruments and manifolds, e.g. in process circuits in the chemical industry.

2.1.3 Mode of operation
The pulsation damper generally has two fluid connections and can therefore be fitted directly inline.

The flow is diverted in the fluid valve so that it is directed straight. This causes direct contact of the flow with the bladder or diaphragm which, in an almost inertia-less operation, balances the flow rate fluctuations via the gas volume.

It particularly compensates for higher frequency pressure oscillations. The charge pressure is adjusted to individual operating conditions.

2.1.4 Design
The HYDAC pulsation damper consists of:

- the welded or forged pressure vessel in carbon steel; available with internal coating or in stainless steel for chemically aggressive fluids.
- the special fluid valve with inline connection, which guides the flow into the vessel (threaded or flange connection).
- the bladder or diaphragm in various elastomers as shown under section 4.2.

2.1.5 Installation
As close as possible to the pulsation source. Mounting position preferably vertical (gas valve pointing upwards).

Preferred and alternative installation positions are shown in schematic form in section 3.

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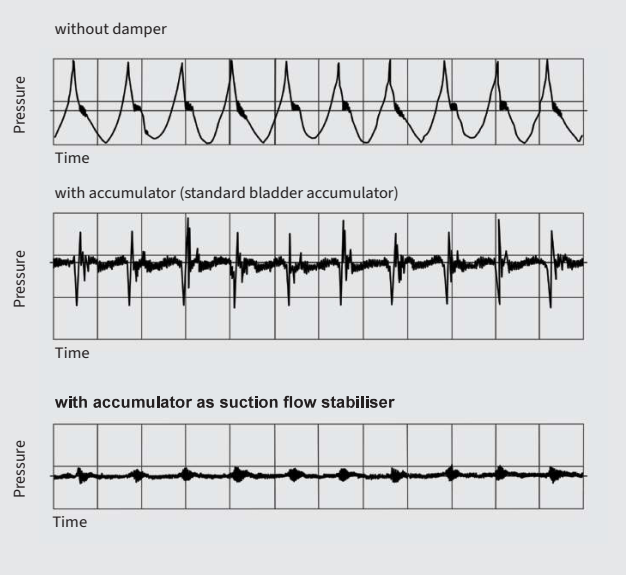
2.2. SUCTION FLOW STABILISER TYPE SB...S



2.2.1 General
The HYDAC suction flow stabiliser

- improves the NPSH value of the system
- prevents cavitation of the pump
- prevents pipe oscillations.

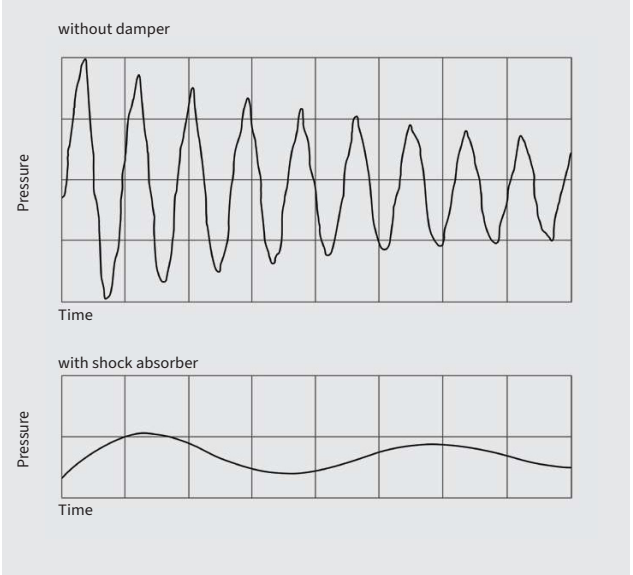
2.2.2 Applications
Main application areas are piston and diaphragm pumps in public utility plants, reactor construction and the chemical industry.

2.2.3 Mode of operation
Trouble-free pump operation is only possible if no cavitation occurs in the pump suction and pipe oscillations are prevented.
A relatively high fluid volume in the suction flow stabiliser in relation to the displacement volume of the pump reduces the acceleration effects of the fluid column in the suction line. Also an air separation is achieved due to the extremely low flow rate in the suction flow stabiliser and the deflection and baffle. Suction flow stabiliser and the deflection and baffle operating conditions, the best possible pulsation damping is achieved.

2.2.4 Design
The HYDAC suction flow stabiliser consists of a welded vessel in steel or stainless steel.
Inlet and outlet are on opposite sides and are separated by a baffle. The upper part houses the encapsulated bladder. In addition, there is an air bleed screw in the cover and a drainage facility on the bottom.

2.2.5 Installation
As close as possible to the suction inlet of the pump. Mounting position vertical (gas valve pointing upwards).

2.3. SHOCK ABSORBER TYPE SB...A



2.3.1 General
The HYDAC shock absorber

- reduces pressure shocks
- protects pipelines and valves from being destroyed.

2.3.2 Applications
The accumulators are particularly suitable for use in pipelines with quick-acting valves or flaps and whilst pumps are being switched on and off.

They are also suitable for energy storage in low pressure applications.

2.3.3 Mode of operation
Sudden changes in pipeline flow, such as those caused by pump failure or the closing or opening of valves, can cause pressures which are many times higher than the normal values.

The shock absorber prevents this by converting potential into kinetic energy and vice versa. This prevents pressure shocks and protects pipelines, valves, monitoring instruments and other pipe fittings from destruction.

2.3.4 Design
The HYDAC shock absorber consists of:

- the welded pressure vessel in carbon steel with or without corrosion protection or in stainless steel.
- the connection including perforated disc which prevents the flexible bladder from extruding from the vessel, and the flange.
- the bladder in various elastomer qualities as shown under section 4.2 with built-in gas valve, which is used for charging pressure p_0 and for possible monitoring activities.

2.3.5 Special version
Shock absorbers can also be in the form of diaphragm or piston accumulators. Available on request.

2.3.6 Installation
As close as possible to the source of the erratic condition.
Mounting position vertical (gas valve pointing upwards).

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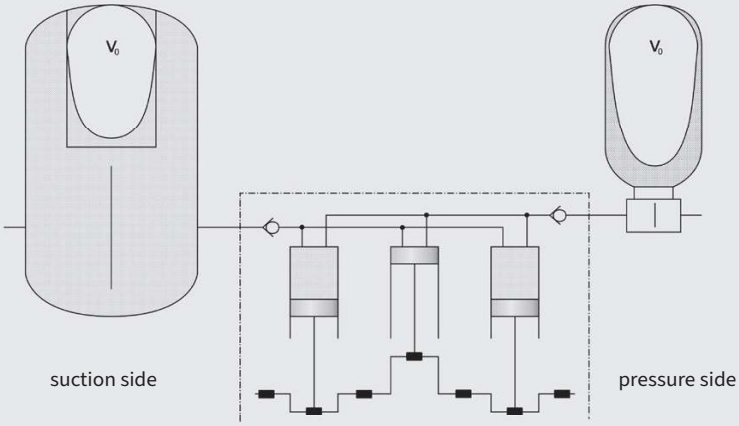
3 SIZING

3.1. PULSATION DAMPER AND SUCTION FLOW STABILISER



On the suction and the pressure side of piston pumps almost identical conditions occur regarding irregularity of the flow rate. Therefore the same formulae for determining the effective gas volume are used for calculating the damper size. That in the end two totally different damper types are used is due to the different acceleration and pressure ratios on the two sides.

Not only is the gas volume V_0 a decisive factor but also the connection size of the pump has to be taken into account when selecting the pulsation damper.
In order to avoid additional variations in cross-section, which represent reflection points for vibrations, and also to keep pressure drop to a reasonable level, the fitting cross-section of the damper must be the same as that of the pipeline.

The gas volume V_0 of the damper is determined with the aid of the formula for adiabatic changes of state.

By giving the residual pulsation or the gas volume, the damper size can be dimensioned with the aid of the HYDAC software ASP (Accumulator Simulation Program).

Designations:

ΔV = fluctuating fluid volume [l]

$\Delta V = m \cdot q$

q = stroke volume [l]

$q = \frac{\pi \cdot d_\kappa^2}{4} \cdot h_\kappa$

d_k = piston diameter [dm]

h_k = piston stroke [dm]

m = amplitude factor

$m = \frac{\Delta V}{q}$

z = no. of compressions/ effective cylinders per revolution

x = residual pulsation [± %]

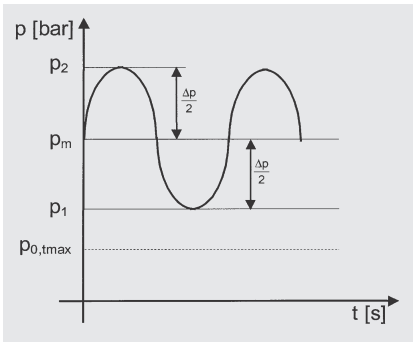
κ = isentropic exponent

Φ = pressure ratio of pre-charge pressure to operating pressure [0.6 ... 0.9]

$\Phi = \frac{p_0}{p_m}$

Δp = cyclic test pressure

$\Delta p = p_2 - p_1$ [bar]



Formulae:

$$V_0 = \frac{\Delta V}{\left[\frac{\Phi}{1-\frac{x}{100}}\right]^{\frac{1}{\kappa}} - \left[\frac{\Phi}{1+\frac{x}{100}}\right]^{\frac{1}{\kappa}}}$$

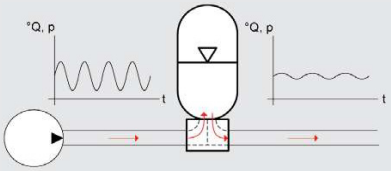
$$\Delta V = m \cdot q$$

$$x\,[\pm\%] = \left|\frac{p_1 - p_m}{p_m} \cdot 100\right|$$

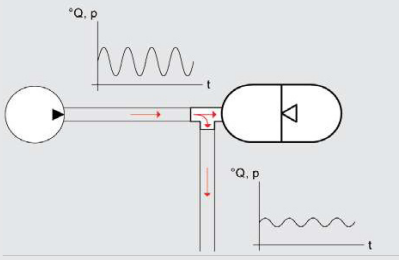
$$= \left|\frac{p_2 - p_m}{p_m} \cdot 100\right|$$

Diagram of mounting options:

Preferred installation configuration with maximum damping effect



Alternative installation configuration using standard accumulator with a T-piece with reduced damping effect



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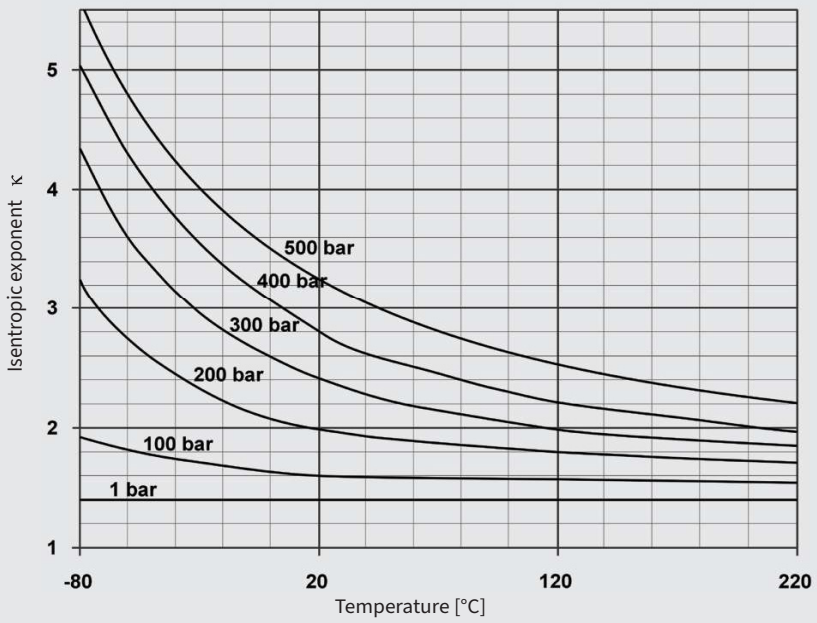
Isentropic exponent dependent on pressure and temperature:



Amplitude factor (m) for piston pump:

z	m value single acting	m value double acting
1	0.548	0.206
2	0.206	0.042
3	0.035	0.018
4	0.042	0.010
5	0.010	0.007
6	0.018	0.005
7	0.005	
8	0.010	
9	0.001	

others on request

3.1.1 Calculation example

Given parameters:

Single-acting 3-piston pump

Piston diameter:	70 mm
Piston stroke:	100 mm
Drive speed:	370 rpm
Flow rate:	427 l/min
Operating temperature:	20 °C
Operating pressure	
– pressure side:	200 bar
– suction side:	4 bar

Required:

a) Suction flow stabiliser for a residual pulsation of ± 2.5%

b) Pulsation damper for a residual pulsation of ± 0.5%

Solution:

a) Determining the required suction flow stabiliser

$$V_0 = \frac{\Delta V}{\left[\frac{\Phi}{1-\frac{x}{100}}\right]^{\frac{1}{\kappa}} - \left[\frac{\Phi}{1+\frac{x}{100}}\right]^{\frac{1}{\kappa}}}$$

$$V_0 = \frac{0.035 \cdot \frac{\pi \cdot 0.7^2}{4} \cdot 1.0}{\left[\frac{0.6}{1-\frac{2.5}{100}}\right]^{\frac{1}{1.4}} - \left[\frac{0.6}{1+\frac{2.5}{100}}\right]^{\frac{1}{1.4}}}$$

$V_0 = 0.54$ l

Selected: SB16S-12 with 1 litre gas volume

b) Determining the required pulsation damper

$$V_0 = \frac{\Delta V}{\left[\frac{\Phi}{1-\frac{x}{100}}\right]^{\frac{1}{\kappa}} - \left[\frac{\Phi}{1+\frac{x}{100}}\right]^{\frac{1}{\kappa}}}$$

$$V_0 = \frac{0.035 \cdot \frac{\pi \cdot 0.7^2}{4} \cdot 1.0}{\left[\frac{0.7}{1-\frac{0.5}{100}}\right]^{\frac{1}{2.0}} - \left[\frac{0.7}{1+\frac{0.5}{100}}\right]^{\frac{1}{2.0}}}$$

$V_0 = 3.2$ l

Selected: SB330P-4

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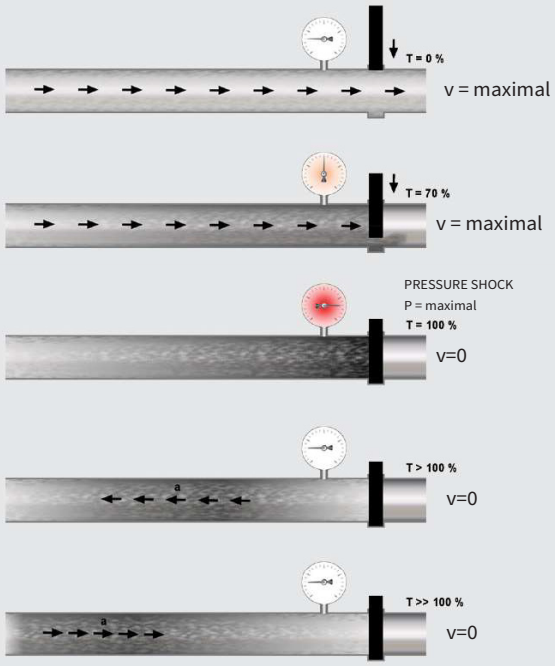
3.2. SHOCK ABSORBER

Pressure shock produced when a valve is closed without a hydraulic accumulator



Simplified pressure shock calculation for the closing of a valve

Estimate of Joukowsky's max. occurring pressure shock

$\Delta p[N/m^2] = \rho \cdot a \cdot \Delta v$

ρ [kg/m³] = fluid density

Δv = $v - v_1$

Δv = change of fluid velocity

v [m/s] = fluid velocity before the change in its condition v

$_1$ [m/s] = fluid velocity after the change in its condition

a [m/s] = propagation velocity of pressure wave

$$a\ [m/s] = \frac{1}{\sqrt{\rho \cdot \left[\frac{1}{K} + \frac{D}{E \cdot e}\right]}}$$

K [N/m²] = compression modulus of the fluid

E [N/m²] = module of elasticity of pipeline

D [mm] = internal diameter of the pipeline e [mm] = wall thickness of the pipeline

The pressure wave runs to the other end of the pipeline and will reach the valve again after time t (reflection time), whereby:

$$t\ [s] = \frac{2 \cdot L}{a}$$

L [m] = length of the pipeline

T [s] = eff. operating time (closing) of the valve

If T < t then:

$p_{max} = p_1 + \Delta p$

If T > t then:

p_{max} $t = p_1 + a\ v\ T$ $\rho \cdot \Delta \cdot$ —

Determining the required damper size

The accumulator must absorb the kinetic energy of the fluid by converting it into potential energy within the pre-determined pressure range. The change of state of the gas is adiabatic in this case.

$$V_0 = \frac{m \cdot v^2 \cdot 0.4}{2 \cdot p_1 \cdot \left[\left[\frac{p_2}{p_1}\right]^{1-\frac{1}{\kappa}} - 1\right] \cdot 10^2} \cdot \left[\frac{p_1}{p_0}\right]^{\frac{1}{\kappa}}$$

m [kg] = weight of the fluid in the pipeline

v [m/s] = change in velocity of the fluid

(p_1 [bar]) = zero head of the pump p

$_2$ [bar] = perm. operating pressure p

$_0$ [bar] = pre-charge pressure

A special calculation program to analyse the pressure curve is available for dimensioning during pump failure or start-up and for manifolds.

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3.2.1 Calculation example Rapid closing of a shut-off valve in a re-fuelling line.

Given parameters:

Length of the pipeline L:
2000 m

Size of pipeline D:
250 mm

Wall thickness of pipeline e:
6.3 mm

Material of pipeline:
Steel

Flow rate Q:
432 $m^3/h = 0.12\ m^3/s$

Density of medium ρ:
980 kg/m^3

Zero feed height of pump p_1: 6 bar

Min. operating pressure p_{min}:
4 bar

Eff. closing time of the valve T:
1.5 s
(approx. 20% of total closing time)

Operating temperature:
20 °C

Compression modulus of the fluid K:
$1.62 \times 10^9\ N/m^2$

Module of elasticity (steel) E:
$2.04 \times 10^{11}\ N/m^2$

Required:

Size of the required shock absorber, when the max. pressure (p_2) must not exceed 10 bar.

Solution:

Determination of reflection time:

$$a = \frac{1}{\sqrt{\rho \cdot \left[\frac{1}{K} + \frac{D}{E \cdot e}\right]}}$$

$$a = \frac{1}{\sqrt{980 \cdot \left[\frac{1}{1.62 \cdot 10^9} + \frac{250}{2.04 \cdot 10^{11} \cdot 6.3}\right]}}$$

$$a = 1120\ m/s$$

$$t = \frac{2 \cdot L}{a} = \frac{2 \cdot 2000}{1120} = 3.575\ s\ *$$

* since T < t the max. pressure surge occurs and the formula as shown in section 3.2. must be used.

$$v = \frac{Q}{A}$$

$$v = \frac{0.12}{0.25^2 \cdot \pi/4} = 2.45\ m/s$$

$$\Delta_p = \rho \cdot a \cdot \Delta v$$

$$\Delta_p = 980 \cdot 1120 \cdot (2.45\text{-}0) \cdot 10^{-5}$$

$$= 26.89\ bar$$

$$p_{max} = p_1 + \Delta_p$$

$$p_{max} = 6 + 26.89 = 32.89\ bar$$

Determining the required gas volume:

$$p_0 \leq 0.9 \cdot p_{min}$$

$$p_0 \leq 0.9 \cdot 5 = 4.5\ bar$$

$$V_0 = \frac{m \cdot v^2 \cdot 0.4}{2 \cdot p_1 \cdot \left[\left[\frac{p_2}{p_1}\right]^{1-\frac{1}{\kappa}} - 1\right] \cdot 10^2} \cdot \left[\frac{p_1}{p_0}\right]^{\frac{1}{\kappa}}$$

with $m = V \cdot \rho = \frac{\pi}{4} \cdot D^2 \cdot L \cdot \rho$

$$V_0 = \frac{\frac{\pi}{4} \cdot 0.25^2 \cdot 2000 \cdot 980 \cdot 2.45^2 \cdot 0.4}{2 \cdot 7 \cdot \left[\left[\frac{11}{7}\right]^{1-\frac{1}{1.4}} - 1\right] \cdot 10^2} \cdot \left[\frac{7}{4.5}\right]^{\frac{1}{1.4}}$$

$$V_0 = 1641\ l$$

Selected:

4 x shock absorbers
SB35AH-450

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4. SPECIFICATIONS

4.1. EXPLANATIONS, NOTES

4.1.1 Operating pressure see tables (may differ from nominal pressure for foreign test certificates).

4.1.2 Nominal volume see tables

4.1.3 Effective gas volume
see tables, based on nominal dimensions. This differs slightly from the nominal volume and must be used when calculating the effective fluid volume.

For diaphragm accumulators, the effective gas volume corresponds to the nominal volume.

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

4.1.5 Permitted operating temperatures
-10 °C ... +80 °C

standard design, others on request

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

In principle, only use nitrogen of at least Class 4.0 (filtration <3 µm).
If other gases are to be used, please contact HYDAC for advice.

When supplied, the accumulator is only pre-charged for storage purposes. Higher pre-charge pressures are possible by arrangement.

4.1.7 Permitted pressure ratio
Ratio of maximum operating pressure p_2 to gas pre-charge pressure p_0. See catalogue section:

- HYDAC Accumulator Technology No. 3.000

4.1.8 General safety instructions
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 dampers (repairs, connecting pressure gauges etc.) must only be carried out once the fluid pressure and the gas pre-charge pressure have been released.

The operating instructions must be observed!

- Bladder Accumulators No. 3.201.BA
- Diaphragm Accumulators No. 3.100.BA
- Piston Accumulators No. 3.301.BA

4.1.9 Working temperature and operating medium
The permitted working temperature of a hydraulic damper is dependent on the application limits of the metal materials and the separation element. Outside this temperature range, special materials must be used. The operating medium must also be taken into account.
The following table displays a selection of elastomer materials including max. temperature range and a rough overview of resistant and non-resistant fluids. Please contact us for help in selecting a suitable elastomer.

Materials		Materialcode	Accumulatortype [1]	Temperature range	Overview of the fluids [2]	
					Resistant to	Not resistant to
NBR	Acrylonitrile butadiene rubber	2	SB, SBO	-15 °C ... + 80 °C	● Mineral oil (HL, HLP) ● Flame-resistant fluids from the HFA, HFB, HFC Synthetic ● ester (HEES) Water ● ● Sea water	● Aromatic hydrocarbons ● Chlorinated hydrocarbons (HFD-S) ● Amines and ketones ● Hydraulic fluids from the group HFD-R ● Fuels
		5	SB, SBO	-50 °C ... + 50 °C		
		9	SB, SBO	-30 °C ... + 80 °C		
ECO	Ethylene oxide epichlorohydrin rubber	3	SB	-30 °C ... +120 °C	● Mineral oil (HL, HLP) ● Flame-resistant fluids from the group HFB Synthetic ● ester (HEES) Water ● ● Sea water	● Aromatic hydrocarbons ● Chlorinated hydrocarbons (HFD-S) Amines and ● ketones ● Hydraulic fluids from the group HFD-R ● Flame-resistant fluids from the groups HFA and HFC ● Fuels
			SBO	-40 °C ... +120 °C		
IIR	Butyl rubber	4	SB	-50 °C ... +100 °C	● Hydraulic fluids from the group HFD-R ● Flame-resistant fluids from the group HFC ● Water	● Mineral oils and mineral greases ● Synthetic ester (HEES) Aliphatic, ● chlorinated and aromatic hydrocarbons Fuels ●
			SBO	-50 °C ... +120 °C		
FKM	Fluorine rubber	6	SB, SBO	-10 °C ... +150 °C	● Mineral oil (HL, HLP) ● Hydraulic fluids from the group HFD ● Synthetic ester (HEES) ● Fuels ● Aromatic hydrocarbons ● Inorganic acids	● Amines and ketones ● Ammonia Skydrol and ● HyJet IV Steam ●

[1] see section 4.2. Model code, material code, accumulator bladder/diaphragm

[2] others available on request

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4.2. MODEL CODE

Pulsation damper, suction flow stabiliser, shock absorber
Not all combinations are possible.
Order example. For further information, please contact HYDAC.

SB330 P – 10 A 1 / 112 U – 330 Al

Series
SB... = with bladder
SBO... = with diaphragm

Type code
A = shock absorber
AH = high flow shock absorber
P = pulsation damper
PH = high flow pulsation damper
S = suction flow stabiliser

Nominal volume [l]

Fluid connection
A = threaded connection
E = threaded connection for weld type construction (diaphragm accumulators only)
F = flange [1]

Type code
1 = standard model (not for screw type diaphragm accumulators or shock absorbers)
2 = back-up type [2]
6 = standard model for screw type diaphragm accumulators type SBO...P-...A6
7 = M28x1.5 gas valve screwed in (only for SB16/35)

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

Fluid connection
1 = carbon steel
2 = high tensile steel
3 = stainless steel [3]
4 = chemically nickel-plated (internal coating) [2]
5 = low temperature steel
6 = other materials

Accumulator shell
0 = plastic (internal coating) [2]
1 = carbon steel
2 = chemically nickel-plated (internal coating) [2]
4 = stainless steel [2] [3]
6 = low temperature steel
7 = other materials

Accumulator bladder [4] / diaphragm
2 = NBR [5]
3 = ECO
4 = IIR
5 = NBR [5]
6 = FKM
7 = other materials (e.g. PTFE, EPDM, ...)
9 = NBR [5]

Certification code
U = European Pressure Equipment Directive (PED)

Permitted operating pressure [bar]

Connection
Al = ISO 228 (BSP), standard connection
Bl = DIN 13 to ISO 965/1 (metric) [1]
Cl = ANSI B1.1 (UNF thread, sealing to SAE standard) [1]
Dl = ANSI B1.20 (NPT thread) [1]
SBO250P-0,075E1 and for SBO210P-0,16E1:
AK = ISO 228 (BSP), standard connection

[1] specify full details of version
[2] [3] not available for all versions dependent
[4] [5] on type and pressure level
when ordering a replacement bladder, state diameter of smallest shell port
observe temperate ranges, see section 4.1.9

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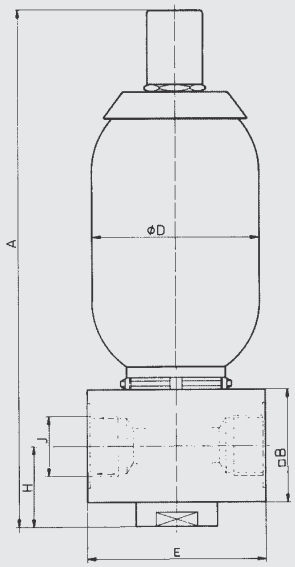
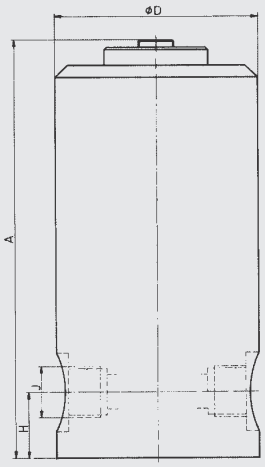
4.3. DIMENSIONS AND SPARE PARTS

4.3.1 Pulsation dampers bladder accumulator

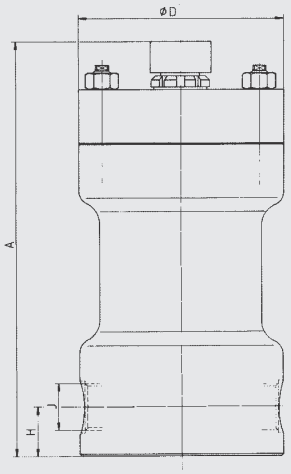
SB330/550P(PH)-...



SB800P-...



SB1000P-...



Dimensions SB

Nominal volume [l]	Series	Max. operating pressure (PED) [bar]	Part no. Carbon steel	Part no. Stainless steel	Eff. Gas volume [l]	A [mm]	□ B [mm]	ØD [mm]	E [mm]	H [mm]	J 2) Thread ISO 228	Weight [kg]
1	SB330P	330	296114	3123952	1	365	80	118	120	57	G 1 1/4	11
	SB550P	550	3435597	3132888		384	70	121		53		13
1.5	SB800P	800 3)	–	–	1.3	346	–	160	–	55		36
	SB1000P	1000 3)	–	–		414	–	215	–	49	1)	94
2.5	SB330P	330	3078967	3108889	2.4	570	80 118			57	G 1 1/4	16
	SB550P	550	3576155	3096755	2.5	589	70	121	120	53		20
4	SB330P	330	3121155	3112225	3.7	455	80	171		57		18
	SB330PH		–	–		491	100		150	85	G 1 1/2	26
5	SB550P	550	4313259	3136856	4.9	917	70	121	120	53	G 1 1/4	26
6	SB330P	330	3140558	3251391	5.7	559	80	171		57		20
	SB330PH		–	–		593	100		150	85	G 1 1/2	28
10	SB330P		3082257	3114689	9.3	620		229				40
	SB330PH		–	–		652	130x140			100	SAE 2" - 6000 psi	50
13	SB330P	330	2107871	–	12	712				85	G 1 1/2	48
20	SB330P		3084825		100 920– 18.4							70
	SB330PH		–	–		952	130x140			100	SAE 2" - 6000 psi	80
24	SB330P	330	3152980	23.6 986–			100			85	G 1 1/2	82
32	SB330P		3121154	–	33.9	1445						100
	SB330PH		–	–		1475	130x140			100	SAE 2" - 6000 psi	110

1) M56x4, high pressure connection DN 16, others on request
2) standard connection code = AI, others on request
3) special design, on request

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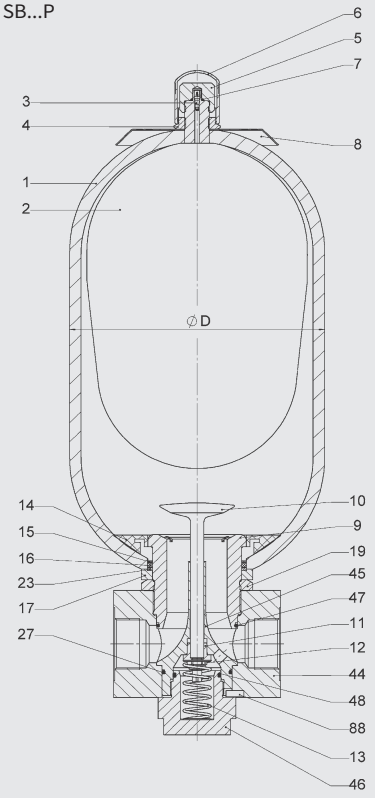
Spare parts

SB...P



Description	Item
Bladder assembly consisting of:	
Bladder	2
Gas valve insert*	3
Retaining nut	4
Seal cap	5
Protective cap	6
O-ring	7
Seal kit consisting of:	
O-ring	7
Washer	15
O-ring	16
Support ring	23
O-ring	27
O-ring	47
O-ring	48

* available separately
Accumulator shell (item 1) and company label (item 8) not available as a spare part

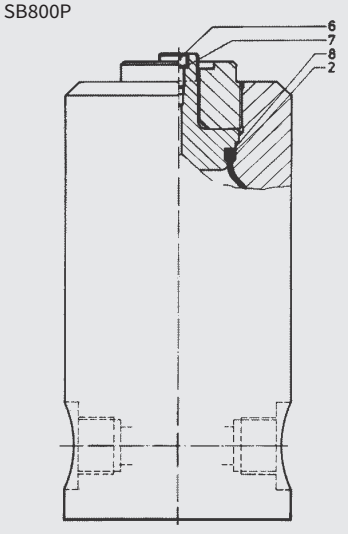
Description Connection assembly consisting of:	Item
Oil valve body	9
Valve plate	10
Damping bush	11
Lock nut	12
Spring	13
Anti-extrusion ring*	14
Washer	15
O-ring	16
Spacer	17
Lock nut	19
Support ring (only for 330 bar)	23
O-ring	27
Connector	44
Guide piece	45
Cap	46
O-ring	47
O-ring	48
Locking key	88

* available separately

NBR, carbon steel
Standard gas valve

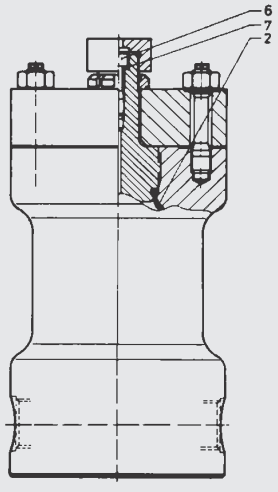
Volume [l]	Bladder assembly	Seal kit	
		SB330P/SB400P	SB550P
1	237624	357055	2106402
2.5	236171		
4	236046		
5	240917		
6	2112097		
10	236088	357058	357061
13	376249		
20	236089		
24	376253		
32	235335		

SB800P



Description	Item
Bladder	2
Charging screw	6
Seal ring U 9.3x13.3x1	7
Support ring	8

SB1000P



Description	Item
Bladder	2
Charging screw	6
Seal ring	7

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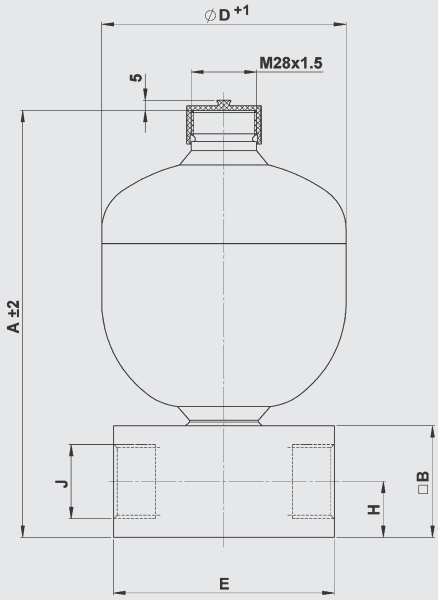
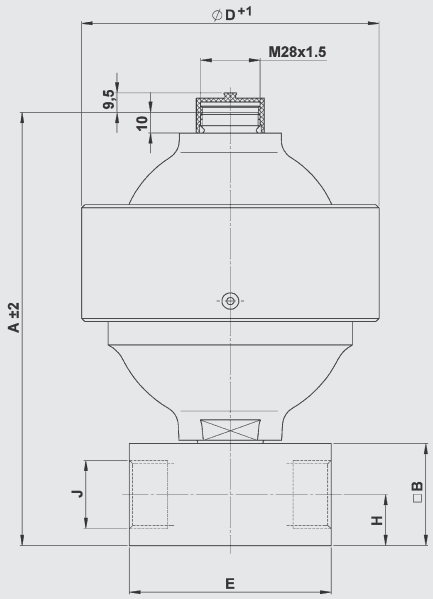
4.3.2 Pulsation dampers diaphragm accumulator

SBO...P...E (welded)



SBO...P...A6 (screwed)



Dimensions SBO

Nominal volume [l]	Series and connection type 1)	Max. operating pressure (PED) Carbon steel [bar]	Max. operating pressure (PED) Stainless steel [bar]	A [mm]	□ B [mm]	ØD [mm]	E [mm]	H [mm]	J Thread ISO 228	Weight [kg]
0.075	SBO250P-...E1...AK	250	–	131	–	64	hex. 41	13	G 1/4	0.9
0.16	SBO210P-...E1...AK	210	180	143	–	74				1
0.32	SBO210P-...E1...Al		160	175	50	93	80	25	G 1/2	2.6
0.5			–	192		105				3
0.6	SBO330P-...E1...Al	330	–	222	60	115	105	30	G1	5.6
0.75	SBO210P-...E1...Al	210	140	217		121				5.1
1	SBO200P-...E1...Al	200	–	231		136				6
1.4	SBO140P-...E1...Al	140	–	244		145				6.2
	SBO210P-...E1...Al	210	–	250		150				7.7
	SBO250P-...E1...Al	250	–	255		153				8.2
2	SBO100P-...E1...Al	100	100	261		160				6.3
	SBO210P-...E1...Al	210	–	267		167				8.9
3.5	SBO250P-...E1...Al	250	–	377		170				13.5
4	SBO50P-...E1...Al	–	50	368		158				7.9
	SBO250P-...E1...Al		180	377		170				13.5
0.25	SBO500P-...A6...Al	500	350	162	50	115 (125)	80	25	G 1/2	5.2 (6.3)
0.6	SBO450P-...A6...Al	450	250	202	60	140 (142)	95		G1	8.9 (9.1)
1.3	SBO400P-...A6...Al	400	–	267		199	105	30		13.8
2	SBO250P-...A6...Al	250	180	285		201				15.6
2.8	SBO400P-...A6...Al	400	–	308		252				24.6
4			–	325		287				36.6

1) standard connection code = AK or Al, others on request
( ) brackets indicate different dimensions for stainless steel version

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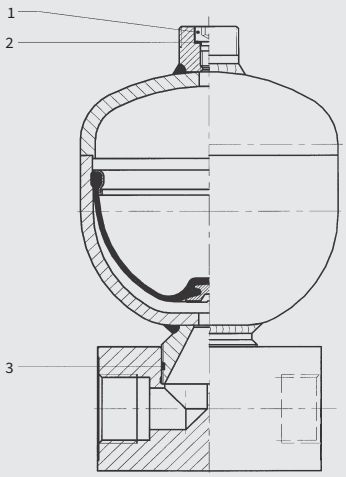
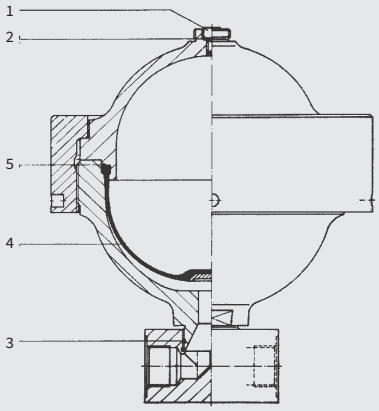
Spare Parts

SBO...P...E



Descriptions	Item
Charging screw	1
Seal ring	2
Seal ring	3

SBO...P...A6



Descriptions	Item
Charging screw	1
Seal ring	2
Seal ring	3
Diaphragm	4
Support ring	5

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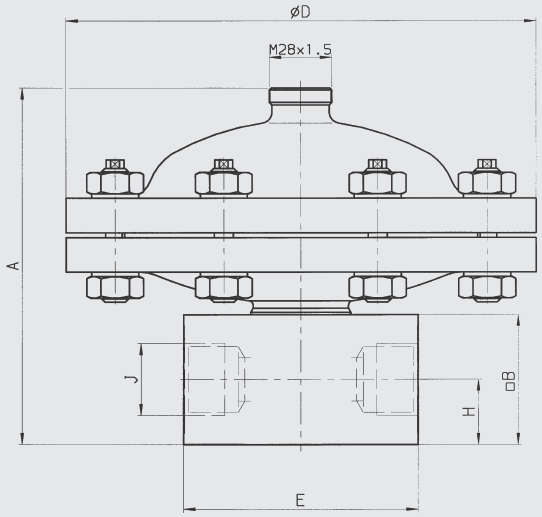
4.3.3 Pulsation damper for aggressive media

SBO...P-...A6/347...(PTFE)



Pulsation damper in stainless steel with PTFE-coated diaphragm. Also available without connection block.

Permitted operating temperature:
-15 °C ... +80 °C

Permitted pressure ratio $p_2 : p_0 = 2 : 1$

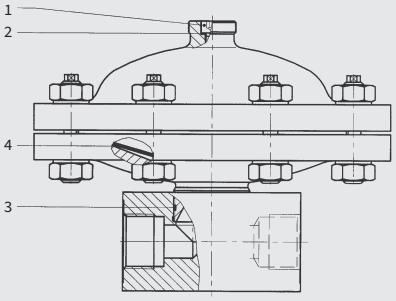
Dimensions

Nominal volume [l]	Max. operating pressure (PED) [bar]	Part no.	A [mm]	□ B ØD [mm] [mm]	E [mm]	H [mm]	J [1] Thread ISO 228	Weight [kg]
0.2	40	4328332 197	140	60	210	105	30	G1	11
	250	4328333			230				27
0.5	40	3091224	165		210				12
	250	3091221	200		230				26

[1] Standard connection code = AI, others on request

Spare Parts

SBO...P-...A6/347...(PTFE)



Description	Item
Charging screw	1
Seal ring	2
Seal ring	3
Diaphragm	4

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SBO...(P)-...A4/777... (PVDF/PTFE)

Figure 1

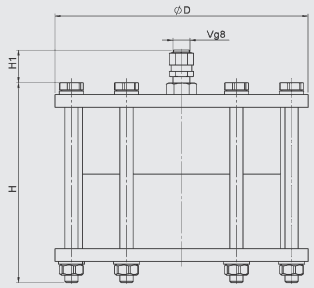
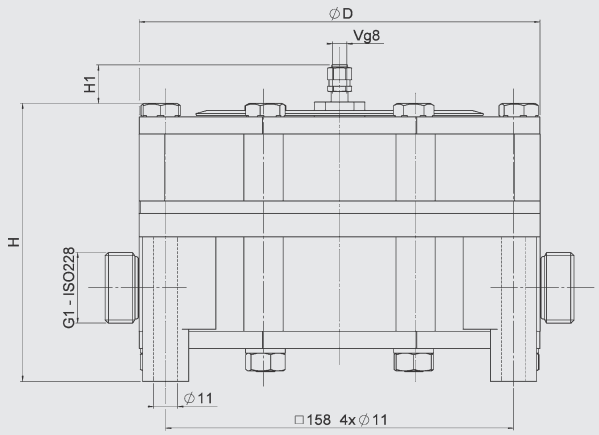


Figure 2

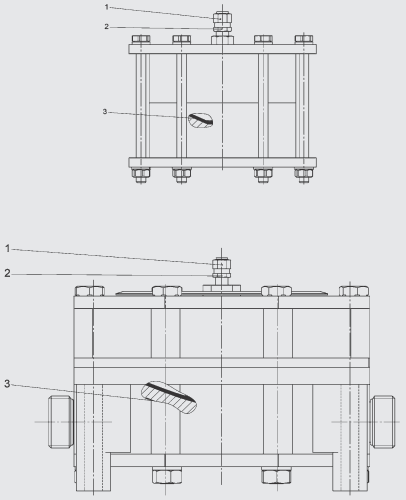


Pulsation damper in PVDF with PTFE-coated diaphragm.
Permitted operating temperature:
-10 °C ... +65 °C
Permitted pressure ratio p_2 : p_0 = 2 : 1
Dimensions

Nominal volume [l]	Max. operating pressure (PED) [bar]	Part no.	ØD [mm]	H [mm]	H1 [mm]	Weight [kg]	Figure
0.08	12	3655864	115	94	15	1.5	1
0.2	10	–	182	128	20	5.7	2
	16	–		130	18	6.4	
	25	3357658					
0.5	10	–		168	20	6	
	16	–		170	19	6.8	
	25	3357657					

Spare parts

SBO...(P)-...A4/777... (PVDF/PTFE)



Descriptions Item Gas valve assembly 1 Gas valve insert brass / stainless steel 2 Diaphragm 3

Relevant operating instruction is available on request.

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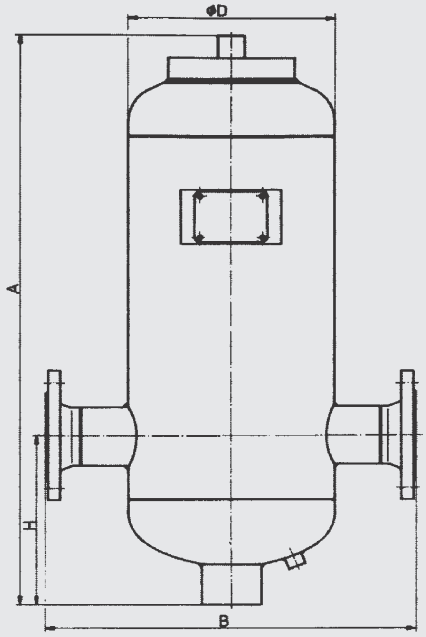
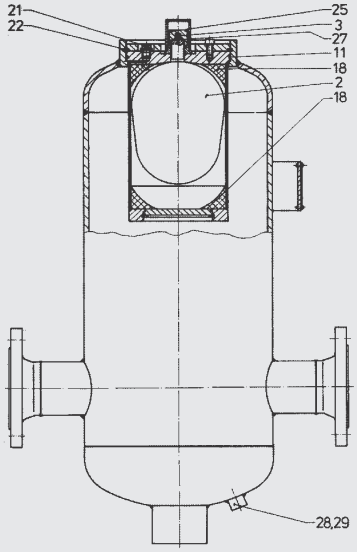
4.3.4 Suction flow stabiliser

SB16S



Spare parts



Dimensions

SB16S – permitted operating pressure 16 bar (PED)

Nominal volume [l]	Fluid volume [l]	Eff. gas volume [l]	A [mm]	B [mm]	ØD [mm]	H [mm]	DN*	Weight [kg]
12	12	1	580	425	219	220	65	40
25	25	2.5	1025					60
40	40	4	890	540	300	250	80	85
100	100	10	1150	650	406	350	100	140
400	400	35	2050	870	559	400	125	380

further pressure ranges 25 bar, 40 bar; others on request
other fluid volumes on request

* to EN1092-1/11 /B1/PN16

Description	Item
Bladder	2
Gas valve insert	3
O-ring	11
Insertion ring, 2x	18
Screw plug	21
Retainer ring	22
Cap nut	25
O-ring	27
Seal ring	28
Screw plug	29

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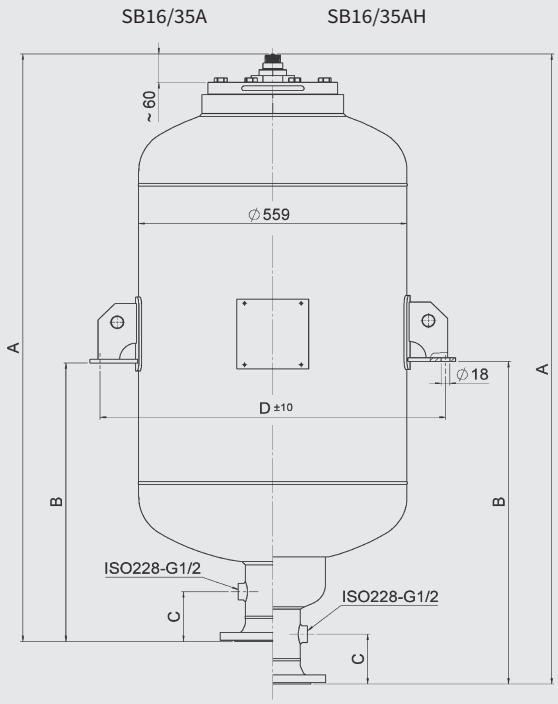
4.3.5 Shock absorber



Dimensions

SB16/35A

perm. operating pressure 16/35 bar (PED)

Nominal volume [l]	Eff. gas volume [l]	SB16A Part no. Carbon steel	Stainless steel	A [mm]	B (approx.) [mm]	C (approx.) [mm]	D ±10 [mm]	Weight Carbon [kg]	SB35A Part no. steel	Stainless steel	A (approx.) [mm]	B (approx.) [mm]	C (approx.) [mm]	D ±10 [mm]	Weight [kg]
150	149	4108288	4108241	1044				127	4108339	4108306	1076	578			171
200	203	4108290	4093557	1275	691			149	4108341	4108307	1318	699			208
300	288	4108291	4108242	1644	920	108	720	178	4108342	4108308	1701	937	121	728	261
375	374	4108292	4108243	2020	1063			214	4108355	4108312	2086	1083			315
450	453	4108294	4108244	2361	1234			244	4108357	4108314	2436	1258			364

Flange to EN1092-1/11 / DN100 / PN16 or PN40
others on request

SB16/35AH

perm. operating pressure 16/35 bar (PED)

Nominal volume [l]	Eff. gas volume [l]	SB16AH Part no. Carbon steel	Stainless steel	A (approx.) [mm]	B (approx.) [mm]	C (approx.) [mm]	D ±10 [mm]	Weight [kg]	SB35AH Part no. Carbon steel	Stainless steel	A (approx.) [mm]	B (approx.) [mm]	C (approx.) [mm]	D ±10 [mm]	Weight [kg]
150	149	4108720	4108702	1135	638				4108773	1166		641			180
200	203	4108721	4108703	1366	754			157	4108775	4108730	1408	762			217
300	288	4108724	4108715	1735	988	108	720	186	4108774	4108734	1791	1000	121	728	270
375	374	4108725	4108717	2111	1127			222	4108776	4108758	2176	1146			324
450	453	4108726	4108718	2452	1298			252	4108778	4108762	2526	1321			373

Flange to EN1092-1/11 / DN100 / PN16 or PN40
others on request

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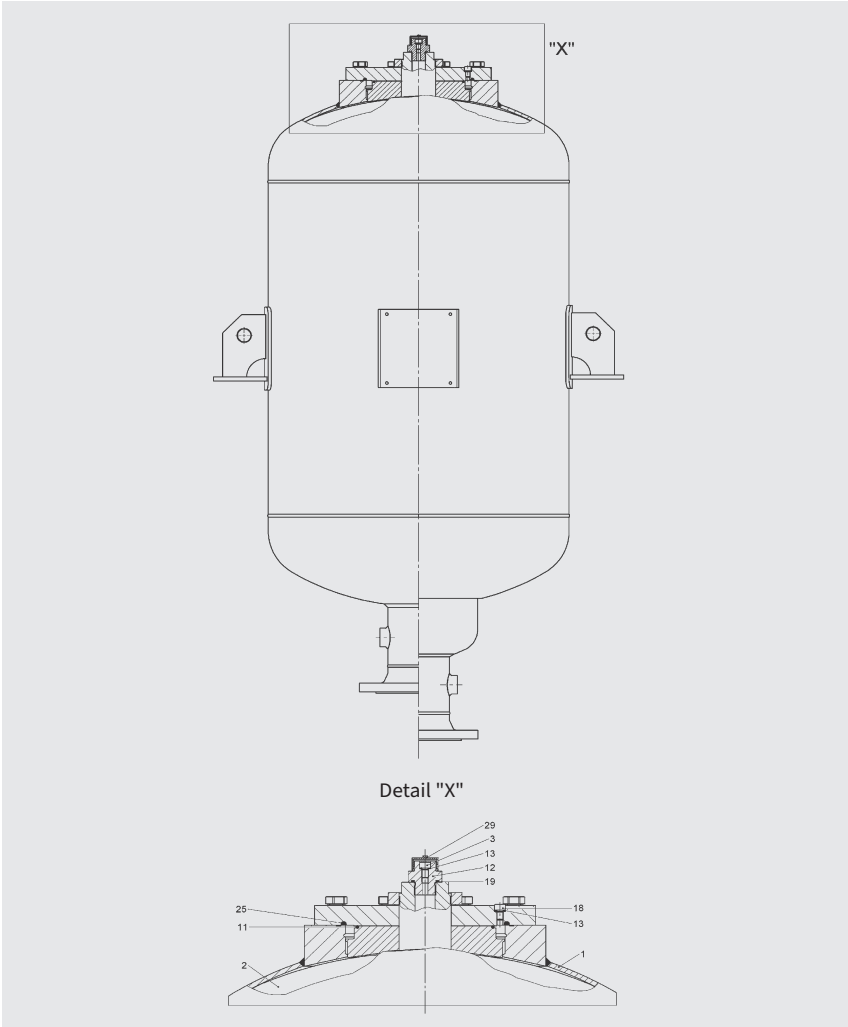
Spare parts

SB16/35A, SB16/35AH

The following spare parts relate exclusively to hydraulic accumulators from construction year 2016 and later.
For low-pressure accumulators of series SB16/35A and SB16/35AH up to construction year 2015 spare parts are available on request.



Description	Item
Bladder	2
Gas valve assembly consisting of:	
Screw plug	3
Gas valve body	12
Seal ring	13
O-ring	19
Protective cap	29
Seal kit consisting of:	
O-ring	11
Seal ring	13
Vent screw	18
O-ring	19
O-ring	25

Accumulator shell (item 1) not available as a spare part

NBR

Nominal B volume [l]	adder	Seal kit	
		Carbon steel	Stainless steel
150	4241264	4241465	4197141
200	4241263		
300	4113771		
375	4113731		
450	4241435		

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