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.

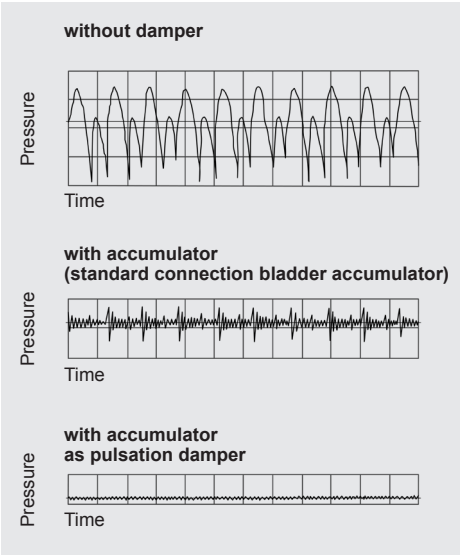
HYDAC hydraulic dampers are particularly suitable for damping such pressure fluctuations.

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 at the bladder or diaphragm. 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 pre-charge pressure is adjusted to individual operating conditions.

2.1.4 Design

The HYDAC pulsation damper consists of:

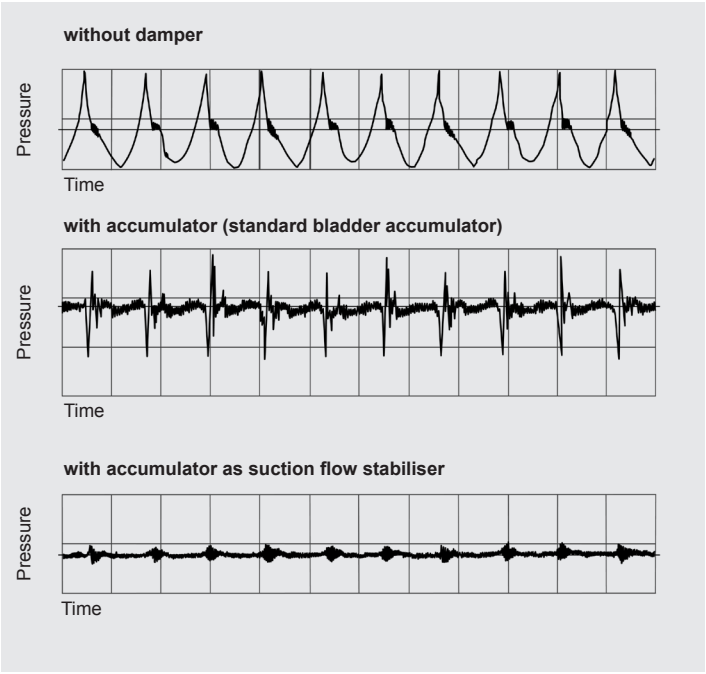
- the welded or forged pressure vessel in carbon steel; available with internal coating or in stainless steel for chemically aggressive fluids;
- the special fluid valve with inline connection, which guides the flow into the vessel. (threaded or flange connection).
- the bladder or diaphragm in various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

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 on a baffle. By adjusting the charging pressure of the bladder to the operating conditions, the best possible pulsation damping is achieved.

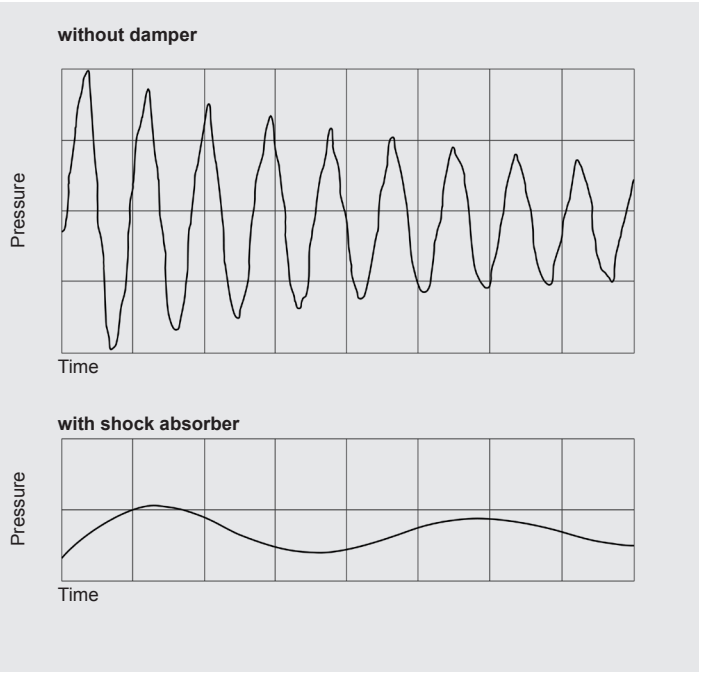
2.2.4 Design

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

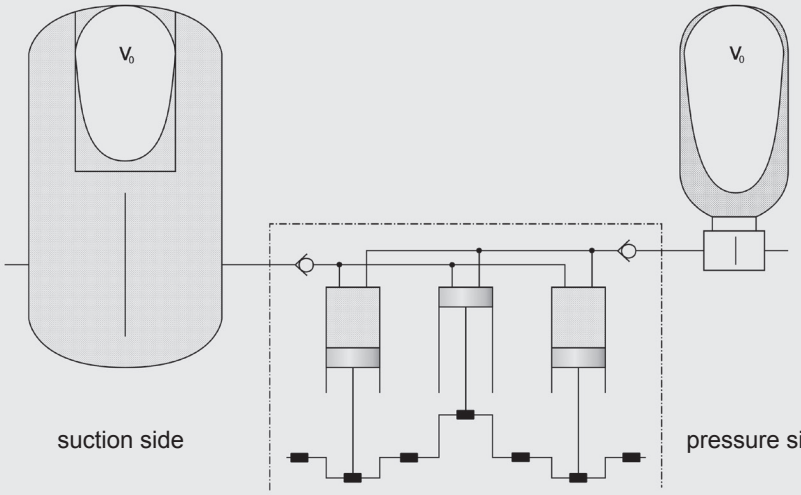
Shock absorbers can also be in the form of diaphragm or piston accumulators. Available on request.

2.3.6 Installation

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

3 SIZING

3.1. PULSATION DAMPER AND SUCTION FLOW STABILISER



On the suction and 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** (**A**ccumulator **S**imulation **P**rogram).

Designations:

ΔV = fluctuating fluid volume [l]
$\Delta V = m \bullet q$

q = stroke volume [l]
$$q = \frac{\pi \bullet d_\kappa^{\,2}}{4} \bullet h_\kappa$$

d_k = piston diameter [dm]

h_k = piston stroke [dm]

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

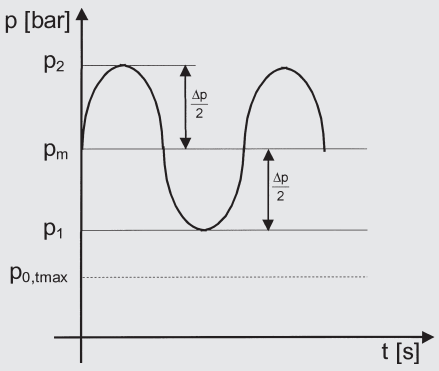
z = no. of compressions / effective cylinders per revolution

x = residual pulsation [± %]

κ = isentropic exponent

Φ = pressure ratio of pre-charge pressure to operating pressure [0.6 to 0.9]
$$\Phi = \frac{p_0}{p_m}$$

Δp = cyclic test pressure
$\Delta p = p_2 - p_1$ [bar]



Formulae:

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

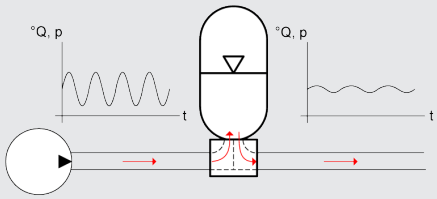
$$\Delta V = m \bullet q$$

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

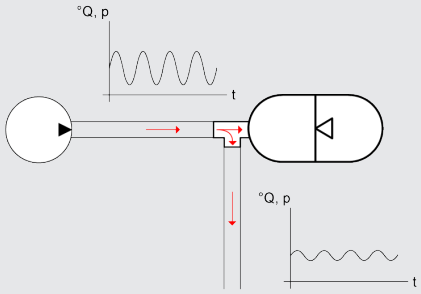
$$= \left|\frac{p_2 - p_m}{p_m} \bullet 100\right|$$

Diagram of mounting options:

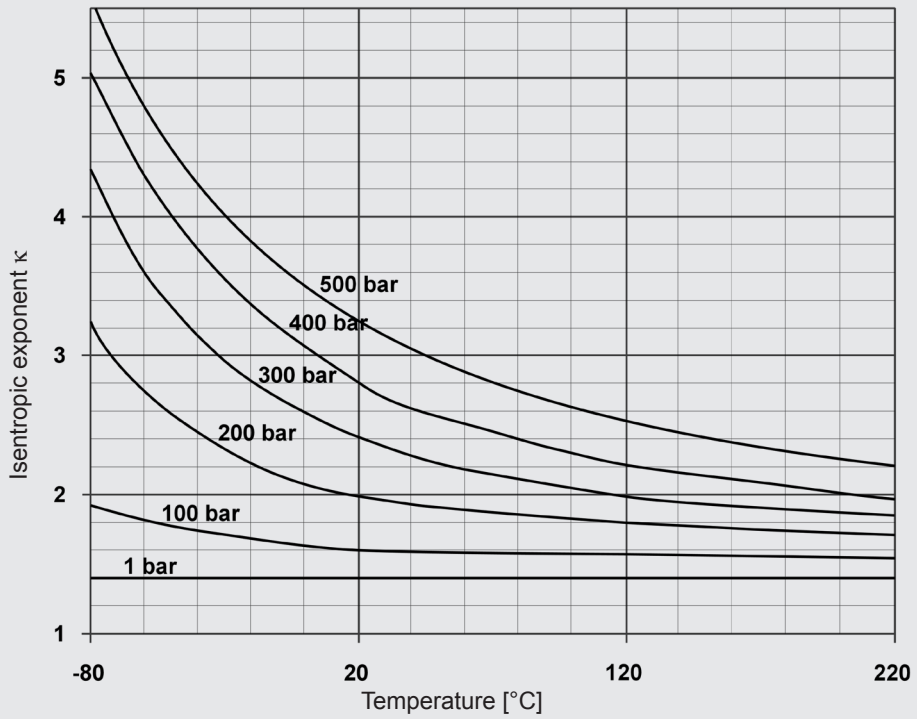
Preferred installation configuration with maximum damping effect



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



Isentropic exponent κ dependent on pressure and temperature:



Amplitude factor (m) for piston pump:

	m value	
z	single acting	double acting
1	0.550	0.250
2	0.210	0.120
3	0.035	0.018
4	0.042	0.010
5	0.010	0.006
6	0.018	0.001
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

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

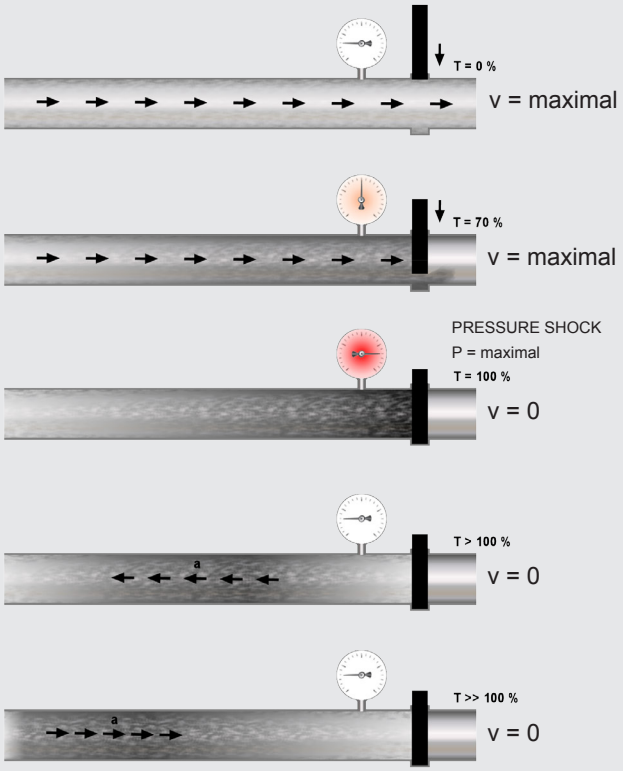
$$V_0 = \frac{0{,}035 \cdot \frac{\pi \cdot 0{,}7^2}{4} \cdot 1{,}0}{\left[\frac{0{,}7}{1-\frac{0{,}5}{100}}\right]^{\frac{1}{2{,}0}} - \left[\frac{0{,}7}{1+\frac{0{,}5}{100}}\right]^{\frac{1}{2{,}0}}}$$

V_0 = 3.2 l

Selected: SB330P-4

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

Δp[N/m²] = $\rho \cdot a \cdot \Delta v$
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

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

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:

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

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.

$$V_0 = \frac{m \cdot \Delta v^2 \cdot 0{,}4}{2 \cdot p_1 \cdot \left[\left[\frac{p_2}{p_1}\right]^{1-\frac{1}{\kappa}} - 1\right] \cdot 10^2} \cdot \left[\frac{p_1}{p_0}\right]^{\frac{1}{\kappa}}$$

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.

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 m³/h = 0.12 m³/s

Density of medium ρ:
980 kg/m³

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:
1.62×10^9 N/m²

Module of elasticity (steel) E:
2.04×10^{11} N/m²

Required:

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

Solution:

Determination of reflection time:

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

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

$$a = 1120 \text{ m/s}$$

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

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

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

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

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

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

$$= 26.89 \text{ bar}$$

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

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

Determining the required gas volume:

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

$$p_0 \leq 0.9 \cdot 5 = 4.5 \text{ bar}$$

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

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

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

$$V_0 = 1641 \text{ l}$$

Selected:

4 x shock absorbers
SB35AH-450

4. TECHNICAL 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 Gas charge
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.

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

4.1.6 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

4.1.7 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.

Please read the operating instructions!

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

4.1.8 Working temperature and operating fluid
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 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]	Accumulator type	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-retardant 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	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 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
			SBO	-40 °C ... +120 °C		
IIR	Butyl rubber	4	SB	-50 °C ... +100 °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
			SBO	-50 °C ... +120 °C		
FKM	Fluorine rubber	6	SB, SBO	-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 4.2. Model code, material code, accumulator bladder/diaphragm

[2] others available on request

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 AI

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

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]
6 = low temperature steel
7 = 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, ...)

Certification code
U = European Pressure Equipment Directive (PED)

Permitted operating pressure [bar]

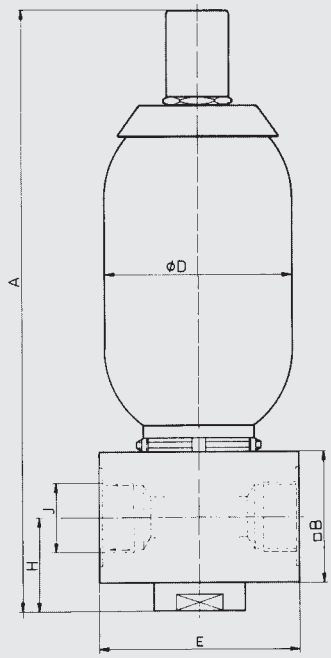
Connection
AI = ISO 228 (BSP), standard connection
BI = DIN 13 to ISO 965/1 (metric) [1]
CI = ANSI B1.1 (UNF thread, sealing to SAE standard) [1]
DI = ANSI B1.20 (NPT thread) [1]
SBO250P-0,075E1 and for SBO210P-0,16E1:
AK = ISO 228 (BSP), standard connection

[1] specify full details of version
[2] not available for all versions
[3] dependent on type and pressure level
[4] when ordering a replacement bladder, state diameter of smallest shell port
[5] observe temperate ranges, see section 4.1.8

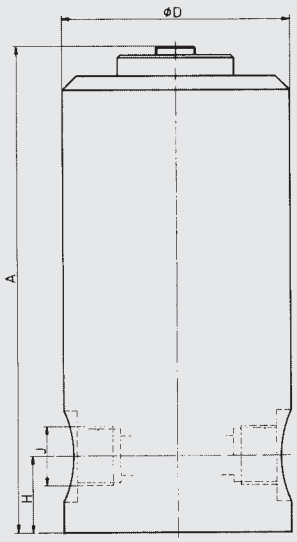
4.3. DIMENSIONS AND SPARE PARTS

4.3.1 **Pulsation dampers bladder accumulator**

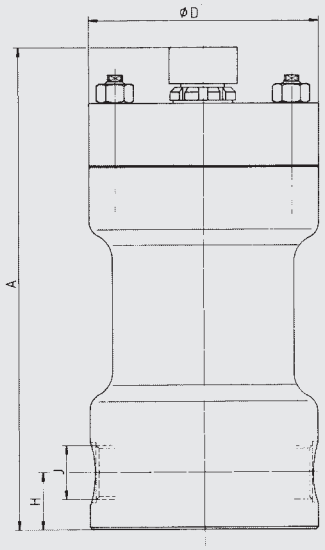
SB330/550P(PH)-...



SB800P-...



SB1000P-...



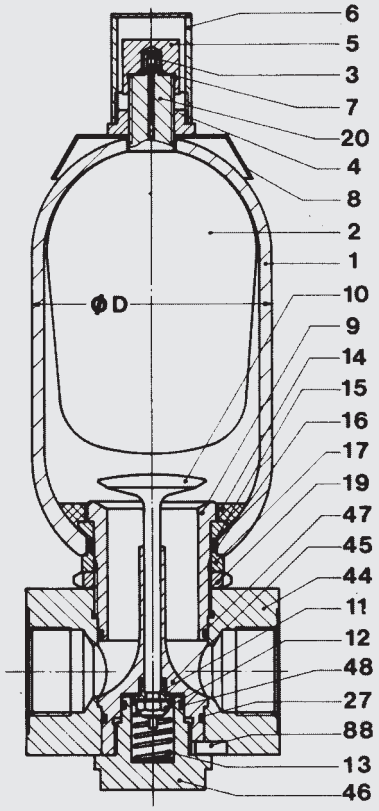
Dimensions SB

Nominal volume [l]	max. operating pressure (PED) [bar]	Eff. gas volume [l]	Weight [kg]	A [mm]	□ B [mm]	Ø D [mm]	E [mm]	H [mm]	J [2] Thread ISO 228	Series
1	330	1	11	365	80	118	120	57	G 1 1/4	SB330P
	550		13	384	70	121		53		SB550P
1.5	800 [3]	1.3	36	346	–	160	–	55		SB800P
	1000 [3]		94	414	–	215	–	49	[1]	SB1000P
2.5	330	2.4	16	570	80	118	120	57	G 1 1/4	SB330P
	550	2.5	20	589	70	121		53		SB550P
4	330	3.7	18	455	80	171		57		SB330P
			26	491	100		150	85	G 1 1/2	SB330PH
5	550	4.9	26	917	70	121	120	53	G 1 1/4	SB550P
6	330	5.7	20	559	80	171		57		SB330P
			28	593	100		150	85	G 1 1/2	SB330PH
10		9.3	40	620		229				SB330P
			50	652	130x140			100	SAE 2" - 6000 psi	SB330PH
13	330	12	48	712	100			85	G 1 1/2	SB330P
20		18.4	70	920						SB330P
			80	952	130x140			100	SAE 2" - 6000 psi	SB330PH
24	330	23.6	82	986	100			85	G 1 1/2	SB330P
32		33.9	100	1445						SB330P
			110	1475	130x140			100	SAE 2" - 6000 psi	SB330PH

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

Spare parts

SB...P



Description	Item
Bladder assembly* consisting of:	
Bladder	2
Gas valve insert	3
Retaining nut	4
Cap nut	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
Anti-extrusion ring*	14
Gas valve insert*	3

* recommended spares

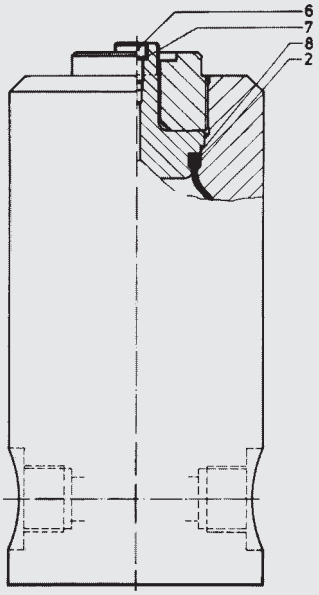
Description	Item
Connection assembly consisting of:	
Oil valve body	9
Valve plate	10
Damping sleeve	11
Lock nut	12
Spring	13
Anti-extrusion ring	14
Washer	15
O-ring	16
Spacer	17
Lock nut	19
Support ring (only for 330 bar)	23
O-ring	27
Connector	44
Guide piece	45
Cap	46
O-ring	47
O-ring	48
Locking key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

O-ring dimensions (mm)

Series	Nom. volume	Item 7	Item 16	Item 27	Item 47	Item 48
SB330P	1- 6 l	7.5x2	55x3.5 [1)]	42.2x3 [1)]	46x3 [1)]	24.2x3 [1)]
SB550P	1- 5 l	7.5x2	50.17x5.33 [1)]	37.82x1.78 [1)]	40.94x2.62 [1)]	23.52x1.78 [1)]
SB330P/PH	10-32 l/4+6 l	7.5x2	80x5 [1)]	57.2x3 [1)]	67.2x3 [1)]	37.2x3 [1)]
SB330PH	10-32 l	7.5x2	100x5 [1)]	64.5x3 [1)]	84.5x3 [1)]	44.2x3 [1)]

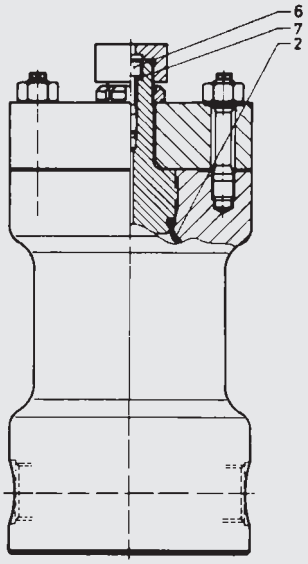
[1)] for code 663 and 665 different dimensions

SB800P



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

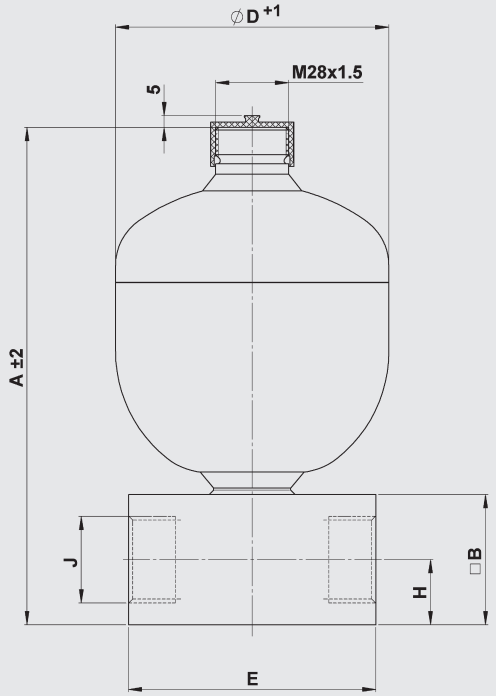
SB1000P



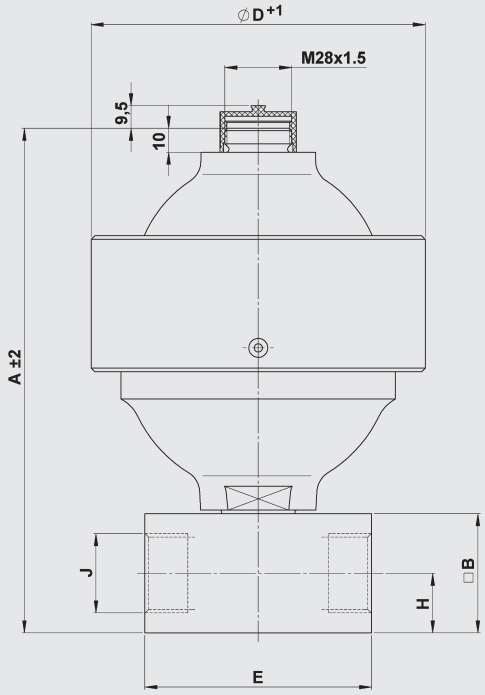
Description	Item
Bladder	2
Charging screw	6
Seal ring	7

4.3.2 Pulsation dampers diaphragm accumulator

SBO...P...E



SBO...P...A6



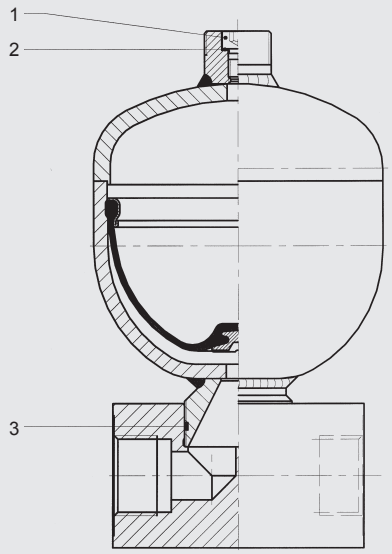
Dimensions SBO

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

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

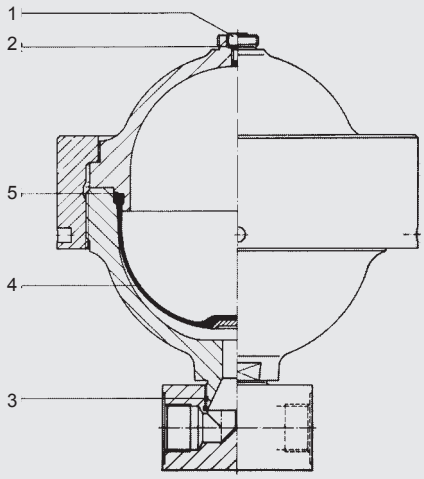
Spare parts

SBO...P...E



Description	Item
Charging screw	1
Seal ring	2
Seal ring	3

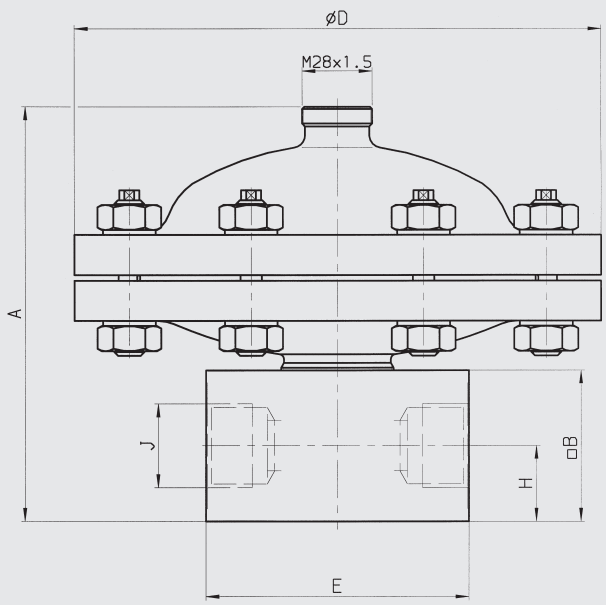
SBO...P...A6



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

4.3.3 Pulsation dampers 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 $p_2 : p_0 = 2 : 1$

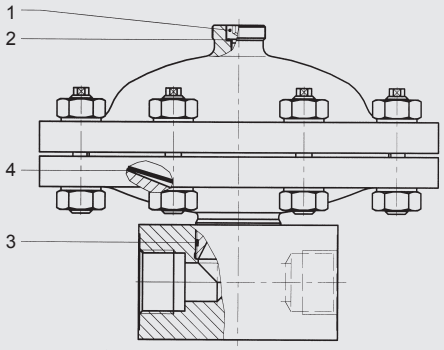
Dimensions

Nominal volume [l]	Max. operating pressure (PED) [bar]	Weight [kg]	A [mm]	□ B [mm]	Ø D [mm]	E [mm]	H [mm]	J [1] Thread ISO 228
0.2	40	11	140	60	210	105	30	G 1
	250	27	197		230			
0.5	40	12	165		210			
	250	26	200		230			

[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

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

Figure 1

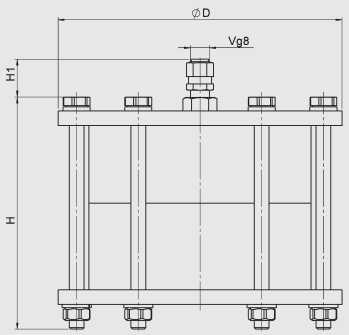
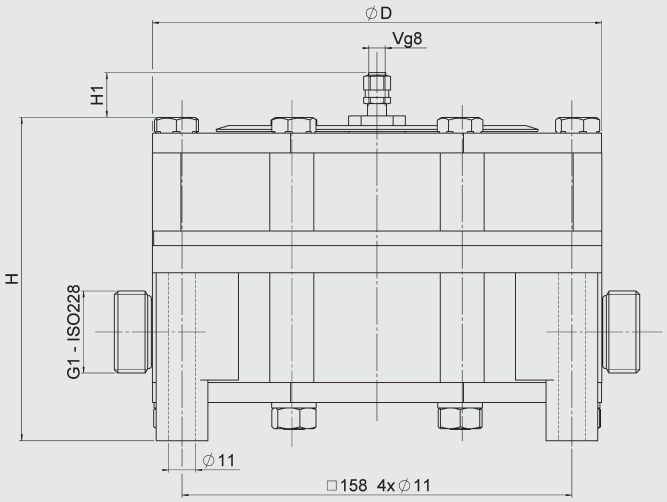


Figure 2



Pulsation damper in PVDF with PTFE-coated diaphragm.

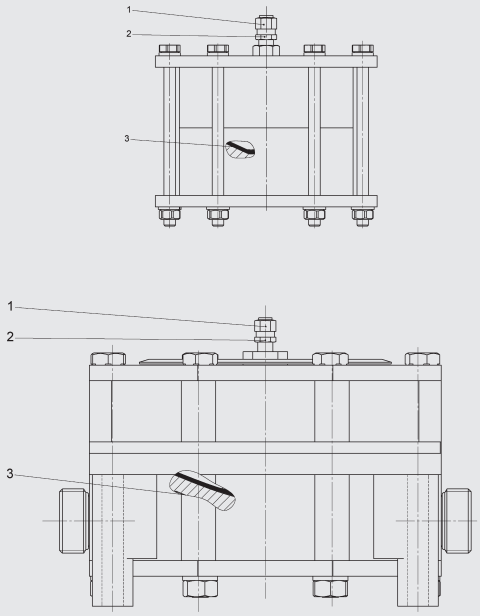
Permitted operating temperature:
-10 °C ... +65 °C

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

Dimensions

Nominal volume [l]	Max. operating pressure (PED) [bar]	Weight [kg]	Ø D [mm]	H [mm]	H1 [mm]	Figure
0.08	10	1.5	115	94	15	1
0.2	10	5.7	182	128	20	2
	16	6.4		130	18	
	25					
0.5	10	6		168	20	
	16	6.8		170	19	
	25					

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

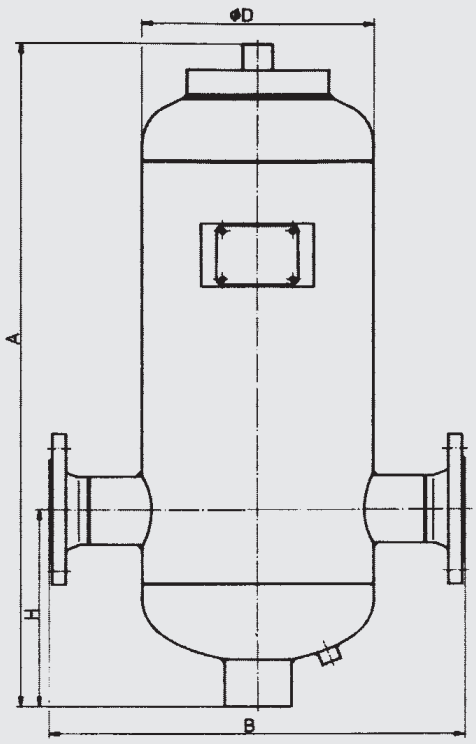


Description	Item
Gas valve complete	1
Gas valve insert brass / stainless steel	2
Diaphragm	3

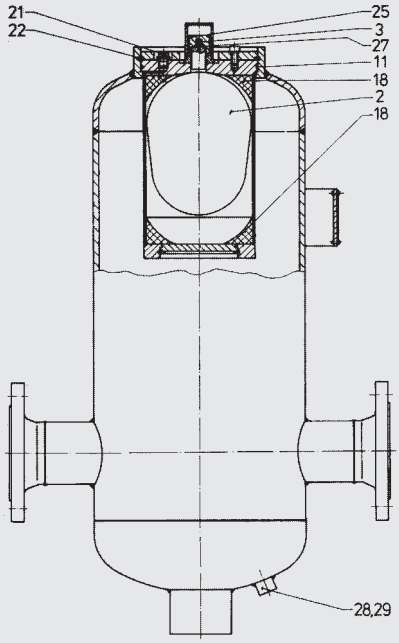
Relevant operating instructions are available on request.

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

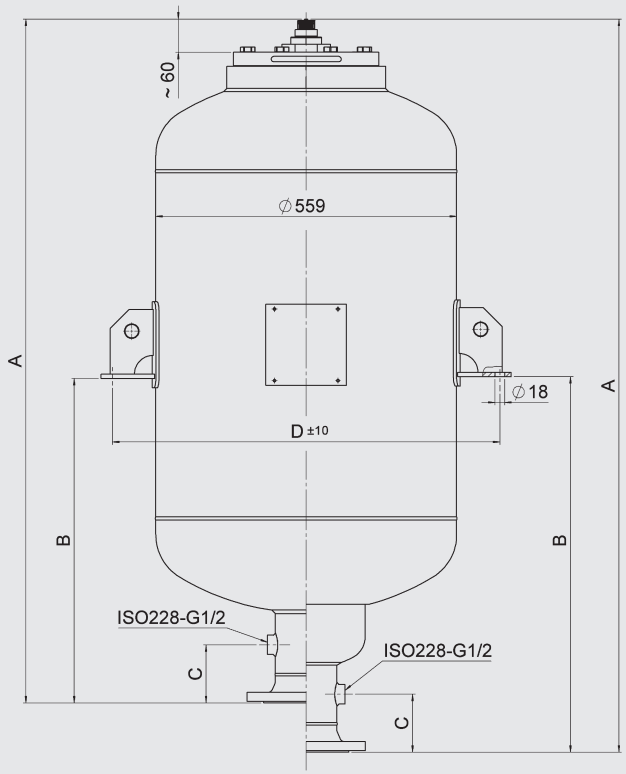
further pressure ranges 25 bar, 40 bar; others on request
other fluid volumes on request

* to EN1092-1/11 /B1/PN16

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

4.3.5 Shock absorber

SB16/35A **SB16/35AH**



Dimensions

SB16/35A

perm. operating pressure 16/35 bar (PED)

Nominal volume [l]	Eff. gas volume [l]	Weight [kg]		A (approx.) [mm]		B (approx.) [mm]		C (approx.) [mm]		D ±10 [mm]	
		SB16A	SB35A	SB16A	SB35A	SB16A	SB35A	SB16A	SB35A	SB16A	SB35A
100	106	110	144	854	881	398	418	108	121	720	728
150	149	127	171	1044	1076	493	578				
200	203	149	208	1275	1318	691	699				
300	288	178	261	1644	1701	920	937				
375	374	214	315	2020	2086	1063	1083				
450	453	244	364	2361	2436	1234	1258				

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

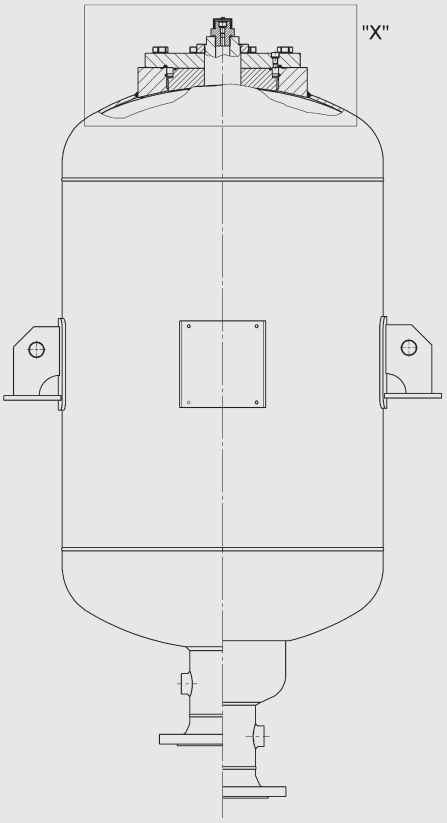
SB16/35AH

perm. operating pressure 16/35 bar (PED)

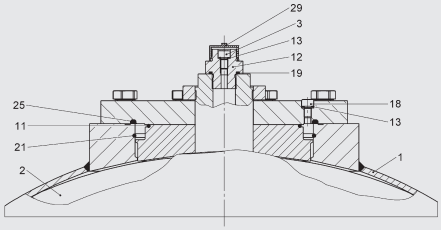
Nominal volume [l]	Eff. gas volume [l]	Weight [kg]		A (approx.) [mm]		B (approx.) [mm]		C (approx.) [mm]		D ±10 [mm]	
		SB16AH	SB35AH	SB16AH	SB35AH	SB16AH	SB35AH	SB16AH	SB35AH	SB16AH	SB35AH
100	106	118	153	945	971	488	508	108	121	720	728
150	149	135	180	1135	1166	638	641				
200	203	157	217	1366	1408	754	762				
300	288	186	270	1735	1791	988	1000				
375	374	222	324	2111	2176	1127	1146				
450	453	252	373	2452	2526	1298	1321				

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

Spare parts



Detail "X"



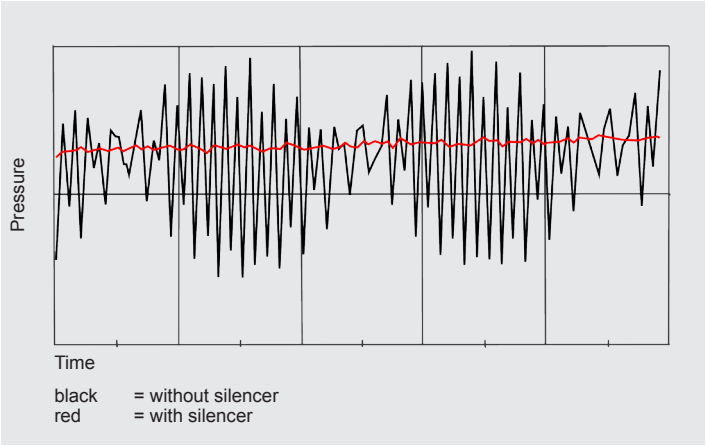
Description	Item
Bladder	2
Gas valve assembly consisting of:	
Lock nut	3
Gas valve body	12
Seal ring	13
O-ring	19
Protective cap	29
Seal kit consisting of:	
O-ring	11
Seal ring	13
Vent screw	18
O-ring	19
Retaining ring	21
O-ring	25

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

5. SILENCER

5.1. APPLICATION

Silencer for fluid noise damping
Type SD...



5.1.1
General

All displacement pumps, such as axial and radial piston pumps, vane, gear or screw pumps produce volume and pressure fluctuations which are exhibited as vibrations and noises. Noises are not only generated and transmitted by the pump. They are also the result of mechanical vibrations and vibrations caused by the fluid pulsations, which are amplified when transmitted to larger surfaces. Insulation and the application of flexible hoses or sound insulation caps resolve only part of the problem, since they cannot prevent the effects of the pulsations being transferred to other areas.

5.1.2 **Applications**

Vehicles, machine tools, plastics machinery, aeroplanes, ships, hydraulic power stations and other systems with a large "surface" are all applications where the noise level can be reduced.

5.1.3 **Mode of operation**

The HYDAC fluid SILENCER is based on the principle of an expansion chamber with interference line.

By reflecting the oscillations within the silencer the majority of the oscillations are dampened across a wide frequency spectrum.

5.1.4 **Design**

The HYDAC SILENCER consists of a welded or forged external housing, an internal tube and two pipe connections on opposite sides.

The SILENCER has no moving parts and no gas charge and is therefore absolutely maintenance free.

The HYDAC SILENCER can be used for mineral oils, phosphate ester and water glycol. A stainless steel model is available for other fluids.

5.1.5 **Special design**

SILENCERS can also be in the form of diaphragm or piston accumulators. Available on request.

5.1.6 **Installation**

It is recommended that one connection side is joined via a flexible hose in order to reduce the transmission of mechanical vibrations.

The installation position of the damper is optional, but the flow direction must be taken into account.

Please read the operating instructions!
No. 3.701.BA

5.2. DIMENSIONING

Silencer

The sizing calculation of the HYDAC SILENCER is designed to result in a small unit with the best possible damping. The starting point for the selection table is to determine the level of transmission damping D from 20 dB upwards.

$$D = 20 \cdot \log \frac{\Delta p_o}{\Delta p_m}$$

Δp_o = cyclic test pressure without silencer
Δp_m = cyclic test pressure with silencer

When selecting the damper the following has to be taken into account:

1) the size of the silencer body
2) the fundamental frequency f of the pump
   f = i • n / 60 in Hz
   i = number of displacement elements
   n = motor speed in rpm

5.2.1 **Calculation example**
Given parameters:

Axial piston pump with 9 pistons
Drive speed: 1500 rpm
Connection: G1 corresponds to D_i = 19 mm
Flow rate: 300 l/min
Operating medium: mineral oil
max. operating pressure: 210 bar

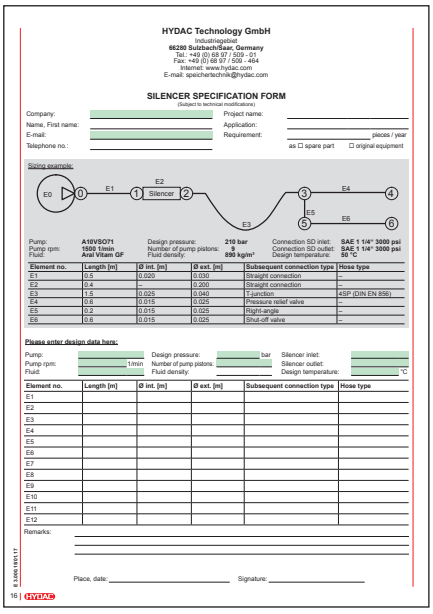
Solution:

Fundamental frequency f

f = i • n / 60 in Hz
= 9 • 1500/60
= 225 Hz

By calculating the fundamental frequency and using the system data (e.g. pipe length, ball valves, pressure, temperature, etc.) we can determine the correct size of silencer for you.
Use the specification sheet to provide the required data quickly and conveniently on the PC and send it to us.
See www.hydac.com or catalogue section

- HYDAC Accumulator Technology
  No. 3.000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Internet: www.hydac.com
E-mail: speichertechnik@hydac.com

SILENCER SPECIFICATION FORM
(Subject to technical modifications)

Company:
Name, First name:
E-mail:
Telephone no.:
Project name:
Application:
Requirement: pieces / year
as ☐ spare part ☐ original equipment

Sizing example:

Element no.	Length [m]	Ø int. [m]	Ø ext. [m]	Subsequent connection type	Hose type
E1	0.2	0.020	0.030	Straight connection	–
E2	0.4	–	0.200	Straight connection	–
E3	1.5	0.025	0.040	T-junction	4SP (DIN EN 856)
E4	0.6	0.015	0.025	Pressure relief valve	–
E5	0.2	0.015	0.025	Right-angle	–
E6	0.6	0.015	0.025	Shut-off valve	–

Please enter design data here:

Element no.	Length [m]	Ø int. [m]	Ø ext. [m]	Subsequent connection type	Hose type
E1					
E2					
E3					
E4					
E5					
E6					
E7					
E8					
E9					
E10					
E11					
E12					

Remarks:

Place, date: Signature:

5.3. MODEL CODE

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

SD330 M – 4.2 / 212 U – 330 AD/AD

Series

Type code
no details = for SD330
B = bladder accumulator base shell*
K = piston accumulator base shell*
M = diaphragm accumulator base shell*

Nominal volume [l]

Damper
0 = without pipe
1 = damper for frequencies > 500 Hz
2 = narrow band damper - DR
3 = broadband damper - DR

Housing material
1 = carbon steel
2 = carbon steel with rust protection*

Material of seal
2 = NBR (-15 °C ... + 80 °C)
6 = FKM (-10 °C ... + 160 °C)

Certification code
U = European Pressure Equipment Directive (PED)

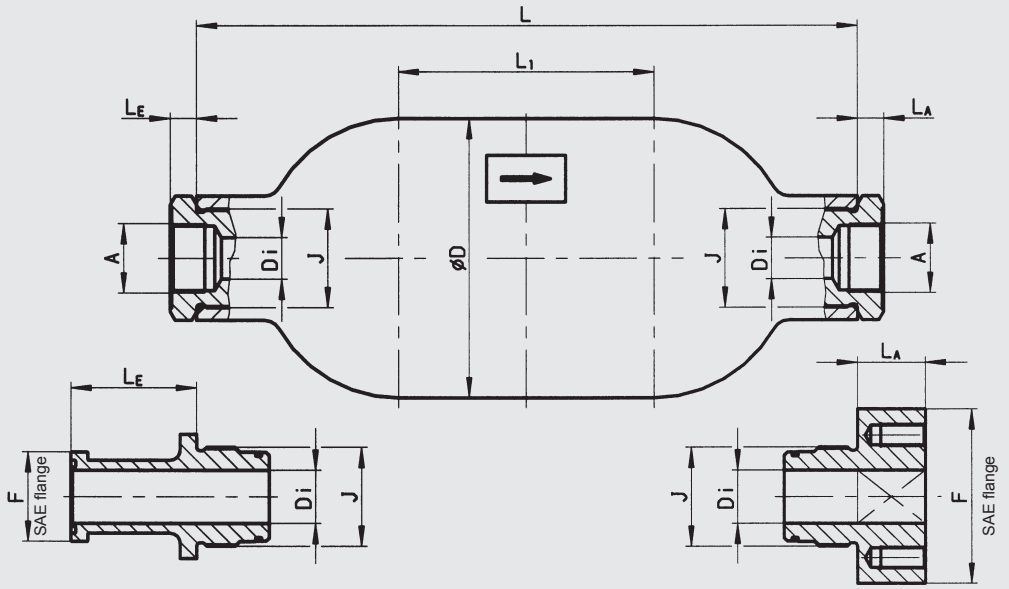
Permitted operating pressure [bar]

Inlet connection/outlet connection
see Table 5.4.1

* only on request

5.4. DIMENSIONS

SD330



Nominal volume [l]	L [mm]	L_1 [mm]	Ø D [mm]	J ISO 228	Weight [kg]
1.3	250	–	114	G 1	6.5
1.8	355	155		G 1 1/4	5.5
4.2	346	–	168	G 1 1/2	12.5
4.7	420	155		G 2	11.4

5.4.1 **Silencer connections**

a) Threaded connection to ISO 228

	Fluid connection A													
	AB G 3/8 D_i = 15 mm		**AC** G 1/2 D_i = 13 mm		**AD** G 3/4 D_i = 16 mm		**AE** G 1 D_i = 19 mm		**AF** G 1 1/4 D_i = 25 mm		**AG** G 1 1/2 D_i = 32 mm		**GG** G 1 1/2 D_i = J	
Nominal volume [l]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]
1.3	17	17	–		–		–		–		–		–	
1.8	–		13	13	13	13	30	30	33	33	–		–	
4.2	–		–		–		–		–		–		Without adapter	
4.7	–		–		16	16	16	16	26	26	36	36	36	36

b) Flange connection SAE J518 (Code 62 - 6000 psi)

	Fluid connection F											
	FG SAE 1/2" D_i = 13 mm		**FH** SAE 3/4" D_i = 19 mm		**FI** SAE 1" D_i = 25 mm		**FK** SAE 1 1/4" D_i = 32 mm		**FL** SAE 1 1/2" D_i = 38 mm		**FM** SAE 2" D_i = 50 mm	
Nominal volume [l]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]	L_E [mm]	L_A [mm]
1.3	–		–		–		–		–		–	
1.8	53	31	59	36	65	36	–		–		–	
4.2	–		–		–		–		0	33	–	
4.7	–		105	36	120	36	76	28	76	28	*	

– not available
* on request

6. NOTE

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

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