HYDAC INTERNATIONAL

Accumulator Technology. Product Catalogue.

E 30.000.1/03.12

1. HYDAC ACCUMULATOR TECHNOLOGY FLUID ENGINEERING EFFICIENCY THROUGH ENERGY MANAGEMENT.

HYDAC Accumulator Technology has over 45 years' experience in research & development, design and production of Hydac accumulators.

Bladder, piston, diaphragm and metal bellows accumulators from HYDAC together form an unbeatable range and as components or units, support hydraulic systems in almost all sectors.

The main applications of our accumulators are:

- Energy storage,
- Emergency and safety functions,
- Damping of vibrations, fluctuations, pulsations (pulsation damper), shocks (shock absorber) and noise (silencer),
- Suction flow stabilisation,
- Media separation,
- Volume and leakage oil adjustment,
- Weight equalization,
- Energy recovery.

Using accumulators improves the performance of the whole system and in detail this has the following benefits:

- Improvement in the functions
- Increase in service life
- Reduction in operating and maintenance costs
- Reduction in pulsations and noise

On the one hand, this means greater safety and comfort for operator and machine.

On the other hand, HYDAC accumulators enable efficient working in all applications.

Basic criteria, such as:

- Design pressure,
- Design temperature,
- Fluid displacement volume,
- Discharge / Charging velocity,
- Fluid,
- Acceptance specifications and also
- Mounting options

are important parameters required for sizing the correct accumulator.

In addition the knowledge developed by our accumulator specialists will help to select the right type of accumulator. The comprehensive range of HYDAC accessories simplifies installation and maintenance according to the specification.

2. QUALITY

Quality, safety and reliability are paramount for all HYDAC accumulator components.

They comply with the current regulations (or standards) for pressure vessels in the individual countries of installation.

In taking delivery of a HYDAC Hydraulic Accumulator therefore, the customer is assured of a high-quality accumulator product which can be used in every country in the world, depending on the certification.

For more details, please turn to Section 4.

All the processes involved, from development, engineering and production to approval and delivery are defined by HYDAC's certified management system and the relevant international accreditation for the manufacture of pressure vessels.

In conjunction with the customer service department at HYDAC's headquarters, service is possible worldwide.

HYDAC's worldwide distributor network means that trained staff are close at hand to help our customers.

This ensures that HYDAC customers have the support of an experienced workforce both before and after sale.

3. SAFETY INFORMATION

Hydraulic accumulators are pressure vessels as defined in the Pressure Equipment Directive 97/23/EC. They are closed vessels which are designed and built to store pressurized fluids. Hydraulic accumulators are charged with nitrogen which is separated from the fluid section by a piston, bladder or diaphragm. Hydraulic accumulators are specifically designed to store and then discharge pressurized fluids.

The regulations for commissioning and operating hydraulic accumulators which are in force at the place of installation must be observed. The plant operator is exclusively responsible for ensuring compliance with these regulations.

Relevant instructions are provided in the Operating Manuals for our products.

As regards production and placing on the market, HYDAC has carried out a comprehensive risk assessment.

Similarly the manufacturer of products incorporating hydraulic accumulators must proceed accordingly (see Pressure Equipment Directive 97/23/EC) and the following principles must be adhered to and in this order of priority:

- Removal or reduction of risks, insofar as this is reasonably possible,
- Application of appropriate protective measures against risks which cannot be eliminated,
- If required, training of the users on the residual risks and instructions on appropriate special measures for reducing the risks during installation and/ or operation.

For safe handling and operation, the operator must draw up a risk assessment for the installation site, particularly in combination with other components and risks.

The resulting measures must be implemented accordingly.

In the case of fundamental risks affecting hydraulic accumulators, e.g.

- Excessive pressure and
- Increase in temperature (in the event of fire)

we already have the relevant products available.

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

3.1. RISK OF EXCESSIVE PRESSURE

Products:

Safety and shut-off block for the fluid side in various sizes and versions.

See catalogue section:

- Safety and shut-off block SAF/DSV No. 3.551

Gas safety valve and gas safety block for the gas side

Bursting discs for gas and fluid sides

See catalogue section:

- Safety equipment for hydraulic accumulators No. 3.552

3.2. RISK OF RISE IN TEMPERATURE

Products:

Safety and Shut-off Block with solenoid-operated valve (open when de-energised) in conjunction with temperature monitoring.

See catalogue section:

- Safety and shut-off block SAF/DSV No. 3.551 or on request

Temperature fuses

See catalogue section:

- Safety equipment for hydraulic accumulators No. 3.552

4. PRESSURE EQUIPMENT DIRECTIVE REGULATIONS

On 29 November 1999 the Directive 97/23/EC (Pressure Equipment Directive) came into force and since 29 May 2002 has been exclusively binding in Europe. This directive applies to the design, manufacture, conformity assessment and placing on the market of pressure equipment and assemblies with a maximum permitted pressure of over 0.5 bar. It guarantees the free movement of goods within the European Community. EU member states must not prohibit, restrict or obstruct the placing on the market and the commissioning of pressure equipment on account of pressure-related hazards, if the equipment complies with the requirements of the pressure equipment directive and has the CE mark, and is subject to a conformity assessment.

Hydraulic accumulators with a capacity of **V ≤ 1 litre**, a maximum permitted pressure **PS ≤ 1000 bar** and a pressure capacity **PS • V ≤ 50 bar • l** for gases of fluid group 2 (non-hazardous fluids) are subject to Article 3, Paragraph 3 of the European Pressure Equipment Directive and do not receive the CE mark.

Inspection of the equipment and installation, operational safety and repeat testing are controlled as before by national laws.

The equipment relating to safety is described in AD2000, ISO 4126 and EN 14359. The repeat testing intervals are stipulated in the new German health & safety regulations.

4.1. OVERSEAS

Pressure accumulators which are installed overseas (outside the EU), are supplied with the relevant test certificates required in the country of installation.

The country of installation must be stated at the time of ordering (see code in Model Code for the particular product: Certificate Code).

HYDAC pressure vessels can be supplied with virtually any test certificate. Please note that the permitted operating pressure can differ from the nominal pressure.

Depending on the authority, the different material requirements must be observed.

4.2. CERTIFICATE CODE = S (U STAMP)

HYDAC Technology GmbH has had authorization since 1985 to use the Code Symbol "U STAMP" on pressure vessels which have been manufactured in conformity with the ASME specifications and to market these using the "NB" symbol, in the jurisdiction (area of application) of “The National Board of Boiler and Pressure Vessel Inspectors“.

4.3. CERTIFICATE CODE = P (KHK certificate)

For the Japanese market, HYDAC Technology GmbH has had approval as a "Self Inspecting Manufacturer" since the year 2000. Consequently, HYDAC is authorized to manufacture and test pressure vessels for the Japanese market and to import them into Japan.

4.4. CERTIFICATE CODE = A9 (MANUFACTURER LICENSING CHINA)

Since 1998 HYDAC Technology GmbH has had approval from the Chinese authority "SELO" as a manufacturer of pressure vessels and valves. HYDAC is therefore authorized to import welded bladder, piston and diaphragm accumulators, and safety valves, into the Chinese market.

In conjunction with this approval, it is absolutely essential to provide the details of the end user/dealer when placing the order.

4.4. CERTIFICATE TABLE

The following table lists the codes used in the model code for different countries of installation.

European member states		Certificate code (AKZ)
AT	Austria	U
BE	Belgium	
BG	Bulgaria	
CY	Cyprus	
CZ	Czech Republic	
DK	Denmark	
EE	Estonia	
FI	Finland	
FR	France	
DE	Germany	
GB	Great Britain	
GR	Greece	
HU	Hungary	U [3]
IE	Ireland (Republic)	U
IT	Italy	
LV	Latvia	
LT	Lithuania	
LU	Luxembourg	
MT	Malta	
NL	Netherlands	
PL	Poland	
PT	Portugal	
RO	Romania	
SK	Slovakia	
SI	Slovenia	
ES	Spain	
SE	Sweden	

Rest of the World		Certificate code (AKZ)
DZ	Algeria	U [3]
AR	Argentina	U [3]
AU	Australia	F [1]
BS	Bahamas	E [3]
BB	Barbados	U [3]
BY	Belarus	A12
BM	Bermuda	U [3]
BO	Bolivia	U [3]
BR	Brazil	U [3]
CE	Canada	S1 [2]
CL	Chile	U [3]
CN	China	A9
CR	Costa Rica	E [3]
EC	Ecuador	U [3]
ET	Egypt	U [3]
HK	Hong Kong	A9
IS	Iceland	U [3]
IN	India	U [3]
ID	Indonesia	U [3]
IL	Israel	U [3]
JP	Japan	P
JO	Jordan	U [3]
KR	Korea (Republic)	U [3]
KW	Kuwait	U [3]
LB	Lebanon	U [3]
LY	Libya	U [3]
MY	Malaysia	U [3]
MX	Mexico	U [3]
NZ	New Zealand	T
NG	Nigeria	U [3]
NO	Norway	U
PK	Pakistan	U [3]
PE	Peru	U [3]
PH	Philippines	U [3]
PR	Puerto Rico	E [3]
RU	Russia	A6
SA	Saudi Arabia	U [3]
SG	Singapore	U [3]
ZA	South Africa	U [3]
SD	Sudan	U [3]
CH	Switzerland	U
SY	Syria	U [3]
TW	Taiwan	U [3]
TH	Thailand	U [3]
TN	Tunisia	U [3]
TR	Turkey	U
UA	Ukraine	A10
US	USA	S [3]
YU	Yugoslavia (former)	U [3]

[1] approval required in the individual territories

[2] approval required in the individual provinces

[3] alternative certificates possible

5. PRODUCT OVERVIEW

5.1. BLADDER ACCUMULATORS

5.1.1 **Standard**
Nominal volumes:
0.5 ... 200 l
Permitted operating pressure:
330 ... 550 bar

5.1.2 **Low pressure**
Nominal volumes:
2.5 ... 450 l
Permitted operating pressure:
up to 40 bar

5.1.3 **High pressure**
Nominal volumes:
1 ... 54 l
Permitted operating pressure:
5 ... 1000 bar

Benefits of HYDAC bladder accumulators:

- High discharge speeds,
- No pressure differential between fluid and gas sides,
- Compact, maintenance-free,
- High charging and discharge frequencies.

5.2. PISTON ACCUMULATORS

5.2.1 **Standard**
Nominal volumes:
up to 3300 l
Permitted operating pressure:
210 ... 350 bar
(higher pressures on request)

5.2.2 **Series SK280**
Nominal volumes:
0.16 ... 5 l
Permitted operating pressure:
280 bar

Benefits of HYDAC piston accumulators:

- Minimal pressure differential between the fluid and gas sides,
- Large usable volume,
- Variable installation position,
- Monitoring of the piston position possible using various systems,
- Particularly suitable for back-up configurations,
- High flow rates possible,
- No sudden discharge of gas when seals are worn.

5.3. DIAPHRAGM ACCUMULATORS

5.3.1 **Diaphragm accumulators**
Weld type
Nominal volumes:
0.075 ... 4 l
Permitted operating pressure:
50 ... 330 bar

Screw type
Nominal volumes:
0.1 ... 4 l
Permitted operating pressure:
210 ... 750 bar

Benefits of HYDAC diaphragm accumulators:

- Design optimised for function and weight,
- Choice of installation positions,
- No pressure differential between fluid side and gas side,
- Low-maintenance and long service life.

5.4. METAL BELLOWS ACCUMULATORS

5.4.1 **Metal bellows accumulators for heavy diesel engines**

Nominal volume:
3.8 l

Permitted operating pressure:
50 bar

Series: SM50P-...
other models on request

Benefits of the HYDAC metal bellows accumulator:

- Gas-tight
- Maintenance-free
- Media resistance over a wide range of temperatures

5.5. HYDRAULIC DAMPERS

5.5.1 **Dampers**

Nominal volumes:
0.075 ... 450 l

Permitted operating pressure:
10 ... 1000 bar

5.5.2 **SILENCER**

Permitted operating pressure:
330 bar

Advantages of the HYDAC hydraulic damper:

- Reduces pressure pulsations,
- Improves the suction performance of displacement pumps,
- Prevents pipe breaks and damage to valves,
- Protects measuring equipment and its function in the system,
- Reduces noise level in hydraulic systems,
- Reduces maintenance and servicing costs and
- Extends service life of the system.

5.6. SPECIAL ACCUMULATORS

5.6.1 **Weight Reduced Hydraulic Accumulators**

Over 80% reduction in weight compared to equivalent carbon steel accumulators.

The choice ranges from weight-optimized accumulators, e.g. by using aluminium, through to light-weight and ultra light-weight accumulators.

5.6.2 **Spring accumulators**

These are fitted with a spring. The energy is produced from the spring force, instead of gas.

Further information on request.

5.7. ACCUMULATOR STATIONS

HYDAC supplies fully assembled accumulator stations which are ready for operation, complete with all the necessary valve controls, fittings and safety equipment

- as an individual accumulator unit or
- in a back-up version with nitrogen bottles to increase the effective volume.

5.8. ACCUMULATOR ACCESSORIES

5.8.1 **Hydraulic accumulators with back-up nitrogen bottles**

HYDAC also offers nitrogen bottles which can be used to back up bladder and piston accumulators. Nitrogen bottles used as back-ups increase the gas volume in the accumulator.

Using HYDAC nitrogen bottles provides the following benefits:

- Cost-effective expansion of the accumulator volume and as a result
- Smaller accumulators for the same gas volume.

5.8.2 **Universal charging and testing unit FPU-1**

Charging hose, pressure gauge and pressure reducer for HYDAC and other makes of accumulator, up to 350 bar.

Higher pressures on request

5.8.3 **Safety and shut-off block SAF/DSV**

Nominal size: 10 ... 50

Permitted operating pressure:
400 bar (DSV 350 bar)

Pressure relief valve:
Nominal width DN12

Benefits of the HYDAC Safety and Shut-off Block:

- Minimum of space and maintenance,
- Minimum of installation required (1 SAF replaces as a rule up to 10 individual pipe connections),
- Considerable reduction in installation time,
- Can be adapted to different types and also different makes of accumulator, and
- Additional valves (pilot-operated check valves, flow control valves, etc).

5.8.4 **Safety equipment**

- Gas safety valve GSV6
- Temperature fuse
- Bursting disc

- Gas safety block

as safety equipment for
HYDAC accumulator products.

Approval according to Pressure Equipment Directive PED and CE mark.

Benefits of the HYDAC Gas safety block:

- A gas safety block simplifies the operation of the hydraulic accumulator on the gas-side and also provides a means of attaching the above safety equipment using the various ports.

5.8.5 **Supports for Hydraulic Accumulators**

Accumulator sets, clamps and consoles for efficient mounting of hydraulic accumulators.

5.8.5 **ACCUSET SB**

Nominal volumes:
1 ... 50 l

Permitted operating pressure:
330 bar

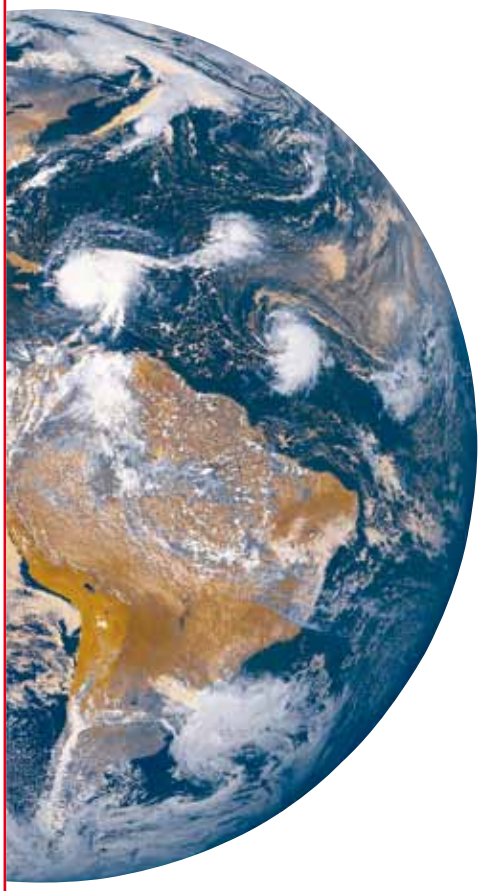
6. INDUSTRIES AND APPLICATIONS

HYDAC Technology GmbH is represented in almost all industries of the world which use hydraulic accumulators.

The main sectors are industrial hydraulics, mobile technology and process technology.

Further applications in oil & gas/ offshore as well as more energy efficient systems utilizing accumulators are gaining in importance.

Listed below is a selection of examples with accumulators/dampers which are typical for these industries:



6.1. INDUSTRIAL HYDRAULICS

Automotive Industry

- General industrial hydraulics, e.g. energy storage

Machine tools

- Support for the hydraulics for tool drive or tool change
- Energy storage in the compact hydraulics of machining centres

Plastics machinery

- Accumulator stations for energy storage during the injection moulding process
- Pulsation damping on the hydraulic drive

Forming machines

- Accumulators used to store energy to support the pump

Iron and steel industry

- Accumulator to maintain the pressure in rolling mills
- Blast furnace hydraulics

Thermal power plants

- Emergency supply for turbine control system
- Pulsation damping on pumps
- Lubrication, control and seal oil supply

Wind turbines

- Accumulators in the pitch control system
- Support of the pitch drive
- Accumulators on braking units

Mining machinery

- Hydraulic accumulators, e.g. in suspended monorails
- Pulsation damping
- Comfort and safety for mobile working machines

Paper Industry

- Energy storage for emergency functions in friction bearing hydraulics
- Energy storage in high/low pressure power units

Test rigs and test systems

- Energy storage on crash test systems
- Pulsation damping on servohydraulic axes

6.2. MOBILE TECHNOLOGY

Automotive technology

- Automatic and manual transmission
- Automatic clutch systems
- Engine management systems
- Pump noise damping
- Accumulators for turbocharger emergency lubrication

Construction Machinery

- Accumulators in braking systems
- Chassis damping
- Bucket damping
- Boom damping on mobile cranes

Agricultural and forestry machines

- Front loader damping
- Accumulators in tractor suspension systems
- Stone strike protection for ploughs
- Boom suspension on field sprayers

Municipal machines

- Energy storage
- Boom damping
- Pulsation dampers
- Chassis damping

Lifting and material handling technology

- Noise-damping
- Energy recovery
- Braking system

Shipping

- Water treatment plants (pump support)
- Pulsation damping on diesel engines
- Heave compensation (cranes)
- Emergency function for lifeboats

6.3. PROCESS TECHNOLOGY

Chemical industry

- Energy storage and pulsation damping on dosing pumps
- Suction flow stabilisation on the suction side of pumps

Loading stations / Refineries

- Shock absorption for valve closing
- Pulsation damping on pipelines

Offshore / Oil & Gas

- Accumulators to support valve closing systems
- Energy storage for deep sea rams
- Blow Out Preventers (BOP)
- Emergency function for safety systems
- Accumulators on wellhead control systems

7. WEBSITE

Please visit us at the following address: www.hydac.com.

In addition to Industries, Service and Fluid Engineering, under **Products » Hydraulic Accumulators**, you will find the standard product range and a comprehensive range of accessories from HYDAC TECHNOLOGY GmbH.

8. SPECIFICATION FORMS

Our aim is to provide optimum customer service both before and after purchasing the accumulator.

The following specification forms are designed to help pre-select the required accumulator/damper or accessories.

You can also download these as a pdf document from the intranet and internet (www.hydac.com/Hydraulic accumulators) under the Downloads tab. You can then complete them at your convenience on your PC and also send them to your HYDAC contact, e.g. by E-Mail.

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General ACCUMULATOR Specification Form (Page 1/2)

(Subject to technical modifications)

Company: _____ Location: _____

Project name: _____ Originator: _____

E-Mail: _____ Tel. no.: _____

Application: _____ Requirement: _____ pieces/year

Note:
The appropriate accumulator can be calculated using the HYDAC **A**ccumulator **S**imulation **P**rogram **ASP**.
Download from www.hydac.com.

Type of accumulator ☐ Bladder accumulator ☐ Piston accumulator ☐ Diaphragm accumulator ☐ _____

Fluids/medium

Fluid: _____ Viscosity at 20 °C: _____ cSt

Density: _____ kg/m³ Viscosity at operating temperature: _____ cSt

Functioning of the pump

☐ Continuous operation ☐ Intermittent operation

Accumulator data

Max. operating pressure: _____ bar

Min. operating pressure: _____ bar

Pre-charge pressure at 20 °C (nitrogen): _____ bar
(See catalogue section: No. 3.000, Sizing)

Ambient temperature: _____ °C

Operating temperature: _____ °C

Complete cycle time: _____ s

Fluid demand diagram for one pump and one consumer:

Accumulator discharge rate: _____ l/min

Accumulator discharge time: _____ s

Flow rate of the pump: _____ l/min

Pump runs continuously: ☐

Pump starts after discharge: ☐

Alternatively:
Fluid demand diagram for several pumps and/or consumers (see Page 2)

Additional details on the accumulator

Industry: _____

Country of installation: _____

Design/Certification: _____

Specification: _____

Materials*

Accumulator shell: _____

Fluid connection: _____

Elastomer: _____

Additional information

Installation dimensions: _____ mm
(height x $Ø_{ext.}$)

Fluid connection: Type: _____

For thread ☐ internal _____

☐ external _____

Standard: _____

Gas connection: _____

Colour/finish: ☐ internal _____

☐ external _____

Spare parts/ Accessories: see www.hydac.com under Products/Accumulators

* dependent on operating temperature and/or fluid resistance

Comments: _____

_____

_____

Date: _____ Name: _____

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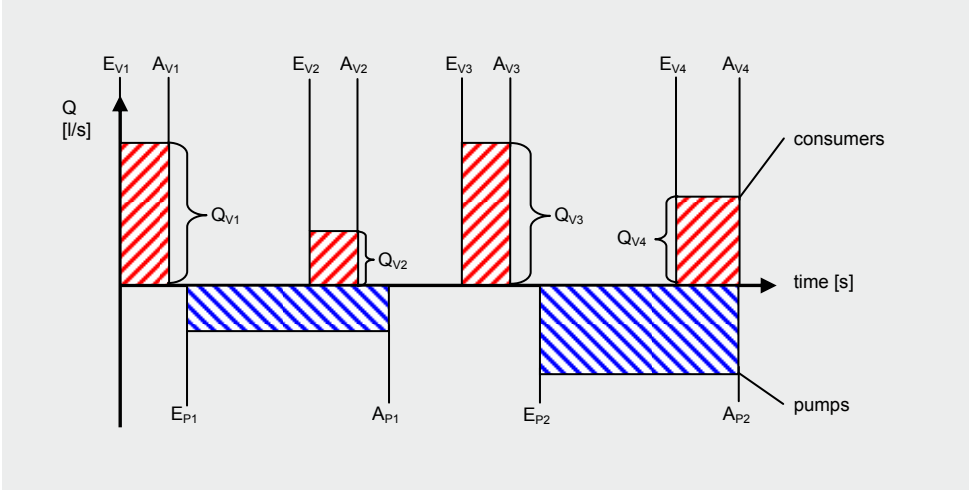
General ACCUMULATOR Specification Form (Page 2/2)

(Subject to technical modifications)

Fluid demand diagram for several pumps and/or consumers

Designation / Example

Q_V = Consumer flow rate [l/s]
E_V = Switch-on time of consumer [s]
A_V = Switch-off time of consumer [s]
E_P = Switch-on time of pump [s]
A_P = Switch-off time of pump [s]



Please indicate cycle data below

Number of consumers: _____

Q_{V1}= _____ E_{V1}= _____ A_{V1}= _____
Q_{V2}= _____ E_{V2}= _____ A_{V2}= _____
Q_{V3}= _____ E_{V3}= _____ A_{V3}= _____
Q_{V4}= _____ E_{V4}= _____ A_{V4}= _____

Number of pumps: _____

Q_{P1}= _____ E_{P1}= _____ A_{P1}= _____
Q_{P2}= _____ E_{P2}= _____ A_{P2}= _____
Q_{P3}= _____ E_{P3}= _____ A_{P3}= _____
Q_{P4}= _____ E_{P4}= _____ A_{P4}= _____

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SHOCK ABSORBER SPECIFICATION FORM (Page 1/2)

(Subject to technical modifications)

Company: _____ Location: _____

Project name: _____ Originator: _____

E-Mail: _____ Tel. no.: _____

Application: _____ Requirement: _____ pieces/year

Note:
The appropriate accumulator can be calculated using the HYDAC **A**ccumulator **S**imulation **P**rogram **ASP**.
Download from www.hydac.com.

Type of accumulator ☐ Bladder accumulator ☐ Piston accumulator ☐ Diaphragm accumulator ☐ _____

Cause of the pressure shock

☐ When pump starts ☐ When pump switches off

☐ When check valve flap (valve) closes

Fluids/media

Fluid [1]: _____

Density: _____ kg/m³

Pipeline data for a single pipe

Length: _____ m

Diameter (internal): _____ mm

Wall thickness: _____ mm

Material of line: _____

Max. permitted pressure in the line: _____ bar

Total closing time of the valve: _____ s

Speed of sound in the system: _____ m/s

Alternatively:
Pipeline data for additional sections of pipe
(see Page 2)

Pump data

Zero head: _____ m

Pressure of the pump at the operating point: _____ bar

Flow rate of the pump at the operating point: _____ l/min

* dependent on operating temperature and/or fluid resistance

[1] please send datasheet

Accumulator data

Max. operating pressure: _____ bar

Min. operating pressure: _____ bar

Pre-charge pressure at 20 °C (nitrogen): _____ bar
(See catalogue section: No. 3.000, Sizing)

Ambient temperature: _____ °C

Operating temperature: _____ °C

Fluid connection: Type: _____

For thread ☐ internal _____

☐ external _____

Standard: _____

Gas connection: _____

Colour/finish: ☐ internal _____

☐ external _____

Spare parts/Accessories: see www.hydac.com
under Products/Hyd. accumulators

Materials*

Accumulator shell: _____

Fluid connection: _____

Elastomer: _____

Additional information on the accumulator/system

Available installation space: _____ m
(L x W x H)

Industry: _____

Country of installation: _____

Design/Certification: _____

Specification: _____

Comments: _____

Date: _____ Name: _____

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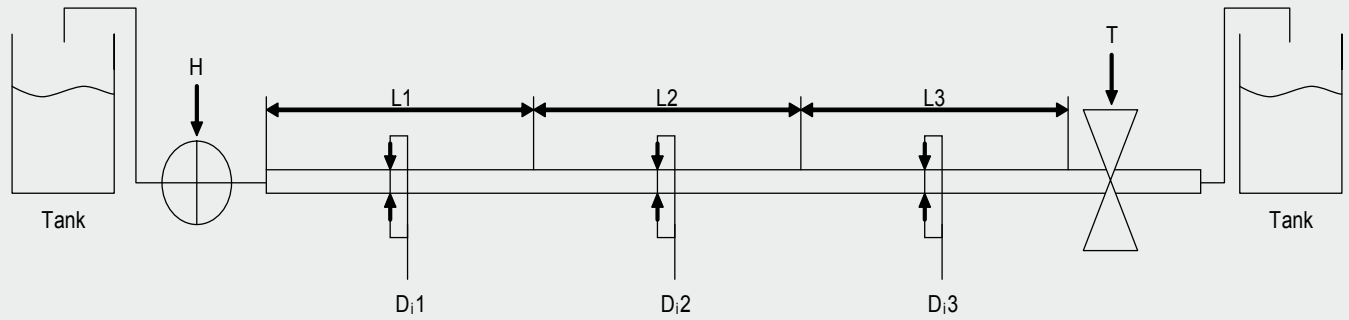
SHOCK ABSORBER SPECIFICATION FORM (Page 2/2)

(Subject to technical modifications)

Pipeline data for additional sections of pipe

Designation / Example

H = Zero head of the pump [m]
D_i = Internal diameter of the pipe [mm]
T = Closing time of the valve [s]
(effectively approx. 30 % of the total closing time)
L = Length of the pipeline [m]



No. of different pipes: 3

L1	= 200 m		D_i1	= 100 mm	
L2	= 50 m		D_i2	= 200 mm	
L3	= 20 m		D_i3	= 500 mm	

Typical values for speed of sound

Water = 1200 m/s
Fuel = 1100 m/s

Please complete below with the pipeline data

No. of different pipes: _____

L1	= _____ m	D_i1	= _____ mm	L5	= _____ m	D_i5	= _____ mm
L2	= _____ m	D_i2	= _____ mm	L6	= _____ m	D_i6	= _____ mm
L3	= _____ m	D_i3	= _____ mm	L7	= _____ m	D_i7	= _____ mm
L4	= _____ m	D_i4	= _____ mm	L8	= _____ m	D_i8	= _____ mm

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PULSATION DAMPER SPECIFICATION FORM

(Subject to technical modifications)

Company: _____ Location: _____

Project name: _____ Originator: _____

E-Mail: _____ Tel. no.: _____

Application: _____ Requirement: _____ pieces/year

Note:
The appropriate accumulator can be calculated using the HYDAC **A**ccumulator **S**imulation **P**rogram **ASP**.
Download from www.hydac.com.

Type of accumulator ☐ Bladder accumulator ☐ Piston accumulator ☐ Diaphragm accumulator ☐ _____

Fluids/medium

Fluid: _____ Viscosity at 20 °C: _____ cSt

Density: _____ kg/m³ Viscosity at operating temperature: _____ cSt

Pump and system data

Oper. press./pump pressure: _____ bar

Flow rate: _____ l/min

Rpm: _____ 1/min

No. of displacements: _____

☐ single ☐ double acting

Pump factor: _____ optional (if available)

Stroke volume: _____ 1 dm³

→ for piston pumps: $V_H = \frac{d^2 \times \pi}{4} \times H \times 10^6$

d = Ø piston: _____ mm

H = stroke length: _____ mm

→ for diaphragm pumps: see manufacturer's specifications

Accumulator data

Pre-charge pressure [1]: _____ bar

Operating temperature: _____ °C

Application: ☐ pressure side ☐ suction side

Required residual pulsation: _____ %

Result: _____ l gas volume [2]

* dependent on operating temperature and/or fluid resistance

[1] see catalogue section: No. 3.000, Sizing

[2] normally pre-charged with nitrogen (N_2)

Additional details on the accumulator

Industry: _____

Country of installation: _____

Design/Certification: _____

Specification: _____

Design pressure: _____ bar

Design temperature: _____ °C

Materials*

Accumulator shell: _____

Fluid connection: _____

Elastomer: _____

Additional information

Installation dimensions: _____ mm
(Height x $Ø_{ext.}$)

Fluid connection: Type: _____

For thread ☐ internal _____

☐ external _____

Standard: _____

Gas connection: _____

Colour/finish: ☐ internal _____

☐ external _____

Spare parts/Accessories: see www.hydac.com
under Products/Hydraulic accumulators

Comments: _____

Date: _____ Name: _____

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SILENCER SPECIFICATION FORM

(Subject to technical modifications)

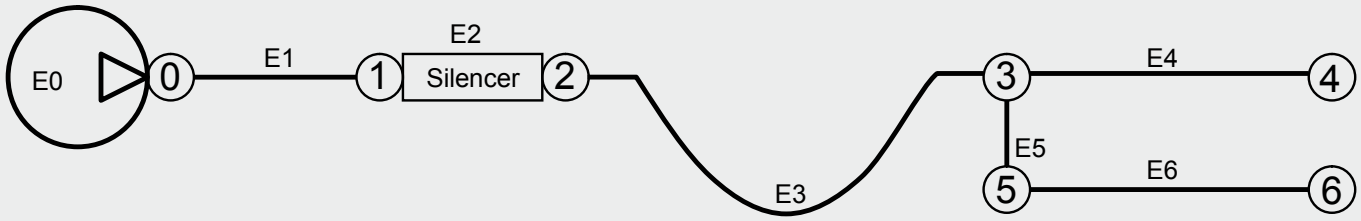
Company: _____ Location: _____

Project name: _____ Originator: _____

E-Mail: _____ Tel. no.: _____

Application: _____ Requirement: _____ pieces/year

Sizing example:



Pump:	**A10VSO71**	Design pressure:	**210 bar**	Silencer inlet:	**SAE 1 1/4“ 3000 PSI**
Pump rpm:	**1500 1/min**	No. of pump pistons:	**9**	Silencer outlet:	**SAE 1 1/4“ 3000 PSI**
Fluid:	**Aral Vitam GF**	Fluid density:	**890 kg/m³**	Design temperature:	**50 °C**

Element no.	Length [m]	Ø int. [m]	Ø ext. [m]	Subsequent connection type	Hose type
E1	0.5	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	–

Design data:

Pump: _____ Design pressure: _____ bar Silencer inlet: _____

Pump rpm: _____ 1/min No. of pump pistons: _____ Silencer outlet: _____

Fluid: _____ Fluid density: _____ Design temperature: _____ °C

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					

Comments: _____

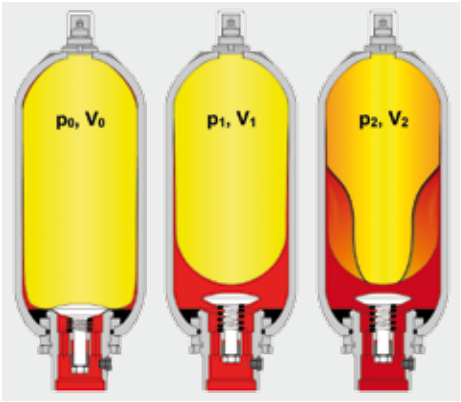
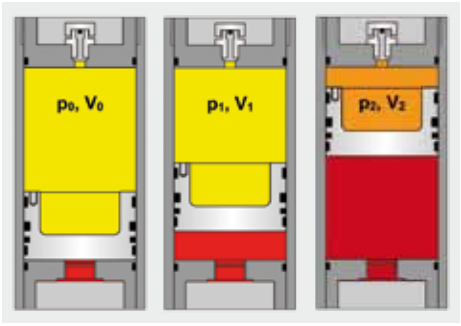
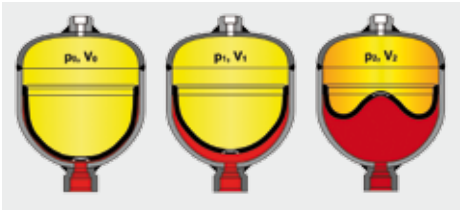
_____

_____

Date: _____ Name: _____

9. SIZING

9.1. DEFINITION OF VARIABLES FOR SIZING A HYDRAULIC ACCUMULATOR

Function principle	Accumulator cycle	Limits for the gas pre-charge pressure
Bladder accumulator  ① ② ③	① The accumulator is pre-charged with nitrogen. The separating element (piston, bladder, diaphragm) shuts off the fluid connection. ② The minimum operating pressure should be higher than the gas pre-charge pressure. This should prevent the separating element from striking the fluid connection every time fluid is discharged. ③ Once the max. operating pressure is reached, the effective volume ΔV is available in the accumulator: p_0 = Gas pre-charge pressure p_1 = Minimum operating pressure p_2 = Maximum operating pressure V_0 = Effective gas volume V_1 = Gas volume at p_1 V_2 = Gas volume at p_2 t_0 = Gas pre-charge temperature t_{min} = Min. operating temperature t_{max} = Max. operating temperature	$p_0 \leq 0.9 \cdot p_1$ with a permitted pressure ratio of $p_2 : p_0 \leq 4 : 1$ For HYDAC low pressure accumulators, the following must also be taken into account: Type SB40: $p_{0\,max}$ = 20 bar Type SB35H: $p_{0\,max}$ = 10 bar
Piston accumulator  ① ② ③		$p_{0,tmin} \geq 2$ bar (piston type 2) $p_{0,tmin} \geq 10$ bar (piston type 1) $p_{0,tmin} \leq p_1 - 5$ bar In extreme cases, during slow charging (isothermal) and rapid discharge (adiabatic) of the effective volume, and after accurate calculation, the gas pre-charge pressure $p_0 \geq p_1$ can be selected. Accumulator supplied uncharged or with 2 bar storage pressure.
Diaphragm accumulator  ① ② ③		a) Permitted pressure ratio: $p_2 : p_0$ Weld type: The pressure ratio of weld-type diaphragm accumulators is between 4 : 1 and 8 : 1, depending on the design, see catalogue section Diaphragm Accumulators, No. 3.100, Point 3.1. Screw type: All sizes: 10 : 1 Other pressure ratios on request b) $p_0 \leq 0.9 \cdot p_1$

9.2. SELECTION OF GAS PRE-CHARGE PRESSURE

The selection of the gas pre-charge pressure defines the accumulator capacity. In order to obtain optimum utilization of the accumulator volume the following gas pre-charge pressures are recommended:

9.2.1 Recommended values for energy storage:

$p_{0,t\,max} = 0.9 \cdot p_1$

for shock absorption:

$p_{0,t\,max} = 0.6$ to $0.9 \cdot p_m$
(p_m = average operating pressure for free flow)

for pulsation damping:

$p_{0,t\,max} = 0.6 \cdot p_m$
(p_m = average operating pressure)
or
$p_{0,t\,max} = 0.8 \cdot p_1$
(for several operating pressures)

During operation the separating element (piston, bladder, diaphragm) must not touch the fluid-side connection.

Since the volume of the gas increases as the temperature increases, the gas pre-charge pressure must be determined at the maximum operating temperature using the recommended values.

9.2.2 Limits for gas pre-charge pressure

(see right-hand column of table)

9.2.3 Temperature effect

So that the recommended gas pre-charge pressures can be maintained, even at relatively high operating temperatures, the $p_{0\,charge}$ for charging and testing cold accumulators must be selected as follows:

$$p_{0,\,t\,charge} = p_{0,t\,max} \cdot \frac{t_{charge} + 273}{t_{max} + 273}$$

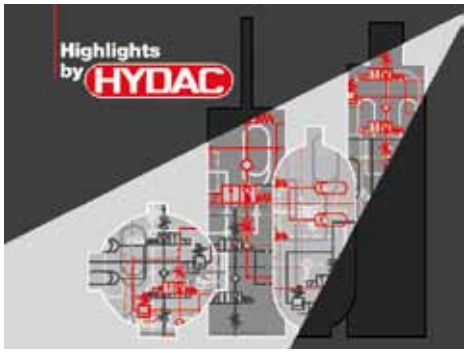
$t_0 = t_{charge}$ (gas charging temperature in °C)

To take the temperature effect into account when sizing accumulators, the pre-charge pressure p_0 at min. temperature t_0 must be selected as follows:

$$p_{0,\,t\,min} = p_{0,t\,max} \cdot \frac{t_{min} + 273}{t_{max} + 273}$$

9.3. ACCUMULATOR SIZING ON YOUR PC

ASP - **A**CCUMULATOR
SIMULATION **P**ROGRAM



You want to size an accumulator for your hydraulic system and need to find out the required gas volume? How does the accumulator actually behave in the system?

The formulae required for this are complicated and also have only limited relevance.

The solution: HYDAC **ASP** - **A**ccumulator **S**imulation **P**rogram:

- Accumulator sizing on your PC with Windows interface for bladder, piston and diaphragm accumulators and systems using back-up nitrogen bottles, taking into account isentropic, isothermal and polytropic changes in condition.
- Calculation of accumulator systems with the possibility of adding accumulators, consumers and pumps with their particular switch-on and switch-off times.
- Simulation of pressure, temperature and volume over the given cycle time. Real gas equations are used for this and the accumulator type and its heat exchange behaviour is taken into account in the calculation.
- Sizing of pulsation dampers.
- Calculation of the gas volume and the residual pulsation of gas-filled pulsation dampers.
- Sizing of shock absorbers, calculation of the required gas volume for "Joukowsky shock".

  Complex pipe systems are possible on request.
- Display of the gas compression and the degree of efficiency.

Example
Petrol tanker filling station

When loading fuels into vehicles, ships or barrels, the flow is suddenly interrupted when the valve closes.

This deceleration of mass results in a pressure shock which is also referred to as a “Joukowsky pressure shock”. By using a hydraulic accumulator, the pressure shock can be reduced to a tolerable level.

Given parameters:

● Temperature:	20 °C Fluid: PETROL (Premium leaded) (Density: 0.760 kg/dm^3)
● Pipe length from pump to valve:	900 m
● Pipe $Ø_{internal}$:	Internal diameter = 107.1 mm (DN100 = 114.3 external, wall thickness = 3.6 mm)
● Zero head of the pump:	147.5 m, equivalent to 11 bar
● Pump pressure at operating point:	10 bar (pre-charge pressure p_0 = 9 bar)
● Max. permitted pressure of the pipe:	12 bar
● Flow rate:	500 l/min
● Closing time of the shut-off valve:	1s (0.33 s effectively)
● Pipe material:	Steel E = 2.1 x 10^5 N/mm²

Required:

a. Maximum Joukowsky pressure shock in bar
b. Maximum flow velocity in the pipe in m/s
c. Required accumulator gas volume in litre

Solution:

a. Maximum Joukowsky pressure shock:	18.867 bar
b. Maximum flow velocity:	0.925 m/s
c. Required accumulator gas volume:	41.795 l

10. NOTE

The information in this brochure relates to the operating conditions and applications described.

For applications and operating conditions not described here, please contact the relevant technical department.

Subject to technical modifications.

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Bladder Accumulators
Standard

1. DESCRIPTION

1.1. FUNCTION

Fluids are practically incompressible and cannot therefore store pressure energy.

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

A bladder accumulator consists of a fluid section and a gas section with the bladder acting as the gas-proof screen. The fluid around the bladder is connected to the hydraulic circuit so that the bladder accumulator draws in fluid when the pressure increases and the gas is compressed. When the pressure drops, the compressed gas expands and forces the stored fluid into the circuit.

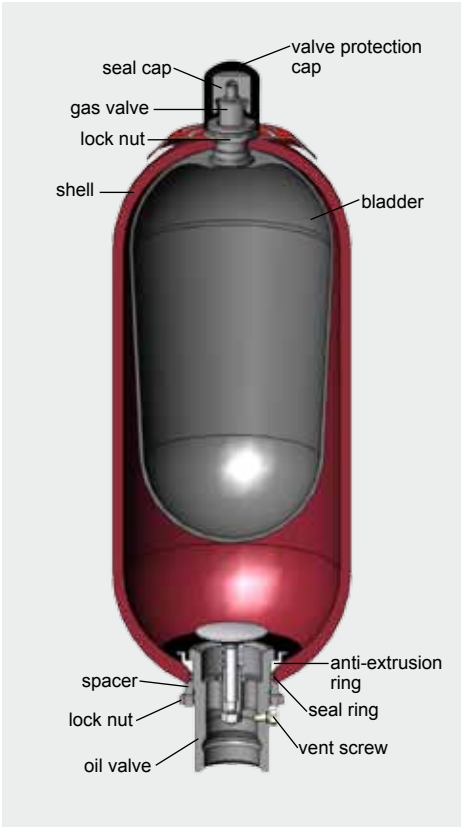
HYDAC bladder accumulators can be used in a wide variety of applications, some of which are listed below:

- energy storage
- emergency operation
- force equilibrium
- leakage compensation
- volume compensation
- shock absorption
- vehicle suspension
- pulsation damping

See catalogue section:

- Hydraulic Dampers No. 3.701

1.2. DESIGN



Design

- **Standard Bladder Accumulator 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 vessel is seamless and manufactured from high tensile steel.
- **Bladder accumulator SB 330N**
  The flow optimised design of the standard oil valve enables the maximum possible operating fluid flow rate to increase to 25 l/s on this accumulator type.
- **High Flow bladder accumulator SB330H**
  HYDAC high flow bladder accumulators, type SB330H, are high performance accumulators with a flow rate of up to 30 l/s. The fluid connection is enlarged to allow higher flow rates.

1.3. BLADDER MATERIAL

The following elastomers are available as standard:

- NBR (acrylonitrile butadiene rubber, perbunan),
- IIR (butyl rubber),
- FKM (fluoro rubber, Viton®),
- ECO (ethylene oxide epichlorohydrin rubber).

The material must be selected according to the particular operating fluid and temperature.

When choosing the elastomer, allowances must be made for the fact that the gas can cool down to below the permitted elastomer temperature if there are adverse discharge conditions (high pressure ratio p_2/p_0, high discharging velocity). This can cause cold cracking in the elastomer. The gas temperature can be calculated using the HYDAC Accumulator Simulation Program ASP.

1.4. CORROSION PROTECTION

For operation with chemically aggressive media, the accumulator shell can be supplied with corrosion protection, such as plastic coating on the inside or chemical nickel-plating. If this is insufficient, then stainless steel accumulators must be used.

1.5. MOUNTING 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. On 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 mounting position is horizontal or at a slant, the effective volume and the maximum permitted flow rate of the operating fluid are reduced.

1.6. TYPE OF MOUNTING

By using an appropriate adapter, HYDAC accumulators, up to size 1 l, can be mounted directly inline.

For strong vibrations and volumes above 1 litre, we recommend the use of HYDAC accumulator supports or the HYDAC accumulator mounting set.

See catalogue sections:

- Supports for Hydraulic Accumulators
  No. 3.502
- ACCUSET SB
  No. 3.503

2. TECHNICAL SPECIFICATIONS

2.1. EXPLANATORY NOTES

2.1.1 Operating pressure

See tables (may differ from nominal pressure for foreign test certificates).

2.1.2 Nominal volume

See tables

2.1.3 Effective gas volume

See tables
Based on nominal dimensions, this differs slightly from the nominal volume and must be used when calculating the effective volume.

2.1.4 Effective volume

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

2.1.5 Max. flow rate of operating fluid

In order to achieve the max. flow rate given in the tables, the accumulator must be mounted vertically. It must be noted that a residual fluid volume of approx. 10 % of the effective gas volume remains in the accumulator.

2.1.6 Fluids

The following sealing and bladder materials are suitable for the fluids listed below.

Material	Fluids
NBR20	Mineral oils (HL, HLP, HFA, HFB, HFC), water
ECO	Mineral oil
IIR	Phosphate ester
FKM	Chlorinated hydro-carbons, petrol

2.1.7 Permitted operating temperature

The permitted operating temperatures are dependent on the application limits of the metal materials and the bladder.

The standard valve bodies, gas valves and accumulator shells are suitable for temperatures from -10 °C ... +80 °C.

Outside these temperatures, special material combinations must be used.
The following table shows the correlation between bladder material and application temperature.

Material	Temperature ranges
NBR20	-15 °C ... + 80 °C
NBR21	-50 °C ... + 80 °C
NBR22	-30 °C ... + 80 °C
ECO	-30 °C ... +120 °C
IIR	-40 °C ... +100 °C
FKM	-10 °C ... +150 °C

2.1.8 Gas charging

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 4.5, filtered to < 3 µm.
If other gases are to be used, please contact HYDAC for advice.

2.1.9 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 = gas pre-charge pressure

2.1.10 Certificate codes

Australia	F1 [1]
Brazil	U3 [3]
Canada	S1 [2]
China	A9
CIS	A6
EU member states	U
India	U3 [3]
Japan	P
New Zealand	T
Switzerland	U
Ukraine	A10
USA	S

[1] Approval required in the individual territories

[2] Approval required in the individual provinces

[3] Alternative certificates possible

On no account must any welding, soldering or mechanical work be carried out on the accumulator shell. After the hydraulic line has been connected it must be completely vented.

Work on systems with hydraulic accumulators (repairs, connecting pressure gauges etc) must only be carried out once the pressure and the fluid have been released.

**Please read the Operating Manual!
No. 3.201.CE**

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

- Accumulators
  No. 3.000

2.1.11 Gas side connection Standard

Series	Volume [l]	Gas valve type
SB330 / SB400	< 1	5/8-18UNF
	< 50	7/8-14UNF
	≥ 50	M50x1.5 / 7/8-14UNF

other pressure ranges on request.

2.2. MODEL CODE
(also order example)

SB330 H – 32 A 1 / 112 U – 330 A 050

Series

Type code
H = high flow
N = increased flow, standard oil valve dimensions
A = shock absorber
P = pulsation damper
S = suction flow stabiliser
B = bladder top-repairable
Combinations possible, e.g. HB - High flow with top-repairable bladder or
PH - pulsation damper with high flow rate.
no details = standard

Nominal volume [l]

Fluid connection
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. on thread M50x1.5 - valve)
G = male thread
S = special connection, to customer specification

Gas side
1 = standard model (see point 2.1.11)
2 = back-up model
3 = gas valve 7/8-14UNF with M8 female 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
9 = special gas valve, to customer specification

Material code [1)]
Standard model = 112 for mineral oils
depending on operating medium
others on request

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

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

Accumulator bladder [2)]
2 = NBR20
3 = ECO
4 = IIR (butyl)
5 = NBR21 (low temperature)
6 = FKM
7 = Others
9 = NBR22

Certificate code
U = PED 97/23/EC

Permitted operating pressure [bar]

Connection
Thread, codes for fluid connections: A, C, E, G
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 B1.20.1 (NPT)
S = special thread, to customer specification

Flange, codes for fluid connection: F
A = DIN flange
B = flange ANSI 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)] Not all combinations are possible
[2)] When ordering spare bladder, please state diameter of the smaller shell port
[3)] Depending on type and pressure rating

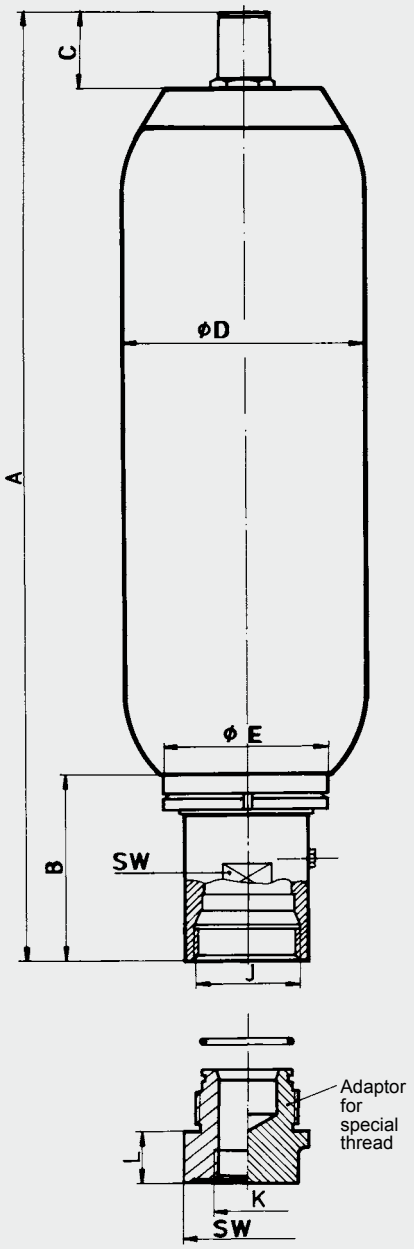
3. DIMENSIONS AND SPARE PARTS

3.1. DIMENSIONS

Nominal volume [l]	Valve	Max. operating pressure (PED 97/23/EC) [bar]	Effective gas volume [l]	Weight [kg]	A max. [mm]	B [mm]	C [mm]	Ø D max. [mm]	J thread ISO 228	Ø E [mm]	SW [mm]	Q [1] [l/s]
0.5	Standard	400	0.5	2.8	270	57	33.5	95.5	G 3/4	50	32	4
1		330	1	4.5	302		58	118				
		550		8.5	334	68		121	G 1	67	45	6
2.5		330	2.4	10	531	63		118	G 1 1/4		50	10
		550	2.5	13.5	539	68		121	G 1		45	6
4		330	3.7		419	63		173	G 1 1/4		50	10
		400										
5		550	4.9	23	867	68		121	G 1		45	6
6		330	5.7	15	531	63		173	G 1 1/4		50	10
10 [2]		330	9.3	25	728				G 1 1/4			
10	Standard	330	9.3	31.5	568	103	58	229	G 2	100	70	15
	N											25
	H		9	34.5	603	138			G 2 1/2	125	90	30
	Standard	400	9.3	37.5	572	103		233	G 2	100	70	15
		500	8.8	45	585	77	68	241				
13	Standard	330	12	43	686	103	58	229	G 2	100	70	15
	N											25
	H			46	695	138			G 2 1/2	125	90	30
	Standard	400		49	666	103		233	G 2	100	70	15
20	Standard	330	18.4	50.5	896	103	58	229	G 2	100	70	15
	N											25
	H		17.5	53.5	931	138			G 2 1/2	125	90	30
	Standard	400	18.4	63.5	896	103		233	G 2	100	70	15
		500	17	75.5	901	77	68	241		110	75	
24	Standard	330	23.6	69	1062	103	58	229	G 2	100	70	15
	N											25
	H		24	72	1097	138			G 2 1/2	125	90	30
32	Standard	330	33.9	87	1411	103	58	229	G 2	100	70	15
	N											25
	H		32.5	90	1446	138			G 2 1/2	125	90	30
	Standard	400	33.9	104.5	1411	103		233	G 2	100	70	15
		500	33.5	127	1446	77	68	241		110	75	
50		330	47.5	117.5	1931	103	68	229	G 2	100	70	15
	N											25
	H			120.5	1966	138			G 2 1/2	125	90	30
	Standard	400		142	1931	103		233	G 2	100	70	15
		500	48.3	169	1951	77		241			75	
60	Standard	330	60	182	1156	138	68	356	G 2 1/2	125	90	30
80			85	221	1406							
100			105	255	1656							
130			133	305	1976							
160			170	396	2006			406				
200			201	485	2306							

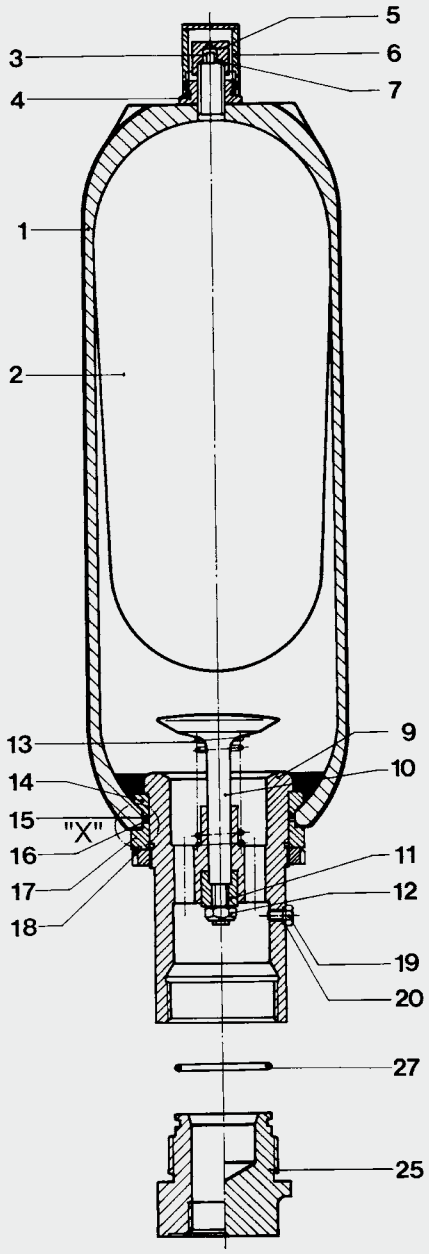
[1] Q = max. flow rate of operating fluid
[2] slimline version, for confined spaces

Dimensions

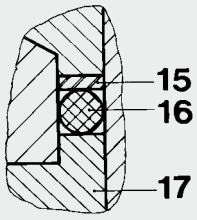


3.2. SPARE PARTS

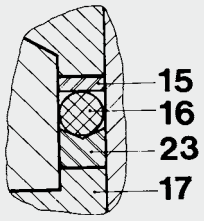
SB330/400/440/500/550
SB330H / SB330N



Detail "X"
SB330/400 – 0.5 ... 6 l



SB330/400/500 – 10 ... 200 l and
SB330H – 10 ... 200 l
SB550 – 1 ... 5 l



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

* available separately

[1] When ordering, please state diameter of the smaller shell port.

Item 1 not available as a spare part.

Item 19 for NBR/Carbon steel: seal ring (item 20) is included

Item 25 must be ordered as an accessory (see Point 4).

3.3. REPAIR KITS

NBR, carbon steel
Nominal volume: 0.5 ... 200 litres
Standard gas valve

Nom. volume [l]	Part no.
0.5	02128169
1	02106261
2.5	02106200
4	02106204
5	02106208
6	02112100
10*	03117512
10	02106212
13	02106216
20	02106220
24	02106224
32	02106228
50	02106252
60	03117513
80	03117514
100	03117515
130	03117516
160	03117517
200	03117558

* slimline version for confined spaces
others on request

4. ACCESSORIES FOR BLADDER ACCUMULATORS

4.1. ADAPTERS (GAS SIDE)

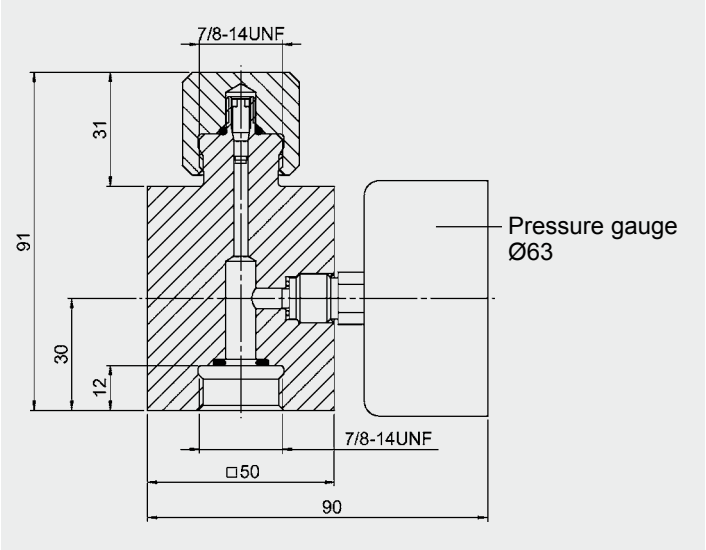
To monitor the accumulator pre-charge pressure, HYDAC offers a selection of gas side adapters.

For standard connection sizes (7/8-14UNF) the adapters shown below are available and must be stated separately at time of ordering.

For other gas-side accumulator connections (e.g. 5/8-18UNF) please contact your HYDAC agent.

4.1.1 **Pressure gauge model:**

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

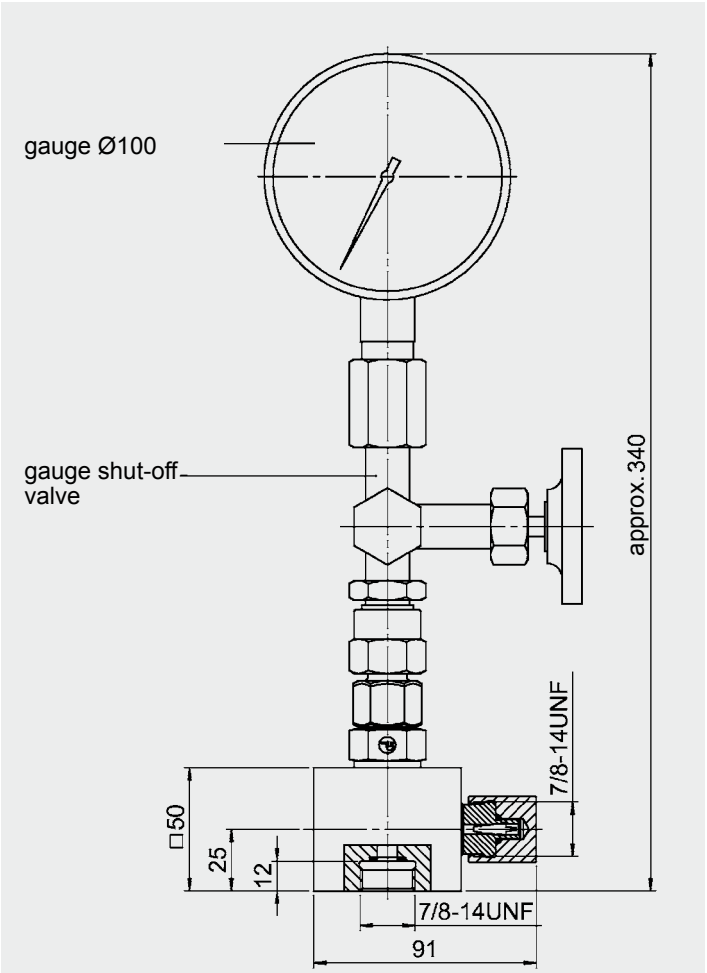


Gauge indication range	Pressure gauge Part no.	Adapter body* Part no.	Adapter assembly Part no.
–	–	00239275	00366621
0 - 10 bar	00614420		02108416
0 - 60 bar	00606886		03093386
0 - 100 bar	00606887		02104778
0 - 160 bar	00606888		03032348
0 - 250 bar	00606889		02100217
0 - 400 bar	00606890		02102117

* p_{max} = 400 bar

4.1.2 **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.



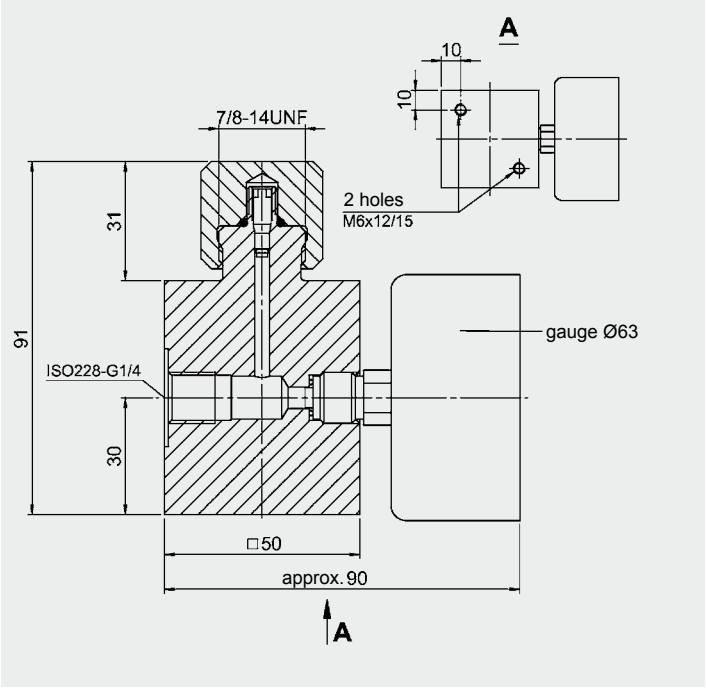
Gauge indication range	Pressure gauge Part no.	Adapter body* Part no.	Adapter assembly Part no.
–	–	00363713	02103381
0 - 25 bar	00631380		02105216
0 - 60 bar	00606771		02110059
0 - 100 bar	00606772		03139314
0 - 160 bar	00606773		03202970
0 - 250 bar	00606774		03194154
0 - 400 bar	00606775		02103226

* p_{max} = 400 bar

4.1.3 **Remote monitoring of the pre-charge pressure**

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

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



Gauge indication range	Pressure gauge Part no.	Adapter body* Part no.	Adapter assembly Part no.
–	–	02116746	03037666
0 - 10 bar	00614420		03095818
0 - 60 bar	00606886		03095819
0 - 100 bar	00606887		03095820
0 - 160 bar	00606888		03095821
0 - 250 bar	00606889		03095822
0 - 400 bar	00606890		03095823

* p_{max} = 400 bar

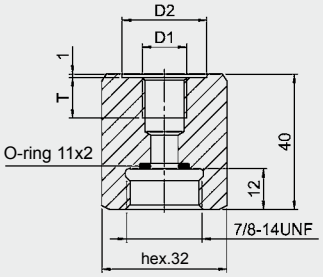


Diagram 1

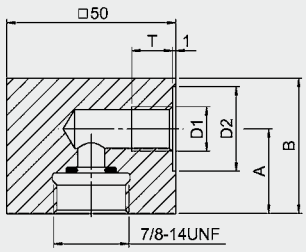


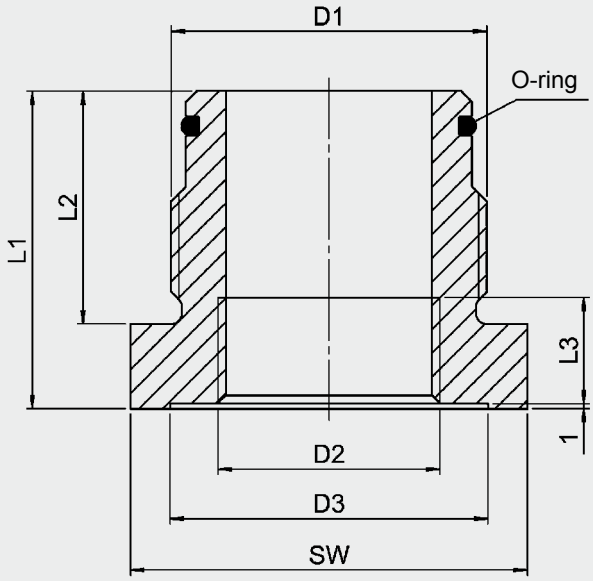
Diagram 2

D1 Threaded connection	D2 [mm]	T	Adapter body* Part no.	Adapter assembly Part no.	Diag.
ISO228- G 1/4	25	14	00238709	02109481	1
			00241740	02102042	2
ISO228- G 3/8	28		00355021	02109483	1
			03280414	00366607	2
ISO228- G 1/2	34	16	02110594	02110636	1
			00237884	00366608	2

* p_{max} = 400 bar

4.2. ADAPTERS FOR STANDARD BLADDER ACCUMULATORS (FLUID SIDE)

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



D1 Accum. conn.* (ISO228-BSP)	D2 [mm]	D3 [mm]	L1 [mm]	L2 [mm]	L3 [mm]	SW [mm]	O-ring [mm]	Part no. NBR/ Carbon steel
G 3/4	G 3/8	28	55	28	12	32	17x3	02104346
	G 1/2		60		14	36		02104348
G 1 1/4	G 3/8	28	50	37	12	46	30x3	02116345
	G 1/2	34			14			02105232
	G 3/4	44			16			02104384
	G 1	50	67		18	65		02110124
G 2	G 1/2	34	60	44	14	65	48x3	02104853
	G 3/4	44			16			02104849
	G 1 1/4	60			20			02107113
	G 1 1/2	68	80		22	70		02105905

* others on request

5. 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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E 3.201.26/03.12

Bladder Accumulators
Low Pressure

1. DESCRIPTION

1.1. FUNCTION

Fluids are practically incompressible and cannot therefore store pressure energy.

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

A bladder accumulator consists of a fluid section and a gas section with the bladder acting as the gas-proof screen. The fluid around the bladder is connected to the hydraulic circuit so that the bladder accumulator draws in fluid when the pressure increases and the gas is compressed. When the pressure drops, the compressed gas expands and forces the stored fluid into the circuit.

HYDAC bladder accumulators can be used in a wide variety of applications, some of which are listed below:

- energy storage
- emergency operation
- force equilibrium
- leakage compensation
- volume compensation
- shock absorption
- vehicle suspension
- pulsation damping

See catalogue section:

- Hydraulic Dampers No. 3.701

1.2. DESIGN

HYDAC low pressure bladder accumulators consist of a welded pressure vessel, a flexible bladder with gas valve and a hydraulic connection with check valve or a perforated disc.

The table shows the different models which are described in greater detail in the pages that follow:

Designation	Perm. pressure [bar] 2)	Volume [l]	Q 1) [l/s]
SB40- 2.5 ... 50	40	2.5 - 50	7
SB40- 70 ... 220		70 - 220	30
SB35HB- 20 ... 50	35	20 - 50	20
SB16A- 100 ... 450	16	100 - 450	15
SB35A- 100 ... 450	35		
SB16AH- 100 ... 450	16		20
SB35AH- 100 ... 450	35		

1) Q = max. flow rate of pressure fluid
2) Higher pressures on request

1.3. BLADDER MATERIAL

The following elastomers are available as standard:

- NBR (acrylonitrile butadiene rubber, perbunan),
- IIR (butyl rubber),
- FKM (fluoro rubber, Viton®),
- ECO (ethylene oxide epichlorohydrin rubber).

The material must be selected according to the particular operating fluid and temperature.
When choosing the elastomer, allowances must be made for the fact that the gas can cool down to below the permitted elastomer temperature if there are adverse discharge conditions (high pressure ratio p_2/p_0, high discharging velocity). This can cause cold cracking in the elastomer.
The gas temperature can be calculated using the HYDAC Accumulator Simulation Program ASP.

1.4. CORROSION PROTECTION

For operation with chemically aggressive media, the accumulator shell can be supplied with corrosion protection, such as plastic coating on the inside or chemical nickel-plating. If this is insufficient, then stainless steel accumulators must be used.

1.5. MOUNTING 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. On 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,
- Pressure surge damping: vertical,
- Volume compensation: vertical.

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

Bladder accumulators SB16A / SB35A and SB16AH / SB35AH must only be installed vertically with the gas side at the top.

1.6. TYPE OF MOUNTING

For strong vibrations and volumes above 1 litre, we recommend the use of HYDAC accumulator supports or the HYDAC accumulator mounting set.

See catalogue sections:

- Supports for Hydraulic Accumulators No. 3.502
- ACCUSET SB No. 3.503

2. TECHNICAL SPECIFICATIONS

2.1. EXPLANATORY NOTES

2.1.1 Operating pressure

See tables (may differ from nominal pressure for foreign test certificates).

2.1.2 Nominal volume

See tables

2.1.3 Effective gas volume

See tables
Based on nominal dimensions, this differs slightly from the nominal volume and must be used when calculating the effective volume.

2.1.4 Effective volume

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

2.1.5 Max. flow rate of the operating fluid

In order to achieve the max. flow rate given in the tables, the accumulator must be mounted vertically. It must be noted that a residual fluid volume of approx. 10 % of the effective gas volume remains in the accumulator.

2.1.6 Fluids

The following sealing and bladder materials are suitable for the fluids listed below.

Material	Fluids
NBR	Mineral oils (HL, HLP, HFA, HFB, HFC), water
ECO	Mineral oil
IIR	Phosphate ester, water
FKM	Chlorinated hydrocarbons, petrol

2.1.7 Permitted operating temperature

The permitted operating temperatures are dependent on the application limits of the metal materials and the bladders.

The standard valve bodies, gas valves and accumulator shells are suitable for temperatures from -10 °C ... +80 °C.

Outside these temperatures, special material combinations must be used.
The following table shows the correlation between bladder material and application temperature.

Material	Temperature ranges
NBR20	-15 °C ... +80 °C
NBR21	-50 °C ... +80 °C
NBR22	-30 °C ... +80 °C
ECO	-30 °C ... +120 °C
IIR	-40 °C ... +100 °C
FKM	-10 °C ... +150 °C

2.1.8 Gas charging

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 4.5, filtered to < 3 µm.
If other gases are to be used, please contact HYDAC for advice.

2.1.9 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 = gas pre-charge pressure

For HYDAC low pressure accumulators, the following must also be taken into account:

Type SB40: $p_{0\,max}$ = 20 bar
Type SB35HB: $p_{0\,max}$ = 10 bar

2.1.10 Certificate codes

Australia	F1 [1]
Brazil	U3 [3]
Canada	S1 [2]
China	A9
CIS	A6
EU member states	U
India	U3 [3]
Japan	P
New Zealand	T
Switzerland	U
Ukraine	A10
USA	S
others on request	

[1] Approval required in the individual territories
[2] Approval required in the individual provinces
[3] Alternative certificates possible

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 incorporating hydraulic accumulators (repairs, connecting pressure gauges etc) must only be carried out once the pressure and the fluid have been released.

Please read the Operating Manual! No. 3.201.CE

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

- Accumulators
  No. 3.000

2.2. MODEL CODE
(also order example)

SB40 A – 100 F 7 / 112 U – 40 A

Series

Type code
H = high flow
N = increased flow, standard oil valve dimensions
A = shock absorber
B = bladder top-repairable
Combinations possible, e.g. HB - High flow with top-repairable bladder
no details = standard

Nominal volume [l]

Fluid connection
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. on thread M50x1.5 - valve)
G = male thread
S = special connection, to customer specification

Gas side
1 = standard model
2 = back-up model
3 = gas valve 7/8-14UNF with M8 female 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
9 = special gas valve, to customer specification

Material code [1)]
Standard model = 112 for mineral oils
depending on operating medium
Others on request

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

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

Accumulator bladder [2) 4)]
2 = NBR20
3 = ECO
4 = IIR (butyl)
5 = NBR21 (low temperature)
6 = FKM
7 = Others
9 = NBR22

Certificate code
U = PED 97/23/EC

Permitted operating pressure [bar]

Connection
Thread, codes for fluid connections: A, C, E, G
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 B1.20.1 (NPT)
S = special thread, to customer specification

Flange, codes for fluid connection: 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

Required gas pre-charge pressure must be stated separately!

[1)] Not all combinations are possible
[2)] When ordering spare bladder, please state diameter of the smaller shell port
[3)] Depending on type and pressure rating
[4)] Standard materials, all other materials on request

3. LOW PRESSURE ACCUMULATORS

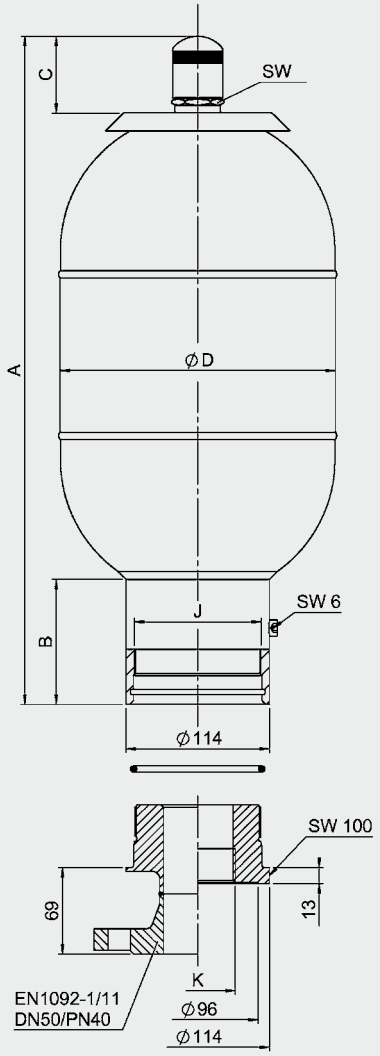
3.1. STANDARD BLADDER ACCUMULATORS SB40-2.5 ... 50

3.1.1 Design

HYDAC standard low pressure accumulators consist of:

- A welded pressure vessel which can be treated with various types of corrosion protection for chemically aggressive fluids, or can be supplied in stainless steel.
- A bladder with gas valve. The bladders are available in the elastomers listed under point 2.1.
- A hydraulic connector with a perforated disc which is held in place with retaining ring.

3.1.2 Dimensions SB40-2.5 ... 50



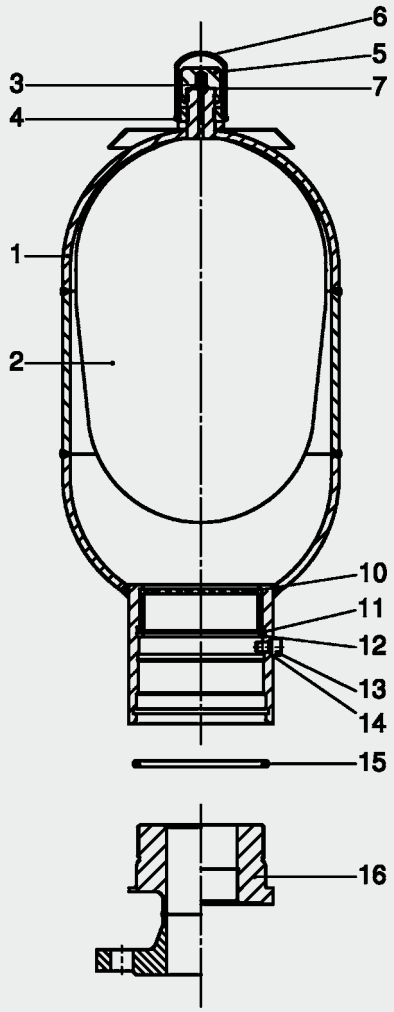
SB40-2.5 ... 50

Permitted operating pressure 40 bar (PED 97/23/EC)

Nominal volume [l]	Eff. gas volume [l]	Weight [kg]	A [mm]	B [mm]	C [mm]	Ø D [mm]	J thread ISO DIN 13	K* thread ISO 228	SW [mm]	Q [1] [l/s]
2.5	2.5	9	541	122	68	108	M100x2	G 2	36	7
5	5.0	13	891							
10	8.7	14	533	106		219				
20	18.0	23	843							
32	33.5	38	1363							
50	48.6	52	1875						68 [2]	

* Item 16 must be ordered separately
[1] Q = max. flow rate of operating fluid (at approx. 0.5 bar pressure drop via adapter)
[2] Lock nut

3.1.3 Spare parts SB40-2.5 ... 50



Description	Item
Bladder assembly [1] consisting of:	
Bladder	2
Gas valve insert*	3
Lock nut	4
Seal cap	5
Valve protection cap	6
O-ring	7
Seal kit consisting of:	
O-ring	7
Vent screw	13
Seal ring	14
O-ring	15
Repair kit [1] consisting of:	
Bladder assembly (see above)	
Seal kit (see above)	
Hydraulic connector assembly consisting of:	
Perforated disc	10
Anti-extrusion ring	11
Retaining ring	12
Vent screw	13
Seal ring	14
O-ring	15

* available separately
[1] When ordering, please state diameter of the smaller shell port.
Item 1 not available as a spare part.

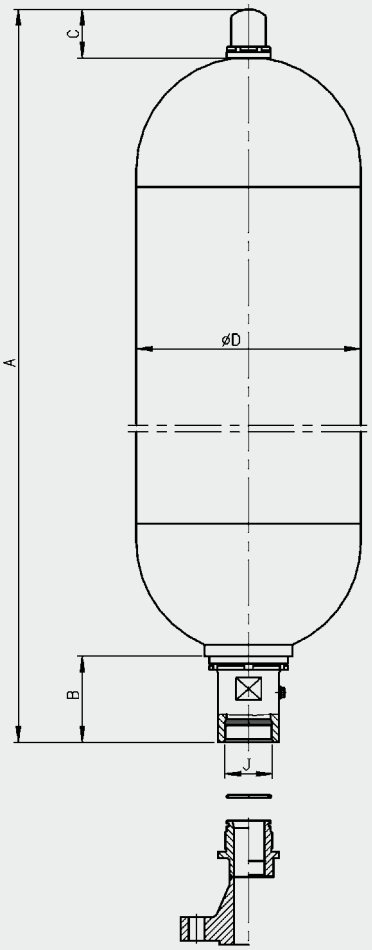
3.2. BLADDER ACCUMULATORS SB40-70 ... 220

3.2.1 Design

HYDAC low pressure accumulators, type SB40-70 ... 220 consist of:

- A welded pressure vessel which is compact and yet suitable for high flow rates and large volumes.
  The pressure vessel is manufactured in carbon steel or in stainless steel.
- A bladder with gas valve.
- A hydraulic connector with check valve.

3.2.2 Dimensions SB40-70 ... 220



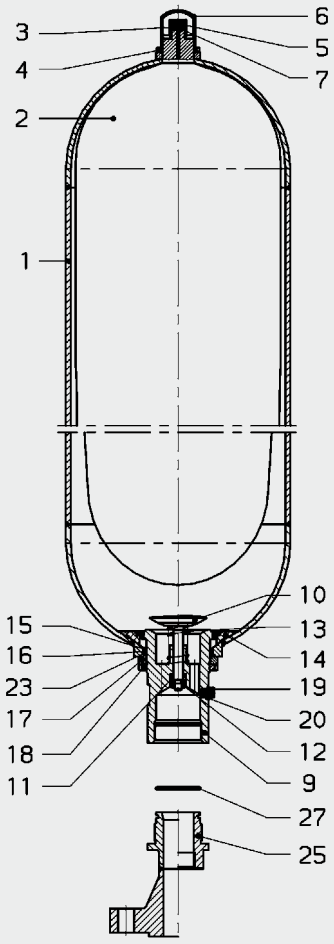
SB40-70 ... 220

Permitted operating pressure 40 bar
(PED 97/23/EC)

Nominal volume [l]	Eff. gas volume [l]	Weight [kg]	A max. [mm]	B [mm]	C [mm]	Ø D [mm]	J thread ISO 228	Q [1] [l/s]
70	64	94	1199	137	78	356	G 2 1/2	30
100	111	113	1629					
130	133	133	1879					
190	192	169	2086			407		
220	220	193	2330					

[1] Q = max. flow rate of operating fluid

3.2.3 Spare parts SB40-70 ... 220



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

* available separately

[1] When ordering, please state diameter of the smaller shell port.

Item 1 not available as a spare part.

Item 19 for NBR/Carbon steel:
seal ring (item 20) included

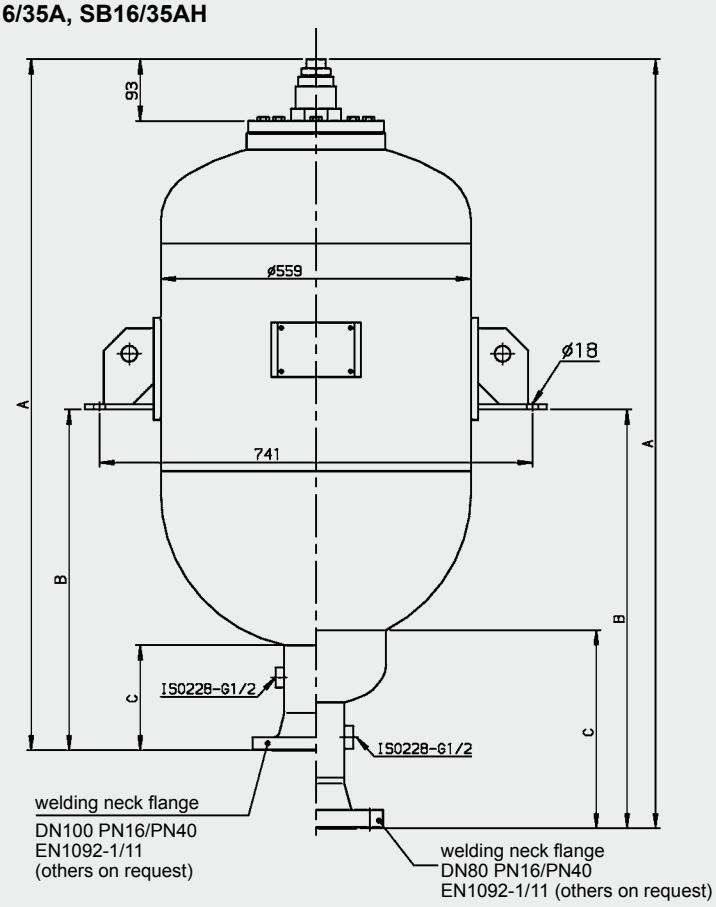
3.3. LOW PRESSURE ACCUMULATORS SB16/35A AND SB16/35AH

3.3.1 Design

HYDAC low pressure bladder accumulators for large volumes, type SB35A and SB16A are in a weld construction in carbon steel or stainless steel.

The hydraulic outlet is covered by a perforated disc which prevents the flexible bladder extruding from the shell. The bladder is top-repairable.

3.3.2 Dimensions SB16/35A, SB16/35AH



SB16/35A

Permitted operating pressure 16/35 bar
(PED 97/23/EC)

Nominal volume [l]	Eff. gas volume [l]	Weight [kg] SB16A	Weight [kg] SB35A	A (approx.) [mm] SB16A	A (approx.) [mm] SB35A	B (approx.) [mm] SB16A	B (approx.) [mm] SB35A	C (approx.) [mm] SB16A	C (approx.) [mm] SB35A	DN*
100	99	84	144	880	880	390	403	185	198	100
150	143	101	161	1070	1080	490	503			
200	187	122	223	1310	1320	685	698			
300	278	155	288	1710	1720	975	988			
375	392	191	326	2230	2240	1250	1263			
450	480	237	386	2325	2635	1465	1478			

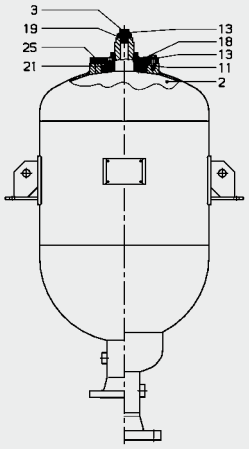
SB16/35AH

Permitted operating pressure 16/35 bar
(PED 97/23/EC)

Nominal volume [l]	Eff. gas volume [l]	Weight [kg] SB16AH	Weight [kg] SB35AH	A (approx.) [mm] SB16AH	A (approx.) [mm] SB35AH	B (approx.) [mm] SB16AH	B (approx.) [mm] SB35AH	C (approx.) [mm] SB16AH	C (approx.) [mm] SB35AH	DN*
100	99	93	153	957	965	457	465	245	254	80
150	143	110	170	1157	1165	557	565			
200	187	131	230	1417	1425	842	850			
300	278	164	297	1865	1873	1092	1100			
375	392	200	335	2307	2315	1342	1350			
450	480	246	395	2702	2710	1542	1550			

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

3.3.3 Spare parts SB16/35A, SB16/35AH



Description	Item
Bladder	2
Lock nut	3
O-ring	11
Seal ring	13
Vent screw	18
O-ring	19
Retaining ring	21
O-ring	25

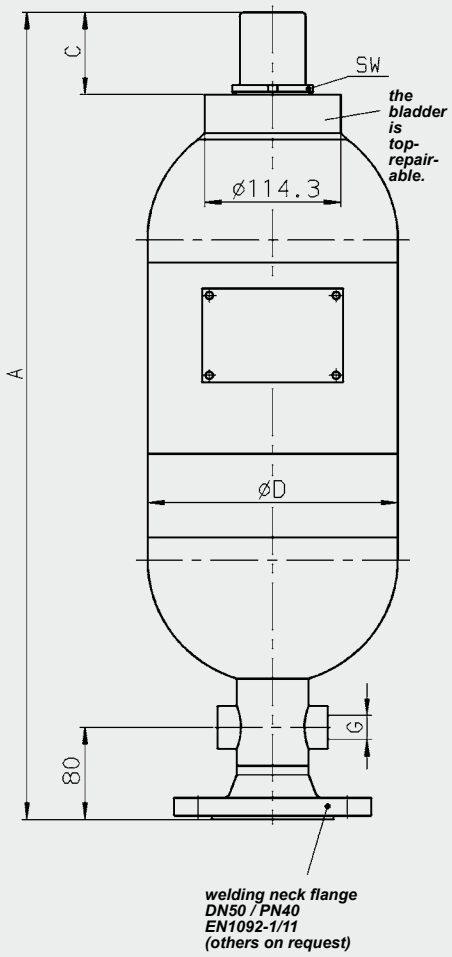
3.4. HIGH FLOW BLADDER ACCUMULATOR SB35HB

3.4.1 Design

HYDAC high flow bladder accumulators type SB35HB are high performance accumulators for flow rates of up to 20 l/s at 2 bar Δp.

They consist of a pressure vessel in a weld construction and a flexible bladder with gas valve.
The pressure vessel contains a fixed perforated disc, permitting a high flow rate through its large free cross-section. For use with chemically aggressive fluids, the shell can be manufactured in stainless steel. See point 2.1. for bladder materials.

3.4.2 Dimensions SB35HB



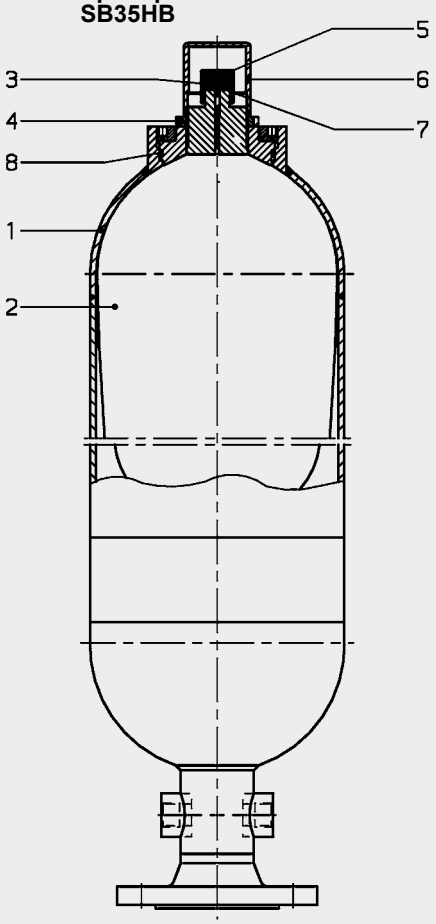
SB35HB

Permitted operating pressure 35 bar
(PED 97/23/EC)

Nominal volume [l]	Eff. gas volume [l]	Weight [kg]	A max. [mm]	C [mm]	Ø D [mm]	J thread ISO 228	SW [mm]	Q [1] [l/s]
20	19.8	43	1081	63	219	G 1/2	36	20
32	35.0	56	1591					
50	50.0	69	2091	78			Ø68 [2]	

[1] Q = max. flow rate of pressure fluid
[2] Lock nut

3.4.3 Spare parts SB35HB



Description	Item
Bladder assembly [1] consisting of:	
Bladder	2
Gas valve insert*	3
Lock nut	4
Seal cap	5
Valve protection cap	6
O-ring	7
Seal kit consisting of:	
Gas valve insert*	3
O-ring	7
O-ring	8
Repair kit [1] consisting of:	
Bladder assembly (see above)	
Seal kit (see above)	

* available separately

[1] When ordering, please state diameter of the smaller shell port.

Item 1 not available as a spare part.

4. 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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Bladder Accumulators
High pressure

1. DESCRIPTION

1.1. FUNCTION

Fluids are practically incompressible and cannot therefore store pressure energy.

The compressibility of a gas (nitrogen) is utilised in hydraulic accumulators for storing fluids. HYDAC bladder accumulators are based on this principle.

A bladder accumulator consists of a fluid section and a gas section with the bladder acting as the gas-proof screen.

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

HYDAC bladder accumulators can be used in a wide variety of applications and are also available in different pressure ranges, see catalogue sections:

- Bladder Accumulators Standard No. 3.201
- Bladder Accumulators Low Pressure No. 3.202
- Accumulators No. 3.000

1.2. CONSTRUCTION

The high pressure bladder accumulator consists of the pressure vessel, the flexible bladder with gas valve and the hydraulic connection with check valve.

1.2.1 **Shell material**

The forged pressure vessel is seamless and manufactured from high tensile chrome molybdenum steel.

1.2.2 **Bladder material**

The following elastomers are available as standard:

- NBR (acrylonitrile butadiene rubber, perbunan),
- IIR (butyl rubber),
- FKM (fluoro rubber, Viton®),
- ECO (ethylene oxide epichlorohydrin rubber).

The material used depends on the particular operating medium and temperature.

When choosing the elastomer, allowances must be made for the fact that the gas can cool down to below the permitted elastomer temperature if there are adverse discharge conditions (high pressure ratio p_2/p_0, high discharging velocity). This can cause cold cracking in the elastomer. The gas temperature can be calculated using the HYDAC Accumulator Simulation Program ASP.

1.2.3 **Corrosion protection**

For operation with chemically aggressive media, the accumulator shell can be chemically nickel-plated internally or supplied with a special plastic coating, such as Duroplast.

For external corrosion protection the accumulator can be supplied with an epoxy resin finish specially for offshore applications.

1.3. MOUNTING POSITION AND TYPE OF MOUNTING

Information on secure mounting positions and mounting elements can be found in the following catalogue sections:

- Bladder Accumulators Standard No. 3.201
- Supports for Hydraulic Accumulators No. 3.502
- ACCUSET SB No. 3.503

2. TECHNICAL SPECIFICATIONS

2.1. MODEL CODE

(also order example)

SB690 - 32 A 1 / 312 U - 690 D

Series

Nominal volume [l]

Fluid connection
A = standard connection

Gas side connection
1 = standard model [2)]
9 = special model (example: 1/4" - BSP)

Material code [1)]

Fluid connection
2 = high tensile steel
3 = stainless steel
6 = low temperature steel

Accumulator shell
0 = plastic coated (internally)
1 = carbon steel
2 = chemically nickel-plated (internal coating)
6 = low temperature steel
8 = plastic coated (e.g. Duroplast) internally and externally

Accumulator bladder
2 = NBR20
3 = ECO
4 = IIR (butyl)
5 = NBR21 (low temperature)
6 = FKM
7 = Others
9 = NBR22

Certificate code
U = PED 97/23/EC

Permitted operating pressure [bar]

Connection
A = Thread to ISO228 (1/2" BSP)
D = Thread to ANSI B1.20.3 (1/2" NPTF)

Required gas pre-charge pressure must be stated separately!

[1)] Not all combinations are possible
[2)] Gas valve in SB < 10 l = 7/8 - 14 UNF,
in SB ≥ 10 l = M50x1.5

2.2. EXPLANATORY NOTES

2.2.1 **Operating pressure**

690 bar (10000 psi)
Higher pressures on request

2.2.2 **Permitted working temperature and elastomer resistance**

NBR20	-15 °C ... +80 °C	water water-glycol mineral oil
NBR21	-50 °C ... +80 °C	
NBR22	-30 °C ... +80 °C	
ECO	-30 °C ... +120 °C	mineral oil
IIR	-40 °C ... +100 °C	phosphate ester, water
FKM	-10 °C ... +150 °C	chlorinated hydrocarbons, petrol

2.2.3 **Gas charging**

Hydraulic accumulators must only be charged with nitrogen.
Never use other gases.
RISK OF EXPLOSION!

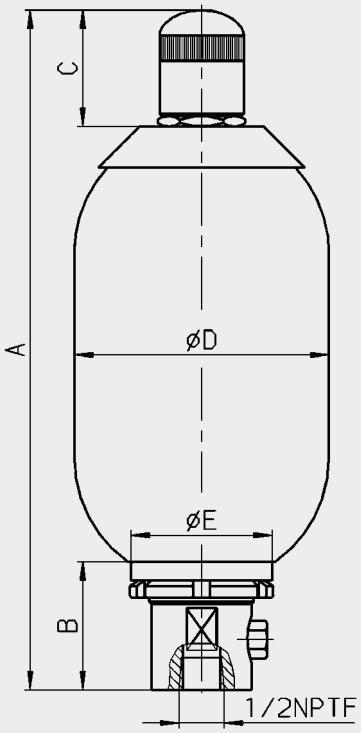
In principle, the accumulator may only be charged with nitrogen class 4.5, filtered to < 3 µm.

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

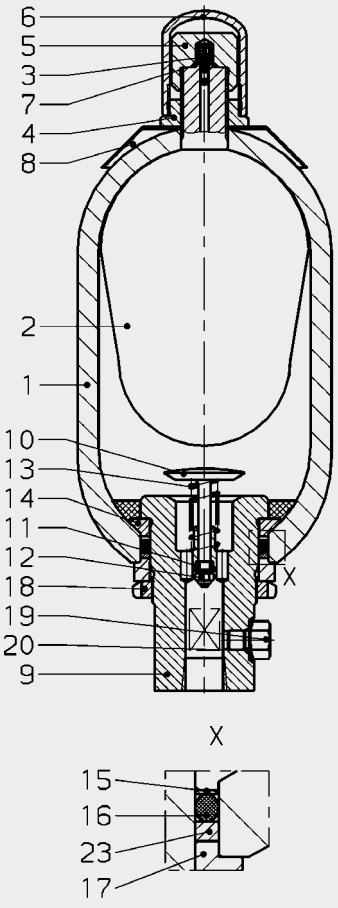
3. DIMENSIONS AND SPARE PARTS

3.1. DRAWINGS

3.1.1 Dimensions



3.1.2 Spare parts



3.2. DIMENSIONS

Nominal volume [l]	Eff. gas volume [l]	Weight [kg]	A max. [mm]	B [mm]	C [mm]	Ø D max. [mm]	Ø E [mm]	SW [mm]
1	1.0	8.5	324	61	58	122	67	45
2.5	2.5	13.5	531					
5	4.9	23	860					
13	12.0	92	700	77	68	250	110	75
20	17.0	114	865					
32	33.5	186	1385					
54	49.7	260	1900					

3.3. SPARE PARTS

3.3.1 Part numbers

NBR

Nominal volume [l]	Seal kit P/N	Bladder assembly P/N	Repair kit P/N	Anti-extrusion ring P/N
1	03182615	03010110	03182617	00293262
2.5		03211568	03201771	
5		03211569	03201772	
13	03182616	03211570	03211573	03028455
20		03211592	03211574	
32		03211571	03211585	
54		03116598	03211586	

Description	Item
Bladder assembly	
consisting of:	
Bladder	2
Gas valve insert	3
Lock nut	4
Seal cap	5
Valve protection cap	6
O-ring	7
Seal kit	
consisting of:	
O-ring	7
Washer	15
O-ring	16
Vent screw	19
Support ring	23
Repair kit	
consisting of:	
Seal kit (see above)	
Bladder assembly (see above)	
Anti-extrusion ring	14

Item 1 not available as a spare part.

4. 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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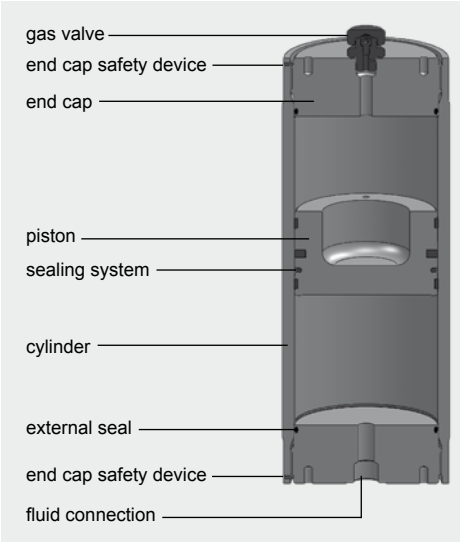
Piston Accumulators

1. DESCRIPTION

1.1. FUNCTION

Fluids are practically incompressible and cannot therefore store pressure energy. The compressibility of a gas (nitrogen) is utilised in hydraulic accumulators for storing fluids. HYDAC piston accumulators are based on this principle.
A piston accumulator consists of a fluid section and a gas section with the piston acting as the gas-proof screen.
The gas section is pre-charged with nitrogen.
The fluid section is connected to the hydraulic circuit so that the piston accumulator draws in fluid when the pressure increases and the gas is compressed.
When the pressure drops, the compressed gas expands and forces the stored fluid into the circuit.

1.2. DESIGN



HYDAC piston accumulators consist of:

- A cylinder with very finely machined internal surface.
- End caps on the gas side and the oil side. Sealed with O-rings.
- A floating steel or aluminium piston which can easily be accelerated due to its low weight.
- A sealing system adapted to the particular application.
  The piston floats on two guide rings which prevent metal-to-metal contact between the piston and the accumulator wall.
  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.
  Suitable materials are also available for low temperature applications.

1.3. SEALING SYSTEMS

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

- Design pressure,
- Effective pressure differential,
- Switching frequency or cycles,
- Temperature fluctuation,
- Operating fluid,
- Cleanliness of fluid (micron rating of filter),
- Maintenance requirements.

The sealing systems differ according to the type of piston used, each of which has its own type and arrangement of seals. The following elastomer sealing materials are available, depending on the operating conditions:

- NBR (acrylonitrile butadiene rubber, perbunan),
- FKM (fluoro rubber, Viton®),
- PUR (polyurethane).

Piston design type		Application	Degree of contamination in the fluid	Notes
	1	● For general accumulator operation without special requirements Application limitations: max. piston velocity: 0.5 m/s	Optimized for applications with a high level of contamination	
	2	● Low-friction design ● For high piston speeds ● 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 ● Slow movements without stick-slip effect Application limitations: max. piston velocity: 0.8 m/s		1 guide ring for pistons with Ø ≤ 150 mm 2 guide rings for pistons Ø ≥ 180 mm
	4	● Low-friction design with emergency safety features ● Slow movements without stick-slip effect ● Very low oil transfer to the gas side Application limitations: max. piston velocity: 5 m/s		

1.4. MOUNTING POSITION

HYDAC piston accumulators operate in any position.
Vertical installation is preferable with the gas-side at the top, to prevent contamination from the fluid settling on the piston seals. For accumulators with certain piston position indicators vertical installation is essential (see 1.7.). Piston accumulators with a piston diameter ≥ 355 mm must only be mounted vertically.

1.5. ADVANTAGES OF HYDAC PISTON ACCUMULATORS

- complete range from 0.1 ... 1200 l nominal volume,
- high ratios possible between pre-charge pressure and max. working pressure,
- economic solution using back-up gas bottles for low pressure differentials,
- high flow rates possible; limitation: max. piston velocity,
- power savings,
- high level of efficiency of the hydraulic installation,
- gas-tight and leakage free,
- no sudden discharge when seals are worn,
- requires little space,
- monitoring of the volume across the entire piston stroke or electrical limit switch.

Further advantages of using the low-friction sealing system:

- minimum friction,
- also suitable for low pressure differentials,
- no start-up friction,
- no stick-slip,
- low noise, no vibration,
- high piston velocity up to 5 m/s for piston type 4,
- improved accumulator efficiency,
- good life expectancy of seals because of low wear,
- suitable for large temperature fluctuations,
- low maintenance requirement.

1.6. TECHNICAL REQUIREMENTS

HYDAC piston accumulators are suitable for high flow rates. With the largest piston accumulator diameter made to date of 800 mm, a flow rate of 1000 l/s can be achieved at a piston velocity of 2 m/s.

1.6.1 **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 type 2 allow velocities of up to 3.5 m/s.

1.6.2 **Permitted velocities**

Gas velocity
The flow velocities in the gas 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 adapter cross-section.

1.6.3 **Function tests and fatigue tests**

Function tests and fatigue tests are carried out to ensure the development and 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 components. In the case of piston accumulators, important information on gas density and the life expectancy of seals is gained from such tests.

Vital data for use in accumulator sizing is gained by altering the working pressure and switching cycles.

1.6.4 **Fluids**

The following sealing materials are suitable for the fluids listed below:

NBR, resistant to:

- mineral oils (HL and HLP)
- fire-resistant fluids from the groups HFA, HFB and HFC
- water and seawater up to approx. 100 °C

NBR, not resistant to:

- aromatic hydrocarbons
- chlorinated hydrocarbons
- amines and ketones
- hydraulic fluids of type HFD

FPM, resistant to:

- mineral oils (HL and HLP)
- hydraulic fluids of type HFD
- fuels as well as aromatic and chlorinated hydrocarbons
- inorganic acids (but not all, please contact our technical department)

FPM, not resistant to:

- ketones and amines
- (anhydrous) ammonia
- organic acids such as formic acid and acetic acid

PUR, resistant to:

- mineral oils (HL and HLP)
- non-flam fluids from the HFA group

PUR, not resistant to:

- water and water-glycol mixtures
- alkalis
- acids

1.6.5 **Temperature ranges of the seals**

Material abbrev.	HYDAC code	Temp. range long-term
NBR	2	-20 °C ... + 80 °C
FPM	6	-15 °C ... +160 °C
PUR	8	-30 °C ... + 80 °C

For temperatures outside these ranges, please contact our technical department for more information. There are also special grades available depending on the application.

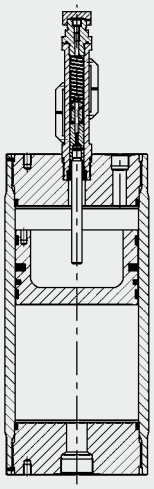
1.6.6 **Gas charging**

Hydraulic accumulators must only be charged with nitrogen.
Never use other gases.
RISK OF EXPLOSION!

In principle accumulators may only be charged with nitrogen class 4.5, filtered to < 3 µm.
If other gases are to be used, please contact HYDAC for advice.

1.7. PISTON POSITION INDICATORS

1.7.1 Electrical limit switch



The electrical limit switch usually monitors the max. charged condition of the piston accumulator.
It can, however, also permit control functions of the attached hydraulics to be carried out over a certain stroke length.

The limit switch consists of the switching rod with a permanent solenoid which is not attached to the the piston and can only achieve a limited stroke, and an anti-magnetic housing and two or more switches.

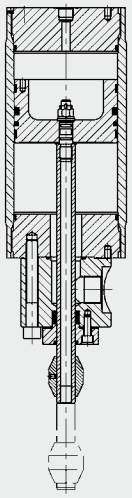
These switches can be normally closed or normally open or bistable. An N/C or N/O and a bistable switch cannot be fitted simultaneously to a limit switch. Our standard limit switch is fitted with a N/C and a N/O switch.

On another model, switching is carried out by inductive proximity switches.

The switch is reset by a spring or the force of gravity.
Vertical installation is preferable, due to the friction and possible wear and tear in the rod guide.
For limit switches with a stroke of > 200 mm, vertical mounting with the gas side at the top is essential.

The maximum piston velocity must not exceed 0.5 m/s over the stroke range of the limit switch.

1.7.2 Protruding piston rod



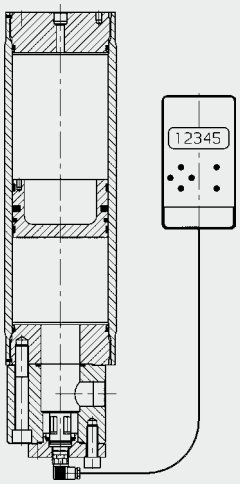
The protruding piston rod permits the position of the piston to be monitored over the whole stroke. It consists of the piston rod, which is fixed to the piston and sealed in, and what is known as the trip cam which actuates the limit switches.

The position of the piston can be monitored at any point using the trip cam. This facility is used mainly to switch the pump on and off.

Normally the piston rod protrudes from the accumulator on the fluid side to avoid possible points of leakage on the gas side. On the protruding piston rod version, the hydraulic connection will be on the side if the size of the end cap does not permit otherwise.

The protruding piston rod functions in any mounting position. There must however be sufficient space available for the protruding piston rod to move in and out. The maximum piston velocity should not exceed 0.5 m/s.

1.7.3 Ultrasonic distance measurement



The piston position is determined by ultrasonic measurement.

It is only possible to take the measurements from the fluid side because a continuous sound carrier medium is required for ultrasound. In order to eliminate false readings, the fluid must be as free of air bubbles as possible. The piston should be mounted such that no air can collect under the sensor.

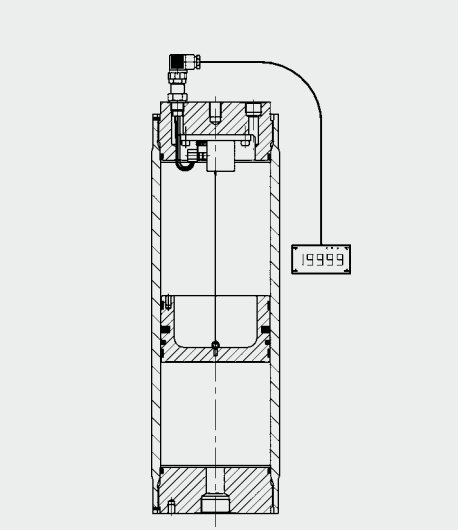
The measurement data is evaluated by a microprocessor and is converted into a continuous measurement signal. It is possible to pick up interim measurement results to switch system parts e.g. turn the pump on and off.

The most important features of the system are:

- Protection class IP 65 according to DIN 40050
- LCD display
- Outputs
  - 5 floating relay change-over switches (with 125 V, 1A rating), of which 1 is error output, and 4 are user-adjustable switching thresholds between 0 and 100 %
  - 4 - 20 mA

The maximum pressure for the sensor must not exceed 350 bar.

1.7.4 Cable tension measurement system



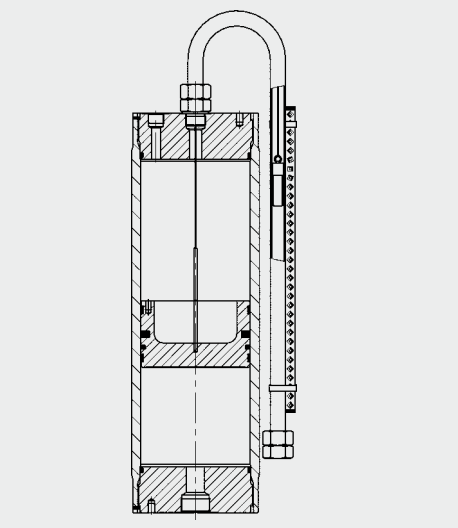
Using the cable tension measurement system, the position of the piston can be determined by means of a cable which is fixed to the piston.

The cable is attached to a wheel which is tensioned by a spring. This wheel alters an electrical resistance via an attached rotary potentiometer during the piston movement. This resistance is converted by a transducer into an electrical signal so that it can be processed directly by a PLC system. The signal is supplied through the end cap via a pressure-tight cable gland. Alternatively various digital display units and transmitters can be connected.

- Digital display unit:
  Supply voltage 230 V AC
  (or 24 V DC)
  4-channel limit comparator
  4 optical coupler outputs
  2 relay contact outputs
  1 RS 232 interface
  (optionally with analogue output
  4 - 20 mA)
- Transmitter:
  Supply voltage 24 V DC
  Analog output 4 - 20 mA

The maximum pressure must not exceed 350 bar. The piston acceleration is limited to certain values according to measurement system forces, approx. 7 ... 30 g, and is limited to a max. velocity of 0.5 m/s. The measurement system is not suitable for rapid volume changes. For such loads, please contact the Technical Dept. of our head office or your local HYDAC agent. The preferred installation position is with the gas-side at the top.
The cable tension measurement system can only be fitted to the gas-side of the piston accumulator.

1.7.5 Magnetic flap indication

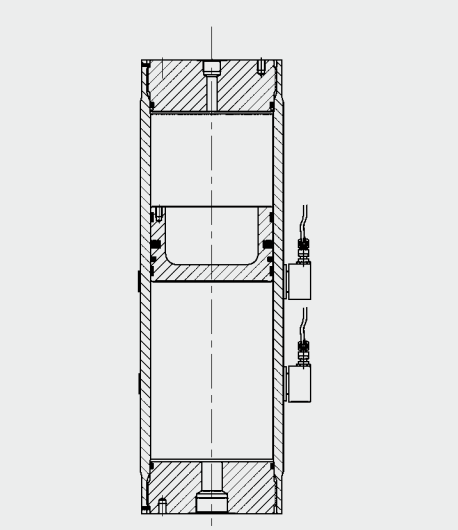


With magnetic flapper indication, the position of a piston can be determined by the colour of a set of magnetic flaps which turn as the piston moves and which are visible externally.

A non-magnetic tube is fitted to the piston accumulator containing a cable, one end of which is fastened to the gas side of the piston, and the other end is attached to a magnet. Along the length of the piston accumulator a housing is also fitted which contains red/white magnetic flaps.
As the magnet moves up or down its tube, the flaps turn to their opposite colour to indicate the piston's position.
When the piston moves towards the gas-side, the indicator moves in the direction of the oil-side. In addition, reed switches can be fitted to switch system parts or measurement scales can be fitted to the tube.

The maximum piston velocity must not exceed 0.5 m/s. No more than 5 cycles per day on average should be carried out. Piston accumulators with magnetic flap indication must only be installed vertically, gas-side at the top.

1.7.6 Piston position switch



With the piston position switch it is possible to detect the piston position in a piston accumulator using ultrasound.

The indicator can be retrofitted using a clamp. No other modification is required. It is therefore possible to install without disrupting operation.

The piston position switch detects the change-over from oil to piston at which point the signal is switched off. This is the case if the piston is in the sound path or has passed it.
There are three different versions available:

- Standard version for hydraulic fluid with a viscosity of up to 100 cSt.
- Special version for hydraulic fluid with a viscosity of up to 500 cSt.
- Special version for use in explosion protected areas.

Supply voltage
18 ... 30 V DC
Switching output:
NPN (or PNP)

Detailed documentation for all piston position indicators is available on request.

2. TECHNICAL SPECIFICATIONS

2.1. EXPLANATORY NOTES

2.1.1 **Nominal volume [l]**
See table at Point 3.1.

2.1.2 **Eff. gas volume V_0 [l]**
These differ slightly from the nominal volume and form the basis of the calculations of the usable volume.

See Point 3.1.1.

2.1.3 **Effective volume ΔV [l]**
The volume (on the fluid side) between the working pressure p_2 and p_1.

2.1.4 **Permitted operating temperature (fluid)**
-10 °C ... +80 °C
263 K ... 353 K
Standard material, others on request

2.1.5 **Certificate codes**

Australia	F [1]
Brazil	U3 [3]
Canada	S1 [2]
China	A9
CIS	A6
EU member states	U [1]
India	U3 [3]
Japan	P
New Zealand	T
Switzerland	U
Ukraine	A10
USA	S
others on request	

[1] Approval required in the individual territories

[2] Approval required in the individual provinces

[3] Alternative certificates possible

2.2. MODEL CODE

(also order example)

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

Series

Nominal volume [l]

Material and piston code
Piston design type (see Point 1.3.)

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

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

Material of seals including piston seals
2 = NBR / PTFE compound
5 = TT-NBR / PTFE compound (low temperature)
6 = FPM / PTFE compound
8 = NBR / PUR (polyurethane)
9 = special qualities

Certificate code
U = PED 97/23/EC

Permitted operating pressure [bar]

Fluid connection
Type of connection (see Table 1)
Standard or specification of the type of connection (see Table 2 + 3)
Size of connection (see Table 4 + 5)

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

Piston diameter

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

Supplementary equipment*
A = electrical limit switch – 35 mm stroke
B = electrical limit switch – 200 mm stroke
C = electrical limit switch – 500 mm stroke
K = protruding piston rod
M = magnetic flap indication
S = cable tension measurement system
U = ultrasonic measurement system
E.. = special switch fixed or adjustable
P = magnetic piston
UP.. = piston position switch
(e.g. UP2 = 2 position switches, UPEX = ATEX version)

Safety equipment*
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*

*if required, please state at time of ordering!

Table 1, Connection type

Code letter	Description
A	Threaded connection (female)
B	Threaded connection (male)
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 range + 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)

Table 4, Threaded model connection sizes

Type Tab.2	Code, size										
	A	B	C	E	E	F	G	H	J	K	L
A	BSP 1/8"	BSP 1/4"	BSP 3/8"	BSP 1/2"	BSP 3/4"	G 1	G1 1/4	G1 1/2	2BSP	G2 1/2	3BSP
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	11/2-11 1/2 NPTF	2-11 1/2 NPTF	2 1/2 - NPTF

Table 5, Flange model connection sizes

Type Tab.3	Code, size										
	A	B	C	E	E	F	G	H	J	K	L
A	DN15	DN25	DN40	DN50	DN65	DN80	DN100	DN125	DN150	DN200	
B	1/2" - 1500#	1" - 1500#	1 1/2" - 1500#	2" - 1500#	2 1/2" - 1500#	3" - 1500#	1/2" - 2500#	1" - 2500#	1 1/2" - 2500#	2" - 2500#	2 1/2" - 2500#
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 G3/4 male, with M28x1.5/M8
B	Gas valve end connection M28x1.5/M8
C	Gas valve 1/2"-20 UNF, male, with M16x2 (ISO 10945)
D	Gas valve M14x1.5, male, with male M16x1.5 (Minimess)
E	Gas valve G3/4, male, with 7/8-14 UNF-VG8
F	Gas valve end connection M42x1.5/M12

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

- Accumulators
  No. 3.000

3. DIMENSIONS

3.1. PISTON ACCUMULATOR

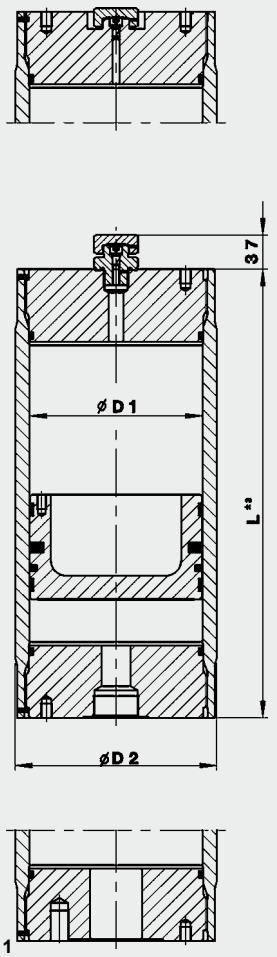


Diagram 1

Volume V min. - max. [l]	Series	Country code U = PED 97/23/EC					
		Permitt. operating pressure [bar]	Ø D1 [mm]	Ø D2 [mm]	Length calculation [1] L = a + (b x V) a [mm]	b [mm]	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	45 – 280
	SK350	350			234		49 – 283
2.5 – 100	SK210	210	180	210	262	39.3	70 – 346
	SK350	350		220			79 – 458
2.5 – 125	SK210	210	200	235	290	31.8	86 – 452
	SK350	350					
10 – 200	SK210	210	250	286	408	20.4	170 – 631
	SK350	350		300			200 – 860
25 – 400	SK350	350	310	350	462	13.2	390 – 1110
25 – 400	SK210	210	355	404	534	10.1	468 – 1338
	SK350	350		434			590 – 2048
200 – 650	SK210	210	490	580	700	5.3	1760 – 3180
	SK350	350					

[1] The lengths calculated are usually rounded up or down in 5 mm increments
[2] Intermediate weights are possible, depending on the length/diameter required

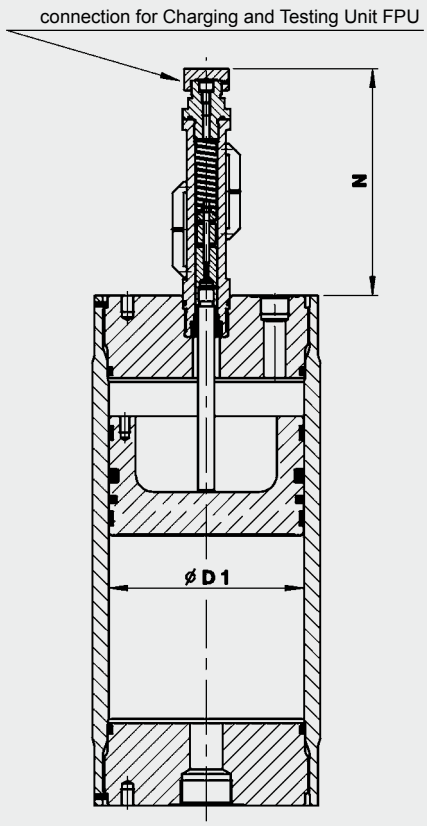
Other pressures, volumes, certificates etc possible on request.

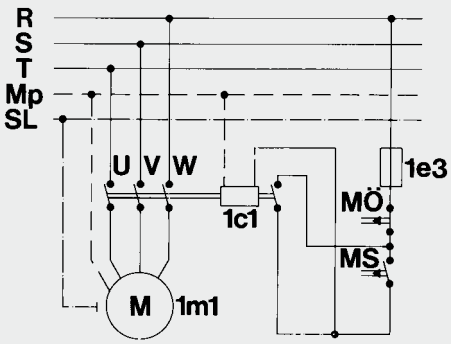
3.1.1 Effective gas volume V_0

The gas volume V is larger than the nominal volume given in the tables in point 3.1. by the amount shown below.

Piston Ø D1	Piston design type			
	1	2	3	4
[mm]	Δ [l]			
60	–	0.040	–	0.040
80	–	0.044	0.081	0.044
100	0.062	0.062	0.270	0.062
125	–	0.169	0.546	0.169
150	–	0.653	0.824	0.653
180	1.213	1.213	1.286	1.213
200	–	0.999	1.601	0.999
250	3.034	3.034	2.617	3.034
310	–	6.221	–	6.221
355	4.514	4.514	–	4.514
490	–	12.705	–	12.705

3.2. PISTON ACCUMULATOR WITH ELECTRICAL LIMIT SWITCH





1m1 = Motor
1c1 = Motor contactor
1e3 = Control cut-out
Mö = Solenoid switch - N/C
Ms = Solenoid switch - N/O

Volume [2] [l]	Series	Country code U Ø D1 [mm]	Gas side connection [3] ISO228	Fluid side connection [4]	N A [mm]	N B [mm]	N C [mm]	Additional weight A [kg]	Additional weight B [kg]	Additional weight C [kg]
0.2	SK350	60 [1]								
0.5										
1										
0.5	SK350	80 [1]								
1										
2										
2.5	SK350	100	G 3/4 lateral	G 1	209	439	679	2.55	4.85	7.15
5										
7.5										
2	SK350	125						2.55	4.85	7.15
5										
15										
6	SK350	150	BSP 3/4"					2.60	4.90	7.20
20										
40										
10	SK210	180	G 1	G 1 1/2				2.60	4.90	7.20
	SK350									
20	SK210									
	SK350									
50	SK210									
	SK350									
20	SK350	200	G 1					2.65	4.95	7.25
40										
100										
50	SK210	250	G 1 1/4	G 2				2.80	5.10	7.40
	SK350									
80	SK210									
	SK350									
120	SK210									
	SK350									
120	SK350	310	G 1 1/4	NW50				2.90	5.20	7.50
150										
200										
130	SK210	355	G 1 1/2					2.80	5.10	7.40
	SK350									
180	SK210									
	SK350									
250	SK210									
	SK350									
200	SK350	490	G 2					3.00	5.30	7.60
400										
600										

[1] Electrical limit switch is not possible for these piston sizes.
[2] Volume details are examples, for others see Point 3.1.
[3] Standard connection for back-up type, others on request
[4] Others on request
for further information, see Point 1.7.

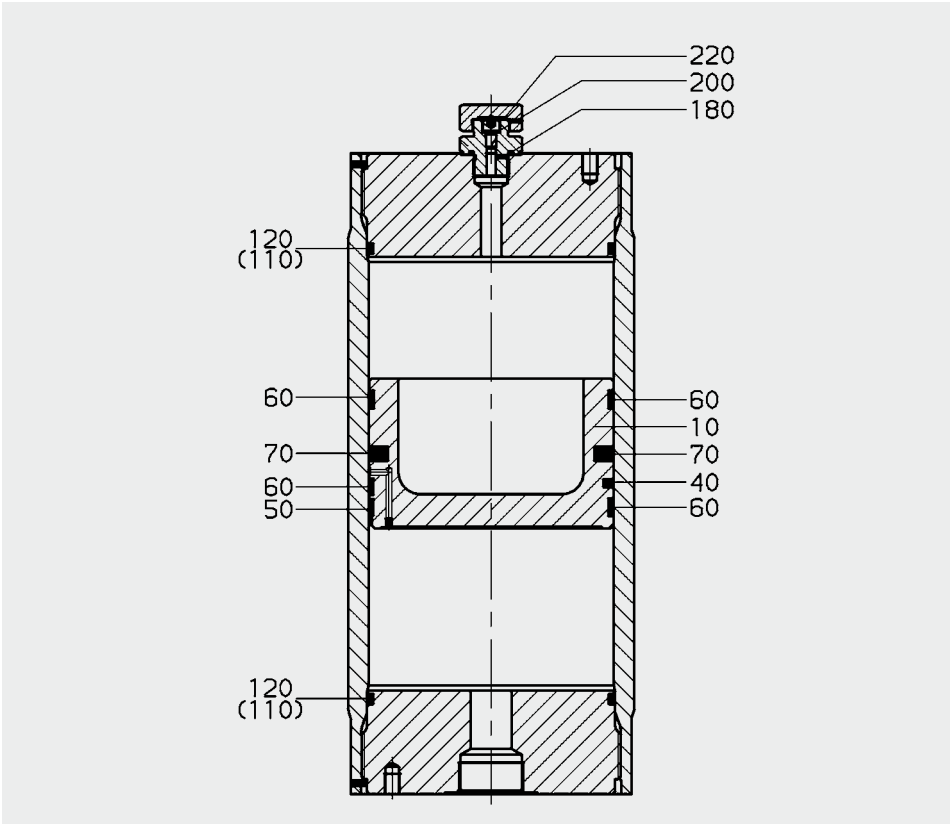
Table 7, Supplementary seal

Piston Ø [mm]	Type	NBR Part no.	FKM (Viton®) Part no.
all diam.	1	00601078	00601109
	2		
	3		
	4	on request	

Note:
When ordering spare parts for the piston accumulator with electrical limit switch, the supplementary seal must be ordered in addition to the seal kit (Point 4).

4. SPARE PARTS

4.1. PISTON ACCUMULATOR



Piston assembly (Table 8)

Piston Ø [mm]	Piston	NBR Part no.	FKM Part no.	PUR Part no.
60	1	–	–	–
	2	03183495	–	–
	3	–	–	03009372
80	1	–	–	–
	2	03183496	03183497	–
	3	03016255	–	02119931
100	1	03128922	03128926	–
	2	03175476	03183117	–
	3	03016163	–	02115547
125	1	–	–	–
	2	03016232	03016253	–
	3	03016254	–	03016150
150	1	–	–	–
	2	03016228	03016229	–
	3	03016230	–	03016231
180	1	03141888	03182493	–
	2	02118451	02112535	–
	3	03046413	–	03046277
200	1	–	–	–
	2	03110811	03016215	–
	3	03016216	–	03016218
250	1	03128924	03128938	–
	2	00353980	00353981	–
	3	03009544	–	03016171
310	1	–	–	–
	2	03016195	03016197	–
	3	–	–	–
355	1	03128925	03128939	–
	2	00356382	00354079	–
	3	–	–	–
490	1	–	–	–
	2	03128989	03128990	–
	3	–	–	–

Seal kit, complete (Table 9)

Piston Ø [mm]	Piston	NBR Part no.	FKM Part no.	PUR Part no.
60	1	–	–	–
	2	03090507	–	–
	3	–	–	03016210
80	1	–	–	–
	2	03041573	03015745	–
	3	03090788	–	03013230
100	1	03128940	03128944	–
	2	00363268	00363269	–
	3	03010398	–	02123414
125	1	–	–	–
	2	03116665	03016234	–
	3	03090870	–	02128104
150	1	–	–	–
	2	03016235	03016237	–
	3	03016236	–	03007546
180	1	03128941	03128945	–
	2	00363270	00363271	–
	3	03010399	–	02123415
200	1	–	–	–
	2	03110810	03016242	–
	3	03016241	–	03113127
250	1	03128942	03128946	–
	2	00363266	00363267	–
	3	03010401	–	03016213
310	1	–	–	–
	2	03016200	03016201	–
	3	–	–	–
355	1	03128943	03128947	–
	2	00363272	00363273	–
	3	–	–	–
490	1	–	–	–
	2	03104100	03128991	–
	3	–	–	–

4.1.1 Piston type 1

Description	Qty.	Item
Piston assembly [1] consisting of:		
Piston	1	10
Seal ring	1	50
Guide ring	2	60
Centre seal	1	70
Seal kit, complete consisting of:		
Seal ring	2	40
Centre seal	1	70
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

4.1.2 Piston type 2

Description	Qty.	Item
Piston assembly [1] consisting of:		
Piston	1	10
Seal ring	1	40
Guide ring	2	60
Centre seal	1	70
Seal kit, complete consisting of:		
Seal ring	1	40
Guide ring	2	60
Centre seal	1	70
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

4.1.3 Piston type 3

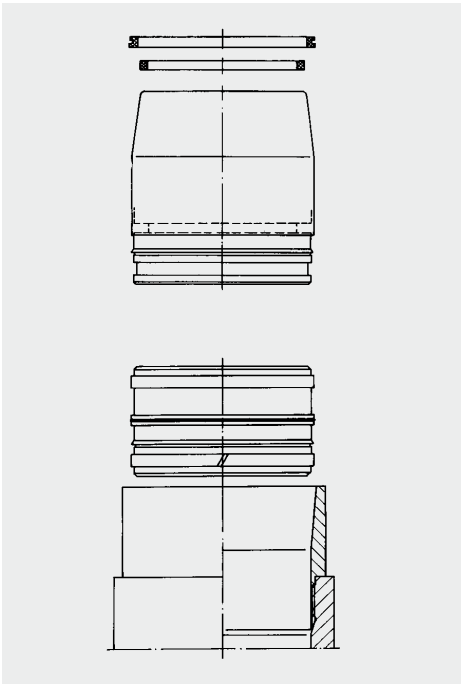
Description	Qty.	Item
Piston assembly consisting of:		
Piston	1	10
Seal ring	1	70
Guide ring	1	60
Seal kit, complete consisting of:		
Seal ring	1	70
Guide ring	1	60
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

[1] Item. 120, 180, 200 und 220 are supplied loose.
Pressure resistant parts cannot be supplied as spares.

Spare parts for piston type 4 are available on request.

4.2. ASSEMBLY INSTRUCTIONS

Before assembling or disassembling a piston accumulator or piston accumulator station, the system must always be depressurized.
The gas and fluid side must be depressurized and the gas valve unscrewed or opened before the accumulator is disassembled. Before the end caps are removed, ensure that the piston is moving freely. This may be achieved by using a rod. Only authorised persons should repair piston accumulators where the piston is jammed.
Piston accumulators with internal diameters up to 250 mm are fitted with a securing pin. This pin is to prevent the end cap being removed incorrectly.
It must be taken out before removing the end cap.
There may be a danger to life due to stray components.
All work must only be carried out by suitably trained staff.
On no account must any welding, soldering or mechanical work be carried out on the accumulator shell.
Please read the Operating Manual!
No. 3.301.CE



Assembly sleeves
for piston accumulators (Table 11)

Piston Ø [mm]	to fit the seals Type 1+2
60	00297430
80	00244991
100	00352198
125	00370734
150	02124157
180	00350148
200	03016276
250	00290035
310	02127304
355	00354147
490	3114220

Piston Ø [mm]	to install the piston
60	02120188
80	00359614
100	00290056 (M105x2) 02117672 (M110x3)
125	02128223
150	02124161
180	00290049 (M186x3) 02122356 (M190x4)
200	03016284
250	00290046
310	02127305
355	00290985
490	03114219

When replacing seals and/or pistons, please read the Operating and Maintenance Instructions (No. 3.301.B).

5. NOTE

The information in this brochure relates to the operating conditions and applications described.

For applications or operating conditions not described, please contact the relevant technical department.

Subject to technical modifications.

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E 3.301.16/03.12

Piston Accumulators
Series SK280

1. DESCRIPTION

1.1. FUNCTION

Fluids are practically incompressible and cannot therefore store pressure energy.

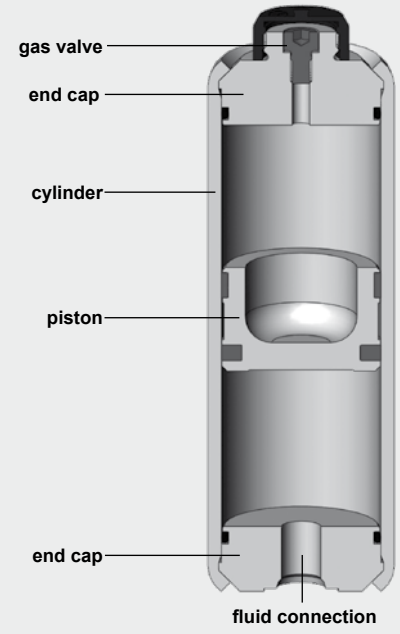
The compressibility of a gas (nitrogen) is utilised in hydraulic accumulators for storing fluids. HYDAC piston accumulators are based on this principle.

A piston accumulator consists of a fluid section and a gas section with the piston acting as the gas-proof screen. The gas section is pre-charged with nitrogen.

The fluid section is connected to the hydraulic circuit so that the piston accumulator draws in fluid when the pressure increases and the gas is compressed.

When the pressure drops, the compressed gas expands and forces the stored fluid into the circuit.

1.2. DESIGN



HYDAC piston accumulators consist of:

- A cylinder with very finely machined internal surface.
- End caps on the gas side and the oil side. Sealed with O-rings.
- A floating steel or aluminium piston.
- A sealing system adapted to the particular application. The piston floats on two guide rings which prevent metal-to-metal contact between the piston and the accumulator wall. Suitable materials are also available for low temperature applications.

1.3. TYPE OF MOUNTING

HYDAC can provide suitable accumulator clamps for the piston accumulator series SK280. The table at point 3 lists the appropriate clamps for each individual diameter. In order to prevent deformation of the cylinder, we recommend that the accumulators are mounted using two clamps, one at each end cap.

1.4. ADVANTAGES OF THE SK280

- Optimized production process, saving on material and manufacturing costs
- Reduced-weight series
- Reduced installation space
- Standard gas valve M28x1.5 integrated into end cap (non-refillable version possible)
- Endurance tested (function and fatigue tests)

1.5. DESIGN PRESSURE

- Standard 280 bar
- Manufactured and tested to PED 97/23/EC

higher pressures on request

1.6. SEALING SYSTEM

- Piston type 3: NBR/PUR
- Temperature range: -30 °C ... +80 °C

others on request

1.7. COMMISSIONING

Please read the Operating Manual!

- Piston accumulators No. 3.301.CE

For further information, please turn to the section:

- Piston Accumulators No. 3.301

2. TECHNICAL SPECIFICATIONS

2.1. MODEL CODE

(also order example)

SK280 - 1 / 3218 U - 280 AAD - VB - 05 - 030

Series

Nominal volume [l]

Material and piston code

Piston design type
(see Point 1.6.)

Material: piston
2 = Carbon steel

Material: cylinder and end caps
1 = Carbon steel

Material: seals including piston seals
8 = NBR/PUR (polyurethane)

Certificate code
U = PED 97/23/EC

Permitted operating pressure [bar]

Fluid connection
AAD = Threaded connection to ISO 228
Size G 1/2

AAE = Threaded connection to ISO 228
Size G 3/4

AAF = Threaded connection to ISO 228
Size G 1

ACE = Threaded connection to SAE J 514
Size 9/16-18 UNF, SAE #6

ACF = Threaded connection to SAE J 514
Size 3/4-16 UNF, SAE #8

ACH = Threaded connection to SAE J 514
Size 1 1/16-12 UN, SAE #12

ACK = Threaded connection to SAE J 514
Size 1 5/16-12 UN, SAE #16

Gas side connection or gas valve
VB = Gas valve type M28x1.5/M8 integrated into gas side end cap
000 = Non-refillable version (see drawing, Point 3.1.) on request

Piston diameter
05 = 50 mm

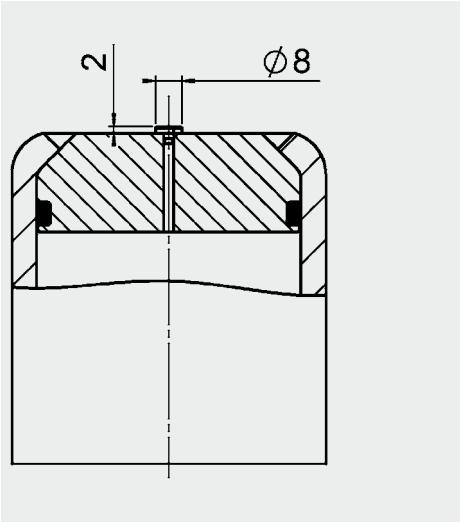
Pre-charge pressure p_0 [bar] at 20 °C, must be clearly stated, if required!

Special sizes and special versions on request.

3. DIMENSIONS

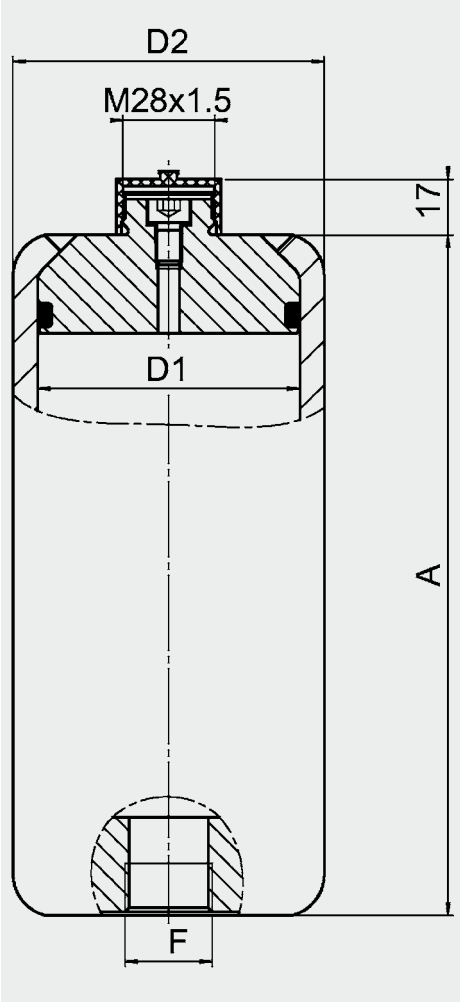
3.1. TYPE -000-

(non refillable)



3.2. TYPE -VB-

(refillable)



Nominal volume [l]	D1 [mm]	D2 [mm]	A ±3 [mm]	F to ISO 228	F to SAE J 514	Weight [kg]	Mounting clamps [1]
0.16	50	60	160	G 1/2	9/16-18UNF	2	3018442 HRGKSM 0 R 58-61/62 ST
0.32			240			2.5	
0.5			335		3/4-16UNF	3.1	
0.75			451			4	
1			590			4.8	
0.32	60	70	205			3	3018444 HRGKSM 0 R 70-73/73 ST
0.5			265			3.5	
0.75			355			4.2	
1			445			5.1	
1.5			620			6.4	
2			800			7.8	
0.5	80	95	210	G 3/4	1 1/16-12UN	6.5	444995 HRGKSM 0 R 92-95/96 ST
0.75			260			7.2	
1			310			8	
1.5			410			9.5	
2			510			11.5	
2.5			605			13	
3			705			14.5	
3.5			805			16	
4			905			17.5	
0.75	100	120	235	G 1	1 5/16-12UN	11.7	444505 HRGKSM 1 R 119-127/124 ST
1			265			12.5	
1.5			330			14.3	
2			395			16	
3			520			19.5	
4			650			23	
5			775			26.3	
6			900			30	

[1] Clamps must be mounted near the end caps in order to prevent deformation of the cylinder. For further information see the following catalogue section:
- Supports for Hydraulic Accumulators No. 3.502

4. NOTE

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Diaphragm Accumulators

1. DESCRIPTION

1.1. FUNCTION

Fluids are practically incompressible and cannot therefore store pressure energy.

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

A diaphragm accumulator consists of a fluid section and a gas section with the diaphragm acting as the gas-proof screen.

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

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

NOTE:

HYDAC diaphragm accumulators when fitted with a HYDAC Safety and Shut-off Block comply with the regulations of the Pressure Equipment Directive PED 97/23/EC and the German regulations on health & safety at work (Betr.Sich.V.).

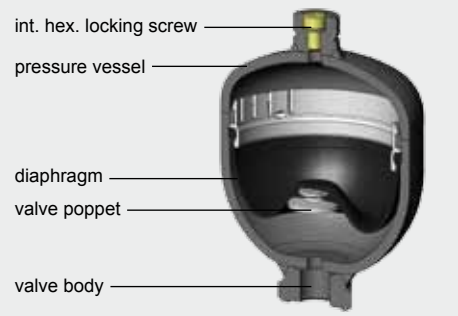
See catalogue section:

- Safety and shut-off block SAF/DSV No. 3.551

1.2. DESIGN

HYDAC diaphragm accumulators are available in two versions.

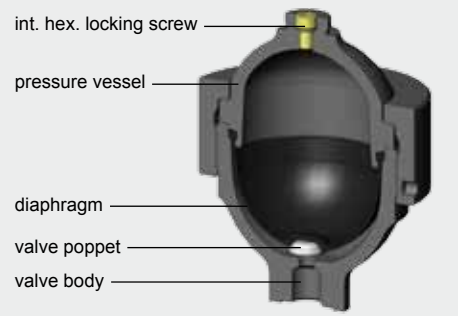
1.2.1 **Weld type**



This consists of:

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

1.2.2 **Screw type**



This consists of:

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

1.2.3 **Diaphragm materials**

The diaphragms are available in the following elastomers:

- NBR (acrylonitrile butadiene rubber, perbunan),
- IIR (butyl rubber),
- FKM (fluoro rubber, Viton®),
- ECO (ethylene oxide epichlorohydrin rubber).

The material must be selected according to the particular operating fluid and temperature.

When choosing the elastomer, allowances must be made for the fact that the gas can cool down to below the permitted elastomer temperature if there are adverse discharge conditions (high pressure ratio p_2/p_0, high discharging velocity). This can cause cold cracking in the elastomer. The gas temperature can be calculated using the HYDAC Accumulator Simulation Program ASP.

1.2.4 **Corrosion protection**

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

1.3. MOUNTING POSITION

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

1.4. TYPE OF MOUNTING

Accumulators up to 2 l can be screwed directly inline.

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

Additional male threads on the hydraulic connection are available for screwing into mounting holes - see table 3.1.

See catalogue section:

- Supports for Hydraulic Accumulators No. 3.502

1.5. GENERAL

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

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

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

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

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

1.5.5 **Fluids**
Mineral oils, hydraulic oils. Other fluids on request.

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

Hydraulic accumulators must only be charged with nitrogen.
Never use other gases.
RISK OF EXPLOSION!

1.5.7 **Permitted operating temperature**
-10 °C ... +80 °C
263 K ... 353 K
for material code 112.
Others on request

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

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

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

Australia	F [1)]
Brazil	U [3)]
Canada	S1 [2)]
China	A9
CIS	A6
EU member states	U
India	U [3)]
Japan	P
New Zealand	T
South Africa	U [3)]
Switzerland	U [3)]
Ukraine	A10
USA	S
others on request	

[1)] approval required in the individual territories
[2)] approval required in the individual provinces
[3)] alternative certificates possible

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 incorporating hydraulic accumulators (repairs, connecting pressure gauges etc.) must only be carried out once the pressure and the fluid have been released.
Please read the Operating Manual! No. 3.100 CE

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

- Accumulators No. 3.000

2. TECHNICAL SPECIFICATIONS

2.1. MODEL CODE

(also order example)

SBO210 – 2 E1 / 112 U – 210 AK 050

Series

Nominal volume [l]

Type [2]

Weld type:
E1 = rechargeable M28x1.5
E2 = sealed gas connection,
with gas pre-charge as requested [4]
E3 = rechargeable,
gas valve M16x1.5 / M14x1.5

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

Material code [2]
depends on operating medium
Standard model = 112 for mineral oils

Fluid connection
1 = carbon steel
3 = stainless steel 1.4571
4 = carbon steel with protective coating [1]
6 = low temperature steel

Accumulator shell
0 = plastic coated
1 = carbon steel
2 = carbon steel with protective coating [1] [3]
4 = stainless steel 1.4571
6 = low temperature steel

Diaphragm
2 = NBR20 (acrylonitrile butadiene)
3 = ECO (ethylene oxide epichlorohydrin)
4 = IIR (butyl)
5 = NBR21 (low temperature NBR)
6 = FKM (fluoro rubber)
7 = other (e.g. PTFE, EPDM ... on request)

Certificate code [2]
U = PED 97/23/EC
For other countries see table

Permitted operating pressure [bar]

Fluid connection [2] **form**
Standard connection = AK or AB

e.g. Form AK = G 3/4
for SBO210-2 see Point 3

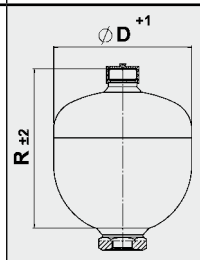
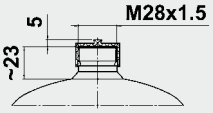
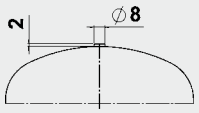
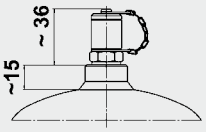
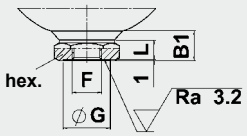
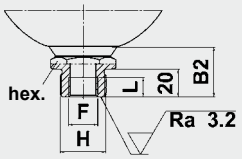
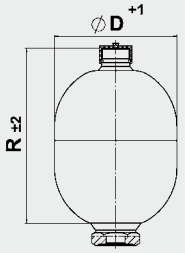
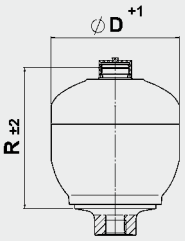
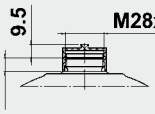
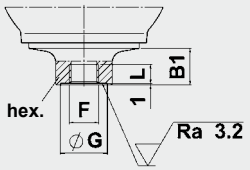
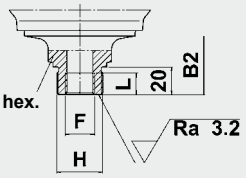
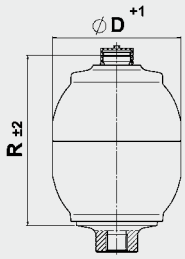
Pre-charge pressure p_0 [bar] at 20 °C, must be stated clearly, if required! [4]

[1] only for screw type
[2] not all combinations are possible
[3] only parts in contact with the medium
[4] only for type E1 or E2, for scheduled orders

3. TECHNICAL SPECIFICATIONS

3.1. WELD TYPE ACCUMULATORS
– non-exchangeable diaphragms –

3.1.1 Drawings

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

* = alternative fluid connections on request

3.1.2 **Dimensions**

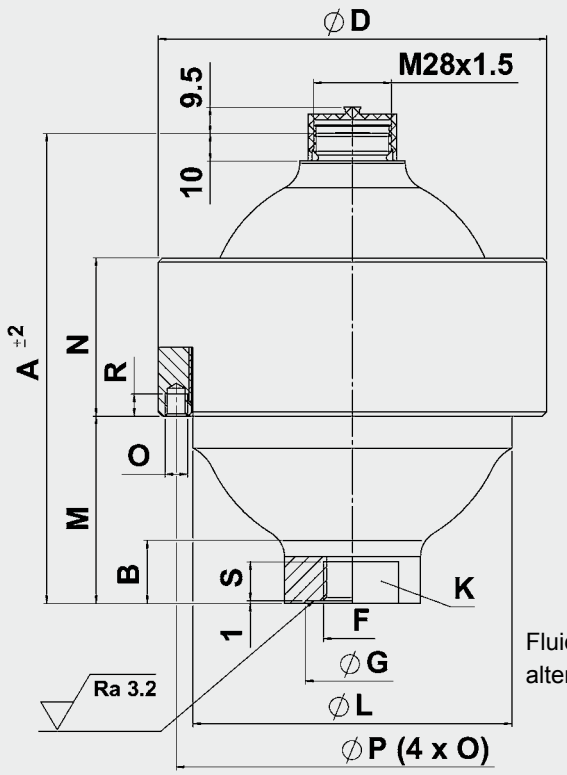
Nom. vol.[1]	Perm. press. ratio	Series	Certificate code U		R	ØD	Weight	Q [2]	**Standard fluid connection**										Diag.
			Permitt. oper. pressure [bar]						**Form AK**					**Form AB**					
[l]	$p_2 : p_0$		Carbon steel	Stainless steel	[mm]	[mm]	[kg]	[l/min]	F ISO 228	ØG [mm]	L [mm]	B 1 [mm]	hex. SW	F ISO 228	H DIN 13	L [mm]	B 2 [mm]	hex. SW	
0.075	8 : 1	250	250	–	91	64	0.7	38	G 1/2	–	14	21	30	not available					1
0.16	8 : 1	210	210	180	103	74	0.8	38	G 1/2	–	14	21	30	not available					1
		300	300	–	108	78	1.1												
0.32	8 : 1	210	210	160	116	93	1.3	95	G 1/2	–	14	21	30	not available					1
		300	300	–	120	96	1.8												
0.5	8 : 1	160	160	–	130	102	1.3	95	G 1/2	–	14	21	30	G 1/2	M33x1.5	14	37	41	1
		210	210	–	133	105	1.7												
0.6	8 : 1	330	330	–	151	115	3.3	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
		350	350	–	130	121	3.5						50					50	3
0.7	8 : 1	100	100	–	151	106	1.8	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
0.75	8 : 1	140	140	–	142	116	1.8	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
		210	210	140	147	121	2.8												
		250	250	–	152	126	3.6									15	42		
		330	330	–	140	126	4.0					26							3
1	8 : 1	200	200	–	159	136	3.6	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
	4 : 1	250	250	–	192	126	4.4												2
		330	330	–	169		4.8					26				15	42		4
1.4	8 : 1	140	140	–	173	145	3.9	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	4
		210	210	–	178	150	5.4												1
		250	250	–	185	153	5.9									15			
		330	330	–	172	155	7.6					33					42		3
2	8 : 1	100	100	100	190	160	4.0	150	G 3/4	44	16	28	46	G 3/4	M45x1.5	16	33	46	1
		210	210	–	198	167	6.6												
	4 : 1	250	250	–	232	153	7.4												2
	8 : 1	330	330	–	181	172	9.2					43					42		3
2.8	4 : 1	210	210	–	250	167	8.2	150	G 3/4	44	16	28	46	G 3/4	M45x1.5	16	33	46	2
		250	250	–	250	170	7.8												
		330	330	–	237	172	11.0					43					42		4
	6 : 1				231							44							3
3.5	4 : 1	250	210	–	306	170	11.2	150	G 3/4	44	16	28	46	G 3/4	M45x1.5	16	33	46	2
		330	330	–	274	172	13.8					44					42		4
4	4 : 1	50	–	50	294	158	5.0	150	G 3/4	44	16	44	46	G 3/4	M45x1.5	16	33	46	2
		250	–	180	306	170	11.2												

[1] Others on request
[2] Max. flow rate of operating fluid

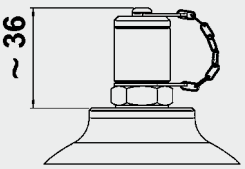
3.2. SCREW TYPE
– exchangeable diaphragm –

3.2.1 **Drawings**

Type A6



Type A3



Fluid connection AK
alternative fluid connections on request

Fig. 5

3.2.2 **Dimensions**

Nom. vol. [1] [l]	Perm. press. ratio $p_2 : p_0$	Series	Certificate code U / Permitt. oper. pressure [bar] Carbon steel	Certificate code U / Permitt. oper. pressure [bar] Stainless steel	Weight [kg]	A [mm]	B [mm]	ØD [mm]	ØL [mm]	M [mm]	N [mm]	O	ØP [mm]	R [mm]	Q [2] [l/min]	Standard fluid connection Form AK F ISO 228	S [mm]	ØG [mm]	K SW	Diag.
0.1	10 : 1	500	500	–	1.9	110	30	95	–	53	35	–	–	–	95	G 1/2	14	–	36	
0.25	10 : 1	500	500	–	3.9	129	20	115	92	56	56	–	–	–	95	G 1/2	14	–	36	
			–	350	4.9			125			60									
		750	–	750	9.0	136	11	153	114	57.5	63							27		
0.6	10 : 1	450	450	250	5.7	170	19	140	115	68	57	–	–	–	95	G 1/2	14	34	41	5
1.3	10 : 1	400	400	–	11.2	212	28	199	160	97	65	M8	180	10	150	G 3/4	16	44	50	
2	10 : 1	250	250	180	11.4	227	17	201	168	101	64	M8	188	10	150	G 3/4	16	44	50	
2.8	10 : 1	400	400	–	22.0	257	30	252	207	106	80	M8	230	10	150	G 3/4	16	44	50	
4	10 : 1	400	400	–	34.0	284	30	287	236	127.5	90	M8	265	10	150	G 3/4	16	44	50	

[1] Others on request
[2] Max. flow rate of operating fluid

4. 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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Metal Bellows Accumulators
for Heavy Diesel Engines

1. DESCRIPTION

In the fuel injection system of heavy diesel engines (e.g. marine engines and engines for power plants / two and four-stroke), pressure fluctuations are generated during the injection process by the high pressure pumps.

In most heavy diesel engines each cylinder has its own injection pump. During the phases of fuel extraction from the supply line, compression and injection as well as the release of unused fuel into the return line, cyclic pressure pulsations can result.

Example:

$$\frac{600\ [\text{rpm}] \times 8\ [\text{cylinders}]}{60\ [\text{s}] \times 2\ [\text{4-stroke}]} = 40\ [\text{Hz}]$$

The supply line and the return line are at a lower pressure than that required for fuel injection and in such dual-pipe systems the above-mentioned pressure fluctuations can cause problems, depending on the size of the pressure variations. It is for this reason that superimposed pressure fluctuations from 0 to approx. 13 bar can occur in a 4.5 bar return line (see the graph, point 2). In other systems pressure peaks of over 50 bar have been measured.

This fluctuating pressure with its unacceptable pressure peaks not only creates an additional stress on the pipe system but also an additional load for all integrated fittings and equipment. Valves, filters, measurement and monitoring devices, e.g. viscosity meters, ... can be seriously impaired or damaged, sometimes even irreparably.

Until now a standard method for reducing or eliminating the pulsations has been to use hydraulic accumulators with nitrogen as the damping element and an elastomer diaphragm or bladder as the separating element between the gas and the fuel. The best damping results may be obtained by installing one damper in the supply line and one in the return line as close as possible to the engine. However, such standard diaphragm and bladder accumulators have two main limitations:

Problems with elastomer resistance to fuels and high temperatures.

Fuels other than diesel oil, such as bio-oils or heavy fuel oil require higher injection temperatures. These can reach 160 °C. Even FKM (Viton®) used for the diaphragm or bladder has compatibility problems under such extreme conditions.

Gas loss through the elastomer

The accumulator gradually loses gas through the elastomer and the higher the temperature the higher the gas loss. If it is not possible to recharge the accumulator regularly, its function will deteriorate and the diaphragm or bladder will split.

These last two disadvantages can only be prevented by a relatively high investment in monitoring and maintenance. Depending on the type of fuel and its operating temperature, it can be necessary to replace the elastomer part after specific intervals.

HYDAC set itself the task of developing a pulsation damper without the problems outlined and which above all would also avoid the problems generated by other solutions (e.g. piston accumulators, spring-actuated accumulators, accumulators with elastic damping elements inside). These solutions have problems either with friction and abrasion or fuel leakage. One of the prime targets was therefore to relieve the system operator of the burden of excessive monitoring and maintenance.

The recently developed solution from HYDAC is the Metal Bellows Accumulator. Instead of a bladder or diaphragm, a metal bellows is used as the flexible separating element between fluid and gas. This bellows is resistant to all conventional fuels over a very wide temperature range. Heavy fuel oil at temperatures of up to 160 °C is no problem for these dampers. The metal bellows is welded to the other components and is therefore completely gas-tight. It is able to move up and down inside the accumulator without any friction or abrasion and it can operate for a very long time (years) with just one adjustment. Monitoring and maintenance for this type of damper is therefore reduced to a minimum.

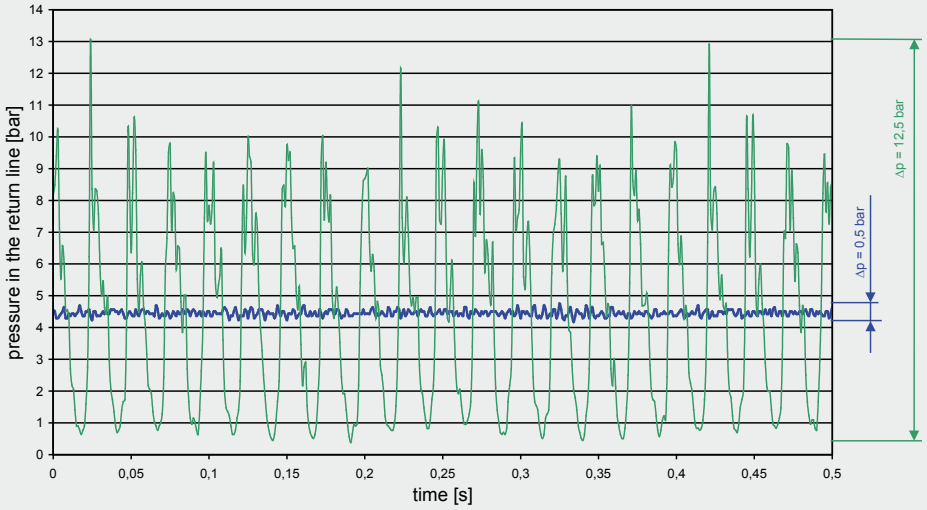
A diverting block is built into the fuel side of the damper which forces the fuel directly into the accumulator, thereby increasing the damping efficiency considerably. If two dampers are fitted to the fuel system (in both supply and return line), no pressure fluctuations can leave the engine before passing through one of the metal bellows dampers.

With this metal bellows accumulator, HYDAC has developed a competitively-priced damper which is unrivalled in terms of maintenance. The purchase costs will be recouped within a short time and as a result of reduced maintenance, the availability of the entire system is increased.
For further benefits, see below.

1.1. BENEFITS OF THE SM50P-...

- Maintenance-free
  – extremely gas-tight
  – frictionless parts (non-wearing)
- Fluid resistant across whole temperature range
- Cost-effective:
  "fit and forget"

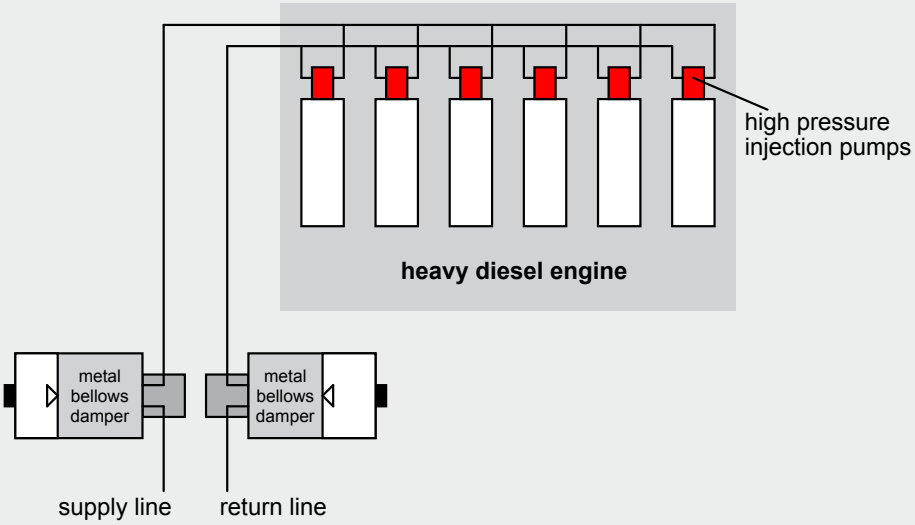
2. PRESSURE GRAPH



green = without damper
blue = with damper

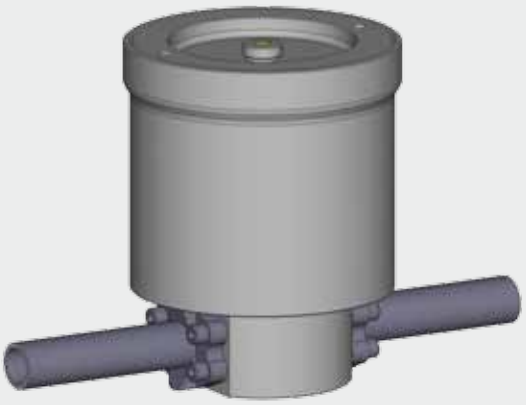
3. INSTALLATION OF THE SM50P-...

3.1. DIAGRAM



3.2. MODEL

3-D standard model, e.g. for inline installation.



Special connections on request

4. TECHNICAL SPECIFICATIONS

4.1. TECHNICAL DATA

Operating pressure:
3 ... 12 bar (others on request)

Max. pre-charge pressure:
4 bar (at max. operating temperature)

Design temperature range:
-10 °C ... +160 °C

Operating fluids:
Diesel and heavy fuel oil, biofuels

Total volume:
3.8 litres

Effective gas volume:
0.5 litre (nitrogen)

Gas-side fluid pre-charge:
0.6 litre (ethylene glycol)

Fluctuating volume:
max. 0.04 litres (others on request)

Material:
Carbon steel (primed externally)

Design and Approval:
PED / ABS / DNV / GL /
LR / BV / AS1210 / ...

Fluid connection:
SAE 1 1/4" - 3000 PSI
SAE 2" - 3000 PSI
SAE 3" - 3000 PSI

Gas connection:
M28x1.5 for Universal charging and testing unit FPU-1
Part no.: 3398235

Mounting position:
Vertical (gas connection at top), others on request

Weight:
22 ... 33 kg depending on the connection size

4.2. MODEL CODE

(example)

SM50 P – 0.5 W E 1/ 116 U – 50 AAJ – 2.5

Type / Series

Type code
_ = accumulator without diverting block*
L = light-weight accumulator*
P = damper with diverting block

Capacity [l]

Version
W = convoluted bellows
M = diaphragm bellows*

Type of shell
A = screw type
E = weld type*
G = formed type*

Type of gas-side connection
1 = gas pressure adjustable (M28x1.5)
2 = gas pressure pre-set, non-adjustable gas locking screw*
3 = gas pressure adjustable (M16x1.5)

Material code

Fluid connection
1 = carbon steel
2 = carbon steel with corrosion protection
3 = stainless steel

Accumulator shell
1 = carbon steel
2 = carbon steel with corrosion protection
4 = stainless steel

Seal material
0 = no seal
2 = NBR*
5 = low temperature NBR*
6 = FKM

Certificate code
U = PED
for others, see catalogue section no. 3.000

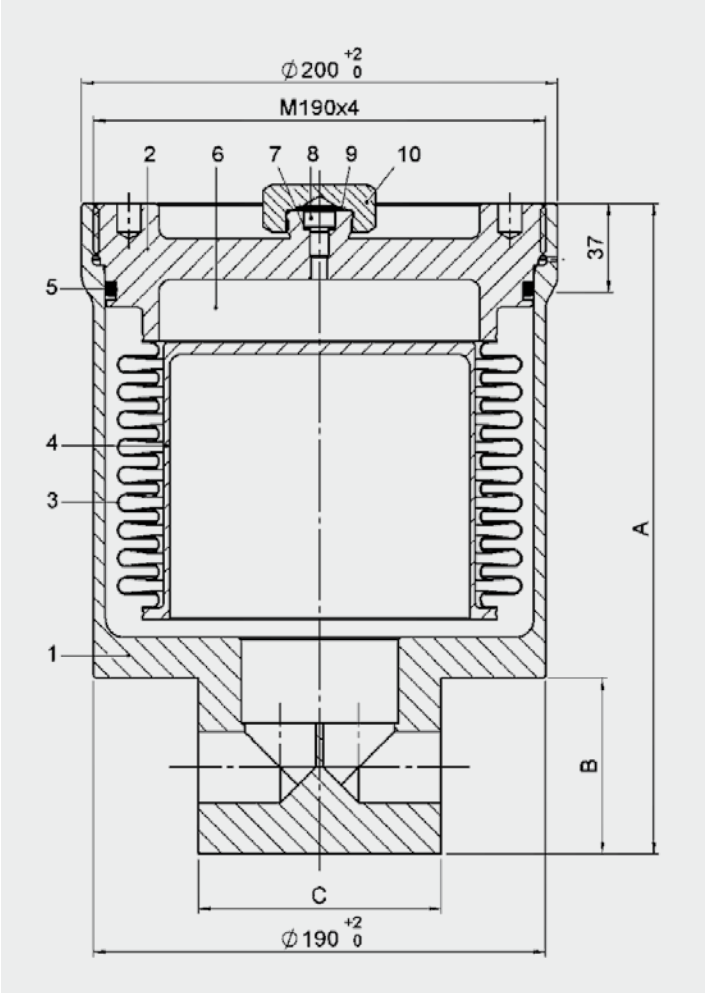
Permitted operating pressure [bar]

Fluid connection
see tables in catalogue section 3.301, Piston Accumulators

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

* currently only on request

4.3. DIMENSIONS



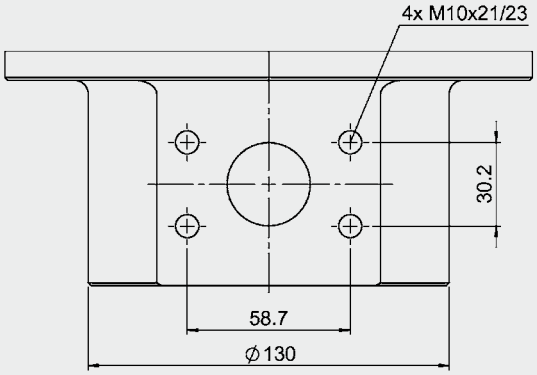
Item	Designation
1	Accumulator lower section
2	Accumulator cover plate
3	Metal bellows
4	Bowl
5	O-ring
6	Nitrogen (N_2) and fluid (e.g. ethylene glycol)
7	Seal ring
8	Adjustable locking screw
9	O-ring
10	Protective cap

4.4. ACCUMULATOR CONNECTION

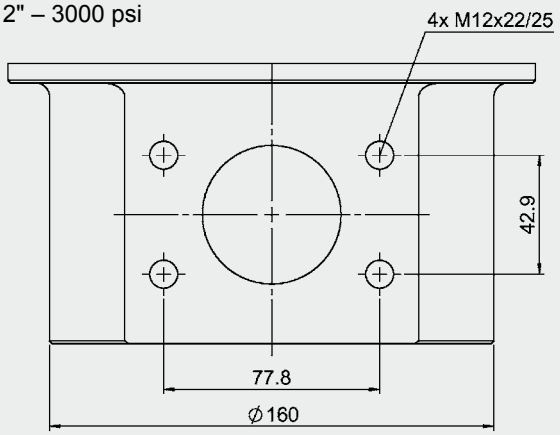
	Dimension [mm]		
	SAE 1 1/4" (FCD)*	SAE 2" (FCF)	SAE 3" (FCH)
A	274	294	333
B	74	94	134
C	102	120	133

* FCD = formerly AD

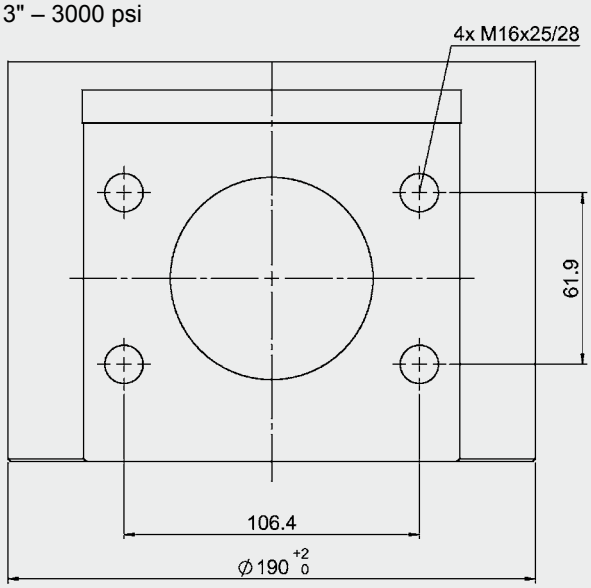
SM50P-3.8A6/116...FCD
SAE 1 1/4" – 3000 psi



SM50P-3.8A6/116...FCF
SAE 2" – 3000 psi



SM50P-3.8A6/116...FCH
SAE 3" – 3000 psi

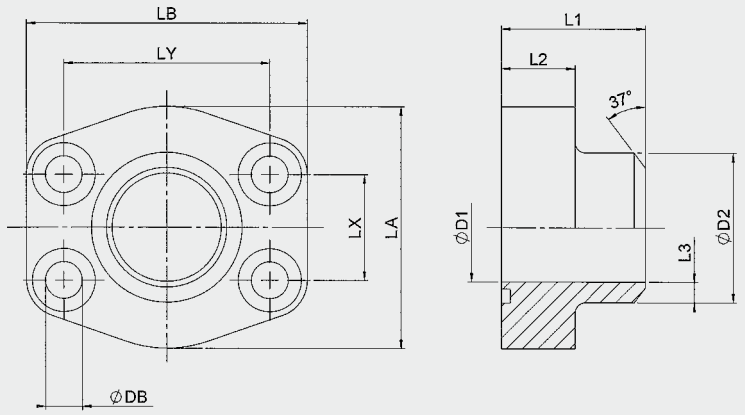


4.5. FLOW RATES / TEMPERATURE DEPENDENCY

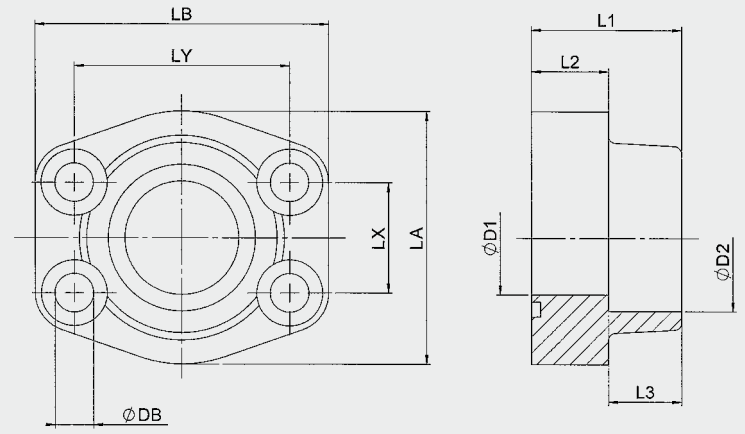
Series SM50P-... Flange SAE [inch] - 3000 psi		Bore [mm]	Max. flow rate Q_{max} [m³/h]	Weight [kg]	Ht. [mm]	Ext. diam. D_a [mm]
1 1/4	**...FCD**	30	< 8	22	274	200
2	**...FCF**	50	8 - 21	25	294	
3	**...FCH**	73	> 21	33	333	

4.6. BUTT WELD AND SOCKET WELD FLANGES

Pressure: 3000 PSI
Seal: FKM (Viton®)



Series SAE [inch]		D1 [mm]	D2 [mm]	L1 [mm]	L2 [mm]	L3 [mm]	LA [mm]	LB [mm]	LX [mm]	LY [mm]	DB [mm]	Screws
1 1/4	**Butt weld flange**	31	42.8	41	21	3.0	< 74	≅ 80	30.2	58.7	10.5	M10x40
2		50	61.0	45	25	5.5	< 94	≅ 103	42.9	77.8	13.5	M12x45
3		73	89.0	50	27	8.0	< 134	≅ 135	61.9	106.4	17.0	M16x50



Series SAE [inch]		D1 [mm]	D2 [mm]	L1 [mm]	L2 [mm]	L3 [mm]	LA [mm]	LB [mm]	LX [mm]	LY [mm]	DB [mm]	Screws
1 1/4	**Socket weld flange**	31	42.8	41	21	20	< 74	≅ 80	30.2	58.7	10.5	M10x40
2		50	61.0	45	25	24	< 94	≅ 103	42.9	77.8	13.5	M12x45
3		73	90.5	50	27	28	< 134	≅ 135	61.9	106.4	17.0	M16x50

5. 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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Hydraulic Dampers

1. HYDRAULIC DAMPERS

1.1. DESCRIPTION

1.1.1 Mode of operation

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 pumps on and off
- sudden linking of spaces with different pressure levels.

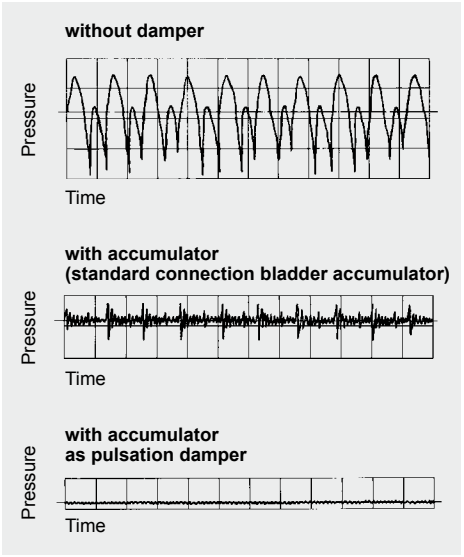
HYDAC hydraulic dampers are particularly suitable for damping such pressure fluctuations.

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
- an increase in pump rpm and feed pressure is possible
- the maintenance and servicing costs can be reduced
- the service life of the system is increased.

1.2. APPLICATION

1.2.1 Pulsation damping TYPE SB...P / SBO...P



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.

Applications

The pulsation damper is particularly suitable for:
hydraulic systems, displacement pumps of all types, sensitive measurement and control instruments and manifolds in process circuits in the chemical industry.

Mode of operation

The pulsation damper has two fluid connections and can therefore be fitted directly inline.

The flow is directed straight at the bladder or diaphragm by diverting it in the fluid valve. This causes direct contact of the flow with the bladder or diaphragm which, in an almost inertialess 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

Construction

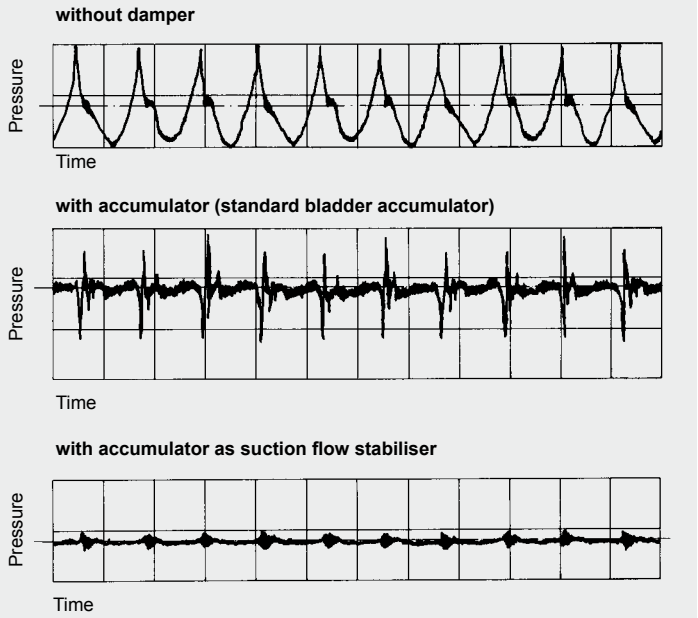
The HYDAC pulsation damper consists of:

- 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 1.4.1.

Installation

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

1.2.2 Suction flow stabiliser Type SB...S



General
The HYDAC suction flow stabiliser

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

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

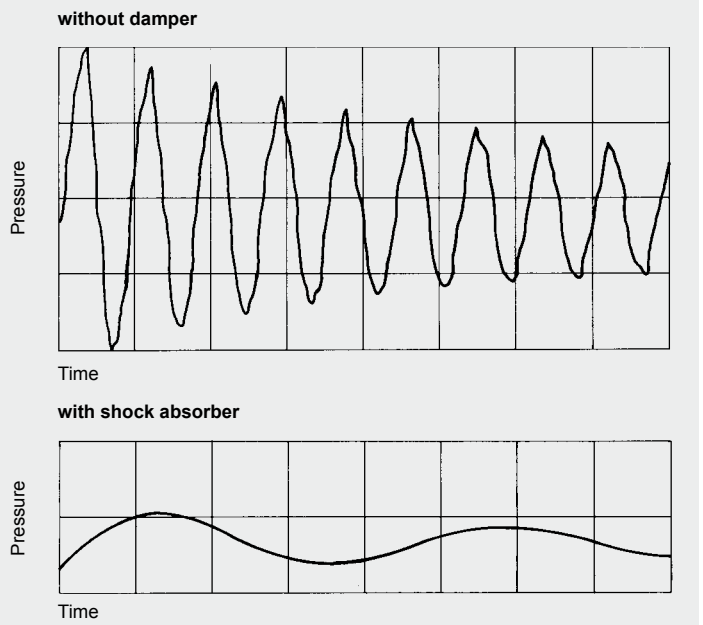
Mode of operation
Trouble-free pump operation is only possible if no cavitation occurs in the pump suction and pipe oscillations are prevented.

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.

Construction
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 a vent screw in the cover plate and a drainage facility on the bottom.

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

1.2.3 Shock absorber Type SB...A



General
The HYDAC shock absorber

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

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.

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, control instruments and other devices from destruction.

Construction
The HYDAC shock absorber consists of:

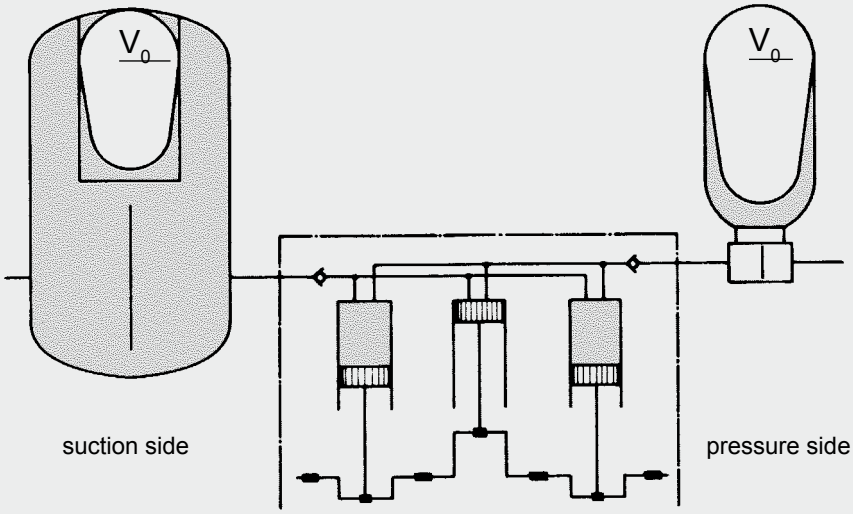
- the welded pressure vessel in carbon steel with or without corrosion protection or in stainless steel;
- the connection including perforated disc which prevents the flexible bladder from extruding from the vessel, and the flange;
- the bladder in various elastomer qualities as shown under point 1.4.1 with built-in gas valve, which is used for charging pressure p_0 and for possible monitoring activities.

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

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

1.3. SIZING

1.3.1 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 drops to a reasonable level, the connection cross-section of the damper must be the same as 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 calculated with the aid of the HYDAC software **ASP** (**A**ccumulator **S**imulation **P**rogram). The results can then be printed out or the data files can be stored in ASP format.

The ASP-program is available free of charge via our website www.hydac.com or via E-Mail to speichertechnik@hydac.com.

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_κ = piston diameter [dm]

h_κ = piston stroke [dm]

m = amplitude factor

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

z = no. of compressions / effective cylinders per revolution

x = residual pulsation [± %]

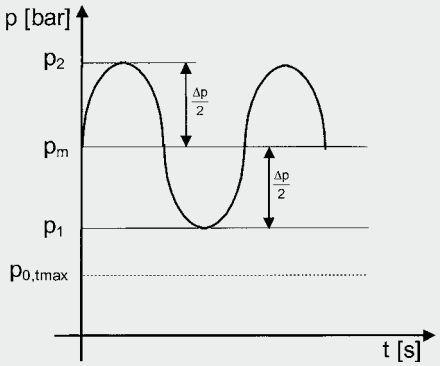
κ = isentropic exponent

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

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

Δp = height of pressure fluctuations

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



Formulae:

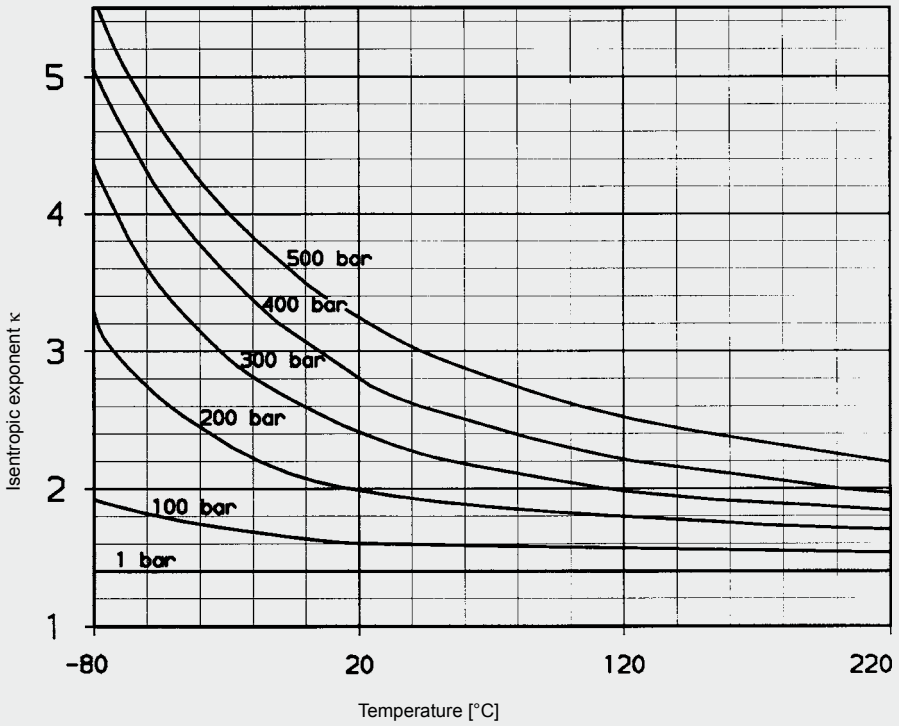
$$V_0 = \frac{\Delta V}{\left[\frac{\Phi}{1-\frac{x}{100}}\right]^{\frac{1}{\kappa}} - \left[\frac{\Phi}{1+\frac{x}{100}}\right]^{\frac{1}{\kappa}}}$$

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

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

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

Isentropic exponent κ dependent on pressure and temperature:



m-values for piston pump
(others on request):

	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	

Calculation example

Given parameters:

Single-acting 3-piston pump

Piston diameter:	70 mm
Piston stroke:	100 mm
Motor speed:	370 min^{-1}
Output:	427 l/min
Operating temperature:	20 °C
Operating pressure	
- Outlet:	200 bar
- Inlet:	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

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

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

V_0 = 0.54 l

Selected: SB16S-25 with 1 l gas volume

b) Determining the required pulsation damper

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

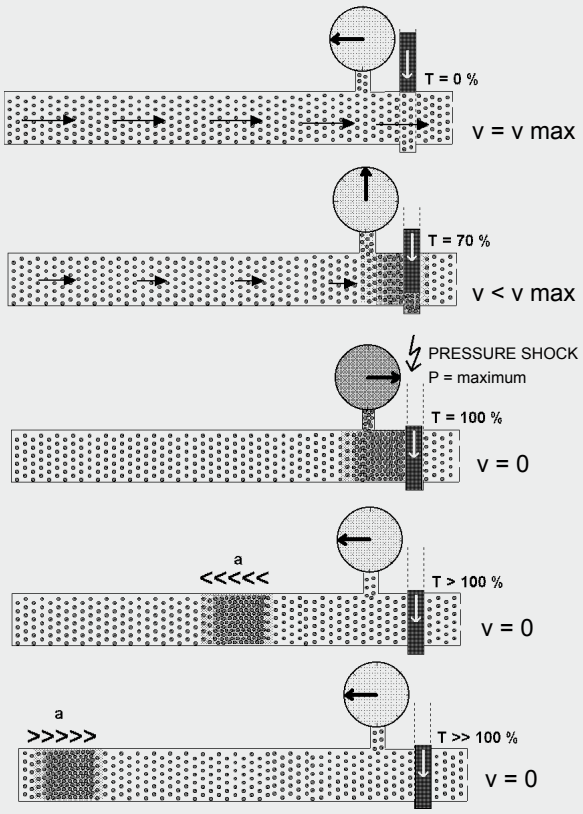
$$V_0 = \frac{0.035 \bullet \frac{\pi \bullet 0.7^2}{4} \bullet 1.0}{\left[\frac{0.7}{1-\frac{0.5}{100}}\right]^{\frac{1}{2.0}} - \left[\frac{0.7}{1+\frac{0.5}{100}}\right]^{\frac{1}{2.0}}}$$

V_0 = 3.2 l

Selected: SB330P-4

1.3.2 **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

$\Delta v = v - v_1$

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) = modulus of elasticity of pipeline

D (mm) = internal diameter of 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) = effective 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

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

m (kg) = weight of fluid in the pipeline

v (m/s) = velocity of the fluid

p_1 (bar) = zero head of the pump

p_2 (bar) = permitted operating pressure

p_0 (bar) = pre-charge pressure

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

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

Given parameters:

Length of the pipeline L:
2000 m

NW 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 head of pump p_1:
6 bar

Min. operating pressure p_{min}:
4 bar

Effective 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

Elasticity modulus (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 Point 1.3.2. 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 off shock absorbers
SB 35AH-450.

1.4. TECHNICAL DATA

1.4.1 **MODEL CODE** (also order example)
Pulsation damper, suction flow stabiliser, shock absorber

SB330 P – 10 A 1 / 112 U – 330 AI

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

Type
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 welded construction (diaphragm accumulators only)
F = flange [4)]

Type code
1 = standard model (not for threaded construction)
2 = back-up model [1)]
6 = standard model for thread-type diaphragm accumulators of the type SBO...P-...A6

Material code [2)]
depends on operating medium
Standard model = 112 for mineral oils

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

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

Accumulator bladder/diaphragm [3)]
2 = NBR20 (acrylonitrile butadiene)
3 = ECO (ethylene oxide epichlorohydrin)
4 = IIR (butyl)
5 = NBR21 (low temperature NBR)
6 = FKM (fluoro rubber)
7 = other (e.g. PTFE, EPDM)

Certification code [2)]
U = PED 97/23/EC

Permitted operating pressure [bar]

Connction
AI = ISO 228 (BSP), standard connection
BI = DIN 13 to ISO 965/1 (metric) [4)]
CI = ANSI B1.1 (UNF thread,sealing to SAE standard) [4)]
DI = ANSI B1.20 (NPT thread) [4)]

SBO250P-0.075E1 and for SBO210P-0.16E1:
AK = ISO 228 (BSP), standard connection

[1)] Not available for all models
[2)] Not all combinations are possible
[3)] When ordering spare bladder, please state diameter of the smaller shell port
[4)] Please give full details when ordering

1.4.2 General

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

Nominal volumes
See tables

Effective gas volume
See tables, based on nominal dimensions. This differs slightly from the nominal volume and must be used when calculating the usable volume.

On the diaphragm accumulator, the effective gas volume corresponds to the nominal volume.

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

Fluids
Mineral oils, hydraulic oils, non-flam fluids, water, emulsions, fuels.
Others on request.

Gas charge
Hydraulic accumulators must only be charged with nitrogen.
Never use other gases.
RISK OF EXPLOSION!

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

Permitted operating temperature
-10 °C ... +80 °C
263 K ... 353 K
with material code 112.

Other media on request.

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

See catalogue section:

- Accumulators
  No. 3.000

General safety instructions
On no account must any welding, soldering or mechanical work be carried out on the accumulator shell.

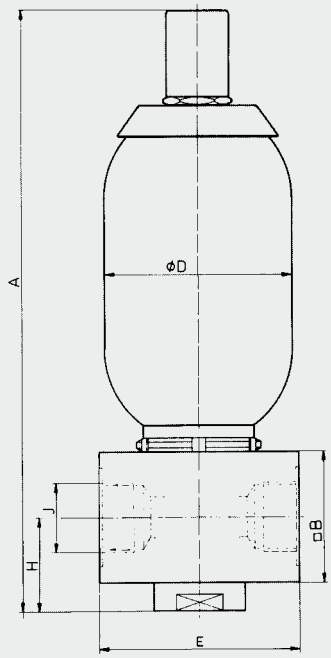
After the hydraulic line has been connected it must be completely vented. Work on systems with hydraulic dampers (repairs, connecting pressure gauges etc) must only be carried out once the pressure and the fluid have been released.

Please read the Operating Manual!

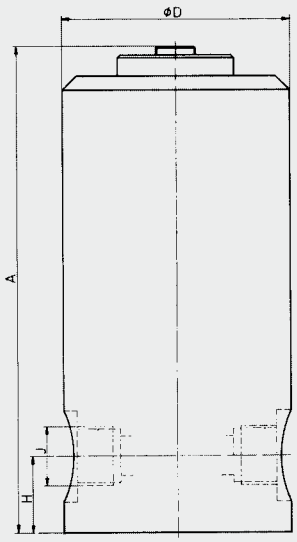
- Bladder Accumulators
  No. 3.201.CE
- Diaphragm Accumulators
  No. 3.100.CE
- Piston accumulators
  No. 3.301.CE

1.4.3 **Pulsation damper**

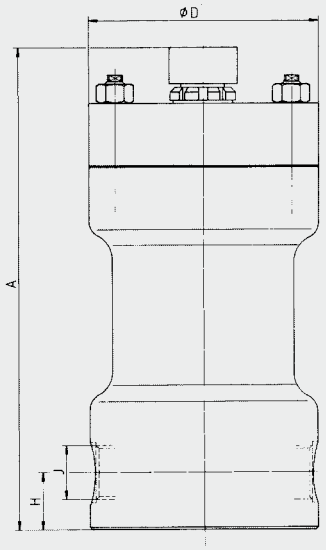
SB330/550P(PH)-...



SB800P-...



SB1000P-...

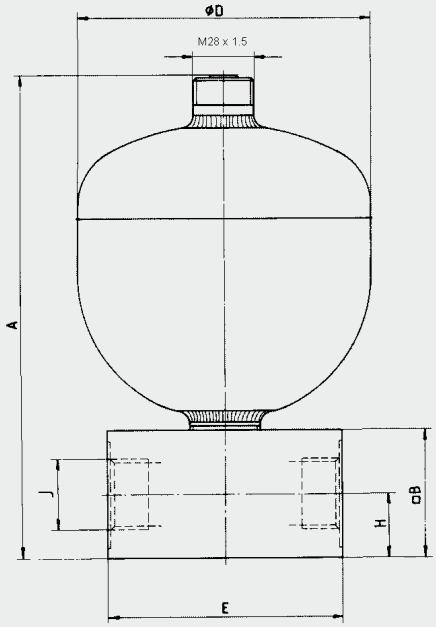


Dimensions SB

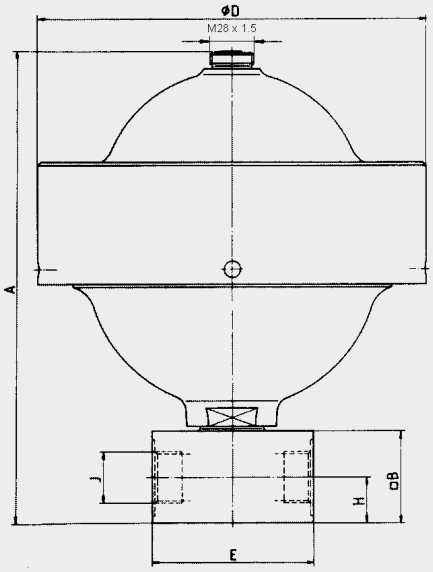
Nominal volume [l]	Max. operating pressure* [bar]	Effective gas volume [l]	Weight [kg]	A [mm]	□ B [mm]	Ø D [mm]	E [mm]	H [mm]	J [2] thread ISO 228	Series
1	330	1.0	11	365	80	118	120	57	G 1 1/4	SB330P
	550		13	384	70	121		53		SB550P
1.5	800 [3]	1.3	36	346	–	160	–	55		SB800P
	1000 [3]		94	414	–	215	–	49	[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	SAE2"-6000 PSI	SB330PH
13	330	12.0	48	712	100			85	G 1 1/2	SB330P
20		18.4	70	920						SB330P
			80	952	130x140			100	SAE2"-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	SAE2"-6000 PSI	SB330PH

* Certification to PED 97/23/EC
[1] M56x4, high pressure connection DN 16, others on request
[2] Standard connection code = AI, others on request
[3] Special model, on request

SBO...P...E



SBO...P...A6



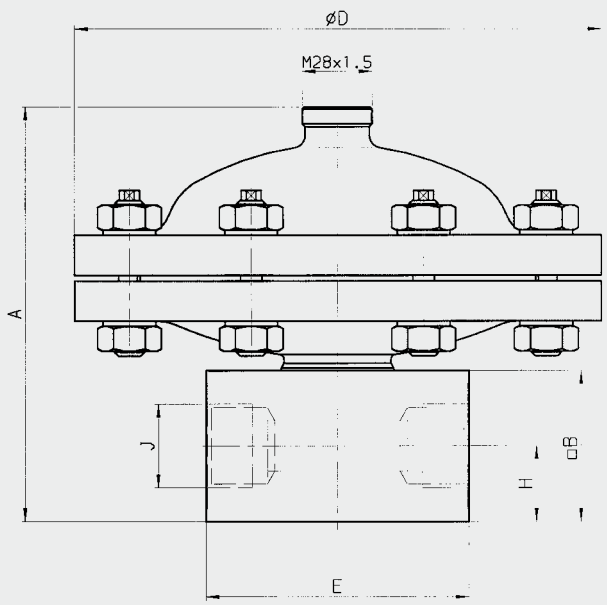
Dimensions SBO

Nominal volume	Max. operating pressure*		Weight	A	□ B	Ø D	E	H	J [1] thread	Series	
	Carbon steel	Stainless steel (NIRO)									
[l]	[bar]	[bar]	[kg]	[mm]	[mm]	[mm]	[mm]	[mm]	ISO 228		
0.075	250	–	0.9	131	–	64	41 hex.	13	G 1/4	SBO250P-...E1	weld-type
0.16	210	180	1.0	143	–	74				SBO210P-...E1	
0.32		160	2.6	175	50	93	80	25	G 1/2		
0.5		–	3.0	192		105					
0.6	330	–	5.6	222	60	115	105	30	G 1	SBO330P-...E1	
0.75	210	140	5.1	217		121				SBO210P-...E1	
1.0	200	–	6.0	231		136				SBO200P-...E1	
1.4	140	–	6.2	244		145				SBO140P-...E1	
	210	–	7.7	250		150				SBO210P-...E1	
	250	–	8.2	255		153				SBO250P-...E1	
2.0	100	100	6.3	261		160				SBO100P-...E1	
	210	–	8.9	267		167				SBO210P-...E1	
3.5	250	–	13.5	377		170				SBO250P-...E1	
4.0	–	50	7.9	368		158				SBO50P-...E1	
		250	13.5	377		170				SBO250P-...E1	
0.25	500	350	5.2 (6.3)	162	50	115 (125)	80	25	G 1/2	SBO500P-...A6	thread-type
0.6	330	250	8.9 (9.1)	202	60	140 (142)	95		G 1	SBO450P-...A6	
1.3	400	–	13.8	267		199	105	30		SBO400P-...A6	
2.0	250	180	15.6	285		201				SBO250P-...A6	
2.8	400	–	24.6	308		252				SBO400P-...A6	
4.0		–	36.6	325		287					

* Certification to PED 97/23/EC
[1] Standard connection code = AI, others on request
( ) Brackets indicate different dimensions for stainless steel version (NIRO)

Pulsation dampers for aggressive media

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



Pulsation damper in stainless steel with PTFE coated diaphragm and PTFE or FFKM seals. Also available without connection block.

Certification to
PED 97/23/EC

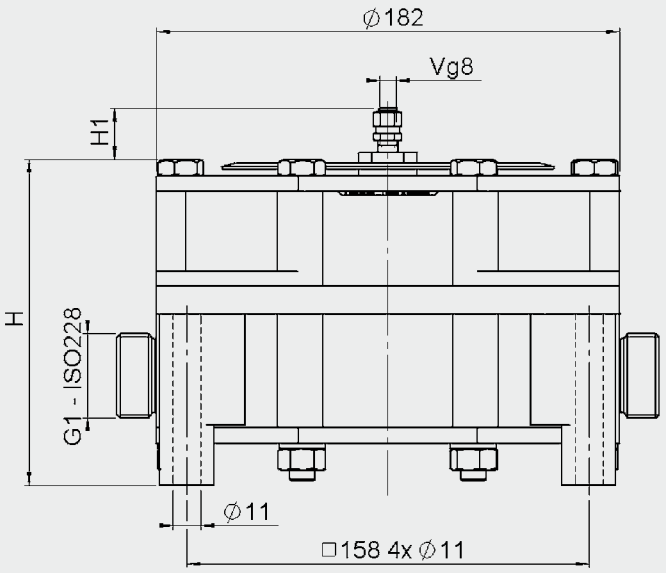
Permitted operating temperature:
-15 °C ... +80 °C

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

Nominal volume [l]	Max. operating pressure [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

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



Pulsation damper in PVDF with PTFE-coated diaphragm.

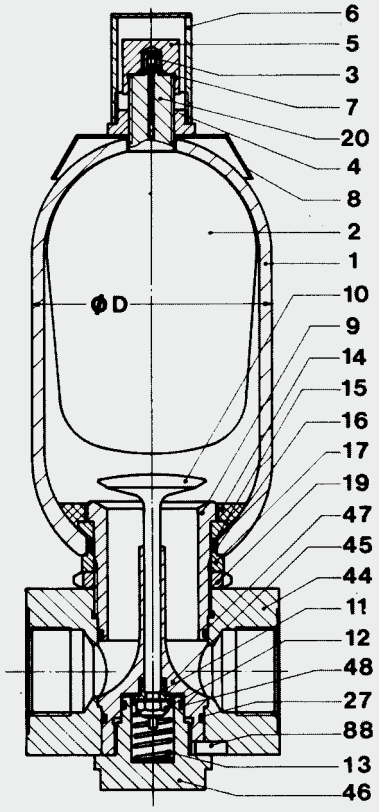
Permitted operating temperature:
-10 °C ... +65 °C

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

Nominal volume [l]	Max. operating pressure [bar]	Weight [kg]	H [mm]	H1 [mm]
0.2	10	5.7	128	20
	16	6.5	130	18
	25			
0.5	10	6.0	168	20
	16	6.8	170	19
	25			

Spare parts

SB...P



Description	Item
Bladder assembly* consisting of:	
Bladder	2
Gas valve insert	3
Retaining nut	4
Cap nut	5
Valve protection 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

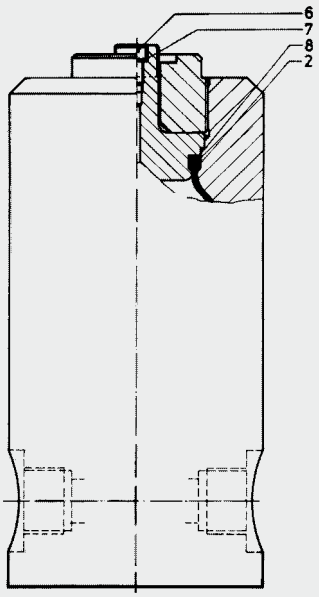
Description	Item
Connection assembly consiting of:	
Oil valve body	9
Valve poppet	10
Damping sleeve	11
Lock nut	12
Spring	13
Anti-extrusion ring	14
Washer	15
O-ring	16
Spacer	17
Lock nut	19
Support ring (only for 330 bar)	23
O-ring	27
Connector	44
Guide piece	45
Cap	46
O-ring	47
O-ring	48
Locking key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

O-ring dimensions [mm]

Series	Nominal vol.	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)]

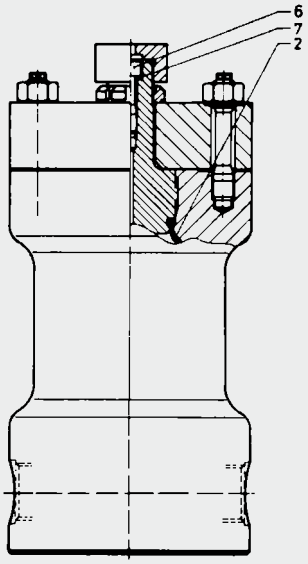
[1)] For code 663 and 665 different dimensions

SB800P



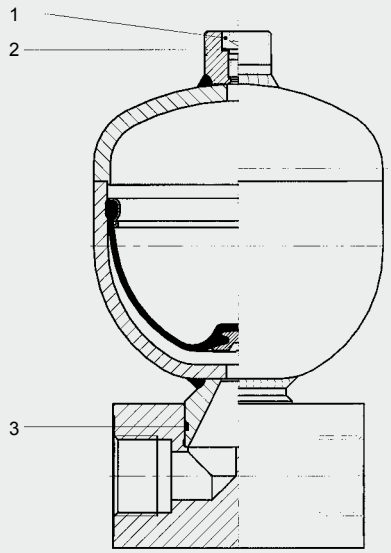
Description	Item
Bladder	2
Charging screw	6
Seal ring U 9.3x13.3x1	7
Support ring	8

SB1000P



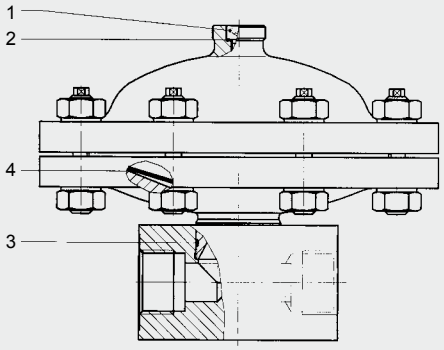
Description	Item
Bladder	2
Charging screw	6
Seal ring	7

SBO...P...E



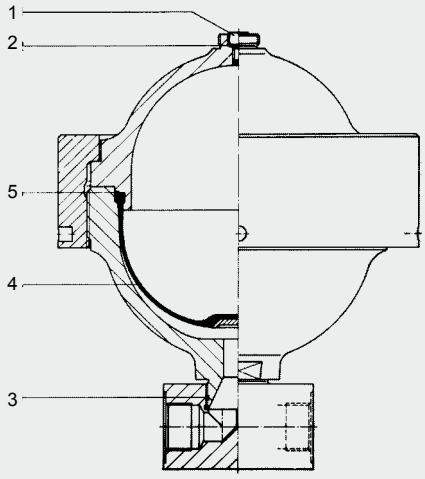
Description	Item
Charging screw	1
Seal ring	2
Seal ring	3

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



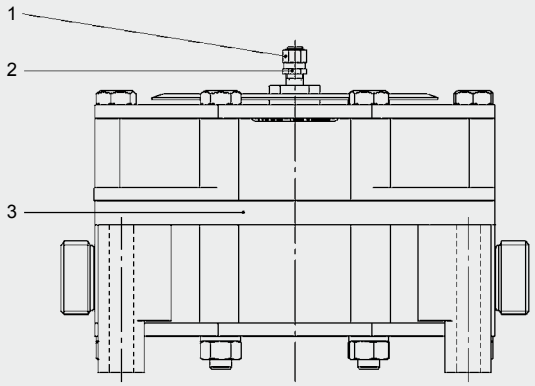
Description	Item
Charging screw	1
Seal ring	2
Seal ring	3
Diaphragm	4

SBO...P...A6



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

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

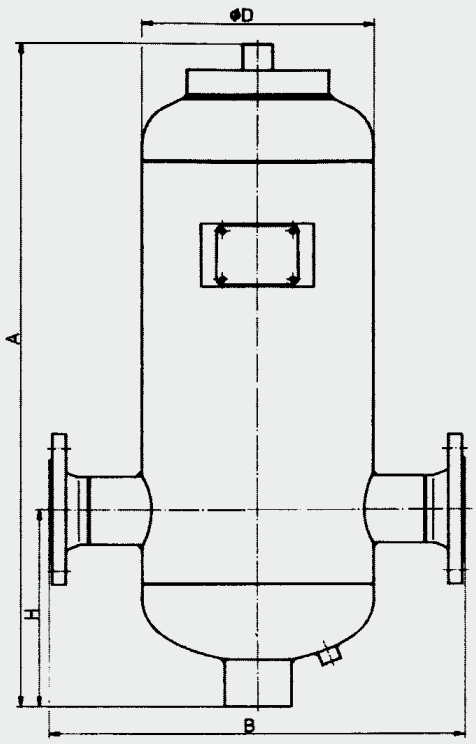


Description	Item
Gas valve complete	1
Gas valve insert brass / stainless steel	2
Diaphragm	3

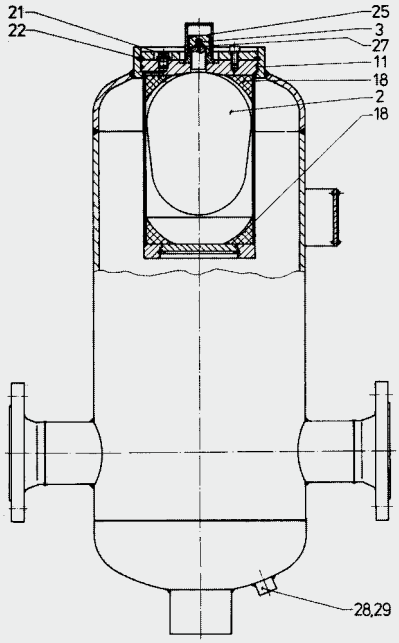
Please read the Operating Manual!
Available on request!

1.4.4 Suction flow stabiliser

SB16S



Spare Parts



Dimensions

SB16S - permitted working pressure 16 bar; certified to PED 97/23/EC

Nominal volume [l]	Fluid volume [l]	Effective 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

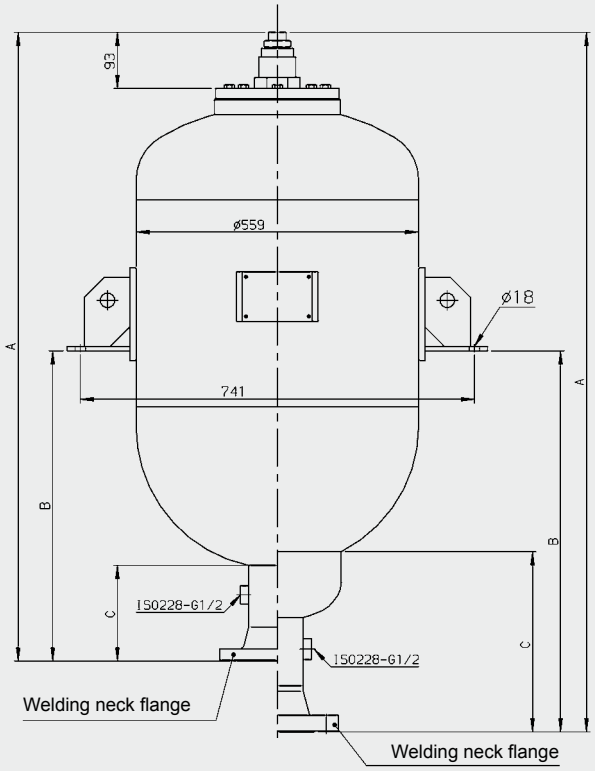
Further pressure ranges 25 bar, 40 bar; others on request.
Other fluid volumes on request

* to EN1092-1/11 /B1/PN16 or PN40

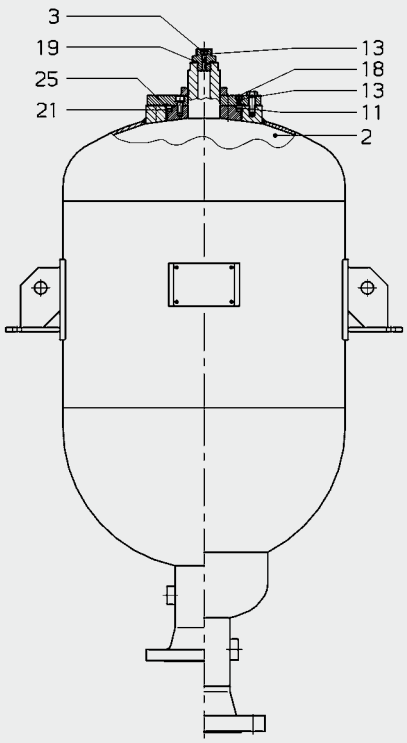
Description	Item
Bladder	2
Gas valve insert	3
O-ring	11
Insertion ring, 2x	18
Lock nut	21
Retaining ring	22
Cap nut	25
O-ring	27
Seal ring	28
Lock nut	29

1.4.5 Shock absorber

SB16/35A(H)



Spare Parts



Dimensions

SB16/35A - permitted operating pressure 16/35 bar (PED 97/23/EC)

Nominal volume	Effective gas volume	Weight [kg]		A (approx.) [mm]		B (approx.) [mm]		C (approx.) [mm]		DN*
[l]	[l]	SB16A	SB35A	SB16A	SB35A	SB16A	SB35A	SB16A	SB35A	
100	99	84	144	870	880	390	403	185	198	100
150	143	101	161	1070	1080	490	503			
200	187	122	223	1310	1320	685	698			
300	278	155	288	1710	1720	975	988			
375	392	191	326	2230	2240	1250	1263			
450	480	237	386	2625	2635	1465	1478			

SB16/35AH - Permitted operating pressure 16/35 bar (PED 97/23/EC)

Nominal volume	Effective gas volume	Weight [kg]		A (approx.) [mm]		B (approx.) [mm]		C (approx.) [mm]		DN*
[l]	[l]	SB16AH	SB35AH	SB16AH	SB35AH	SB16AH	SB35AH	SB16AH	SB35AH	
100	99	93	153	957	965	457	465	245	254	80
150	143	110	170	1157	1165	557	565			
200	187	131	230	1417	1425	842	850			
300	278	164	297	1865	1873	1092	1100			
375	392	200	335	2307	2315	1342	1350			
450	480	246	395	2702	2710	1542	1550			

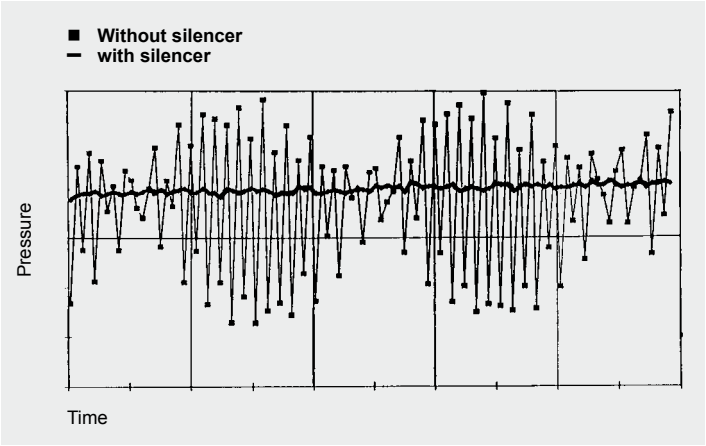
* to EN1092-1/11 /B1/PN16 or PN40
others on request

Description	Item
Bladder	2
Lock nut	3
O-ring	11
Seal ring	13
Vent screw	18
O-ring	19
Retaining ring	21
O-ring	25

2. SILENCER

2.1. APPLICATION

2.1.1 **Silencer** for fluid noise damping
Type SD...



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, the use of flexible hoses and silencer covers can provide only partial solutions to the problem as they do not prevent transmission to other areas.

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.

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 damped across a wide frequency spectrum.

Construction

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.

Special model

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

Installation

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

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

Please read the Operating Manual!
No. 3.701.CE

2.2. SIZING

2.2.1 **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 = height of pressure fluctuations without silencer
Δp_m = height of pressure fluctuations with silencer

For the selection of 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 min^{-1}

2.2.2 **Calculation example**

Given parameters:

Axial piston pump with 9 pistons
Motor speed: 1500 min^{-1}
Connection: G1 corresponds to D_i = 19 mm
Flow rate: 300 l/min
Operating medium: mineral oil
Max. permitted operating pressure: 210 bar

Solution:

1) Fundamental frequency f
   f = i • n / 60 in Hz
   = 9 • 1500/60
   = 225 Hz
2) From the "Damping curve" graph, the following SILENCER type can be selected:
   SD330-S10/012U-330AE/AE
   Transmission damping ≈ 31 dB
   Pressure drop ≈ 2 bar

2.3. TECHNICAL DATA

2.3.1 **Model code SD**
(also order example)

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]

Material code

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 protective coating*

Seal material
2 = NBR (acrylonitrile butadiene)
6 = FPM (fluoro rubber)

Certificate code
U = PED 97/23/EC

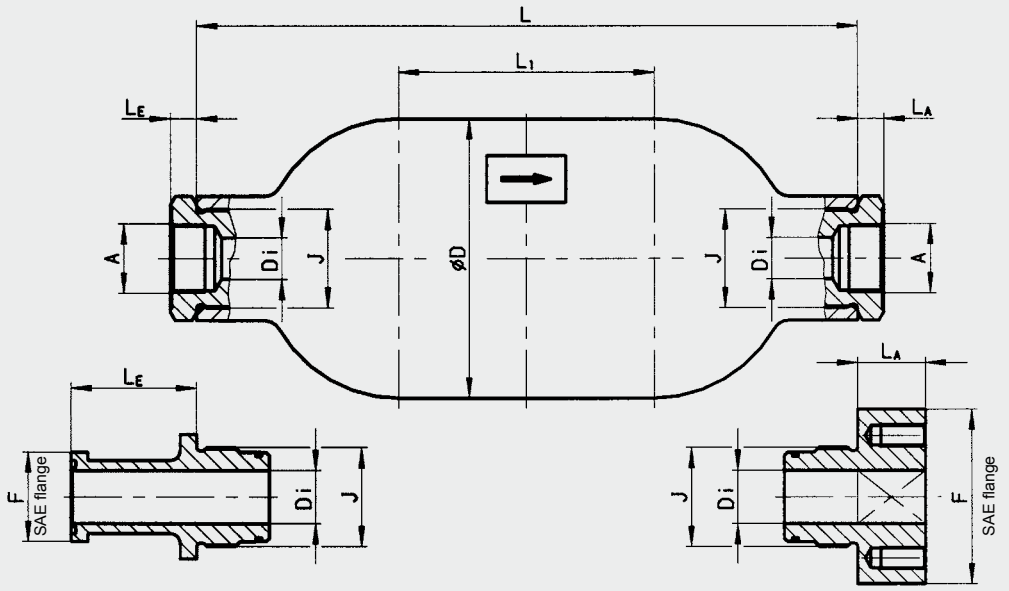
Permitted operating pressure [bar]

Inlet connector / Outlet connector
see Table 2.3.3

* only on request

2.3.2 **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
5.5	815	615	114	G 1 1/4	14.0

2.3.3 **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
5.5	–		13	13	13	13	30	30	33	33	–		–	

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	*	
5.5	53	31	59	36	65	36	–		–		–	

- not available
* on request

3. 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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E-Mail: speichertechnik@hydac.com

Accumulator Stations

1. GENERAL

HYDAC supplies fully assembled piston accumulator stations which are ready for operation, complete with all the necessary valve controls, ball valves and safety equipment

- as an individual accumulator unit or
- in a back-up version with nitrogen bottles to increase the effective volume.

The HYDAC system approach creates a HYDAC system, for example, bladder or piston accumulator stations, by integrating individual HYDAC components.

An accumulator station can be composed of

- piston accumulators with nitrogen bottles,
- bladder accumulators with nitrogen bottles or
- nitrogen bottles alone.

The modular construction of the accumulator stations enables HYDAC to incorporate all customer requirements. HYDAC can calculate the required accumulator volume using the accumulator sizing program, taking the customer's own operating data into account:

- **ASP** - **A**CCUMULATOR **S**IMULATION **P**ROGRAM

Please read the relevant operating manual for the individual HYDAC components!

2. MODEL CODE

(also order example)

SS 350 K – 4 x 250 / 12 x 320 (U)

Type of accumulator
SS = accumulator station

Max. operating pressure [bar]

Series
K = piston accumulator
B = bladder accumulator
N = nitrogen bottles

Number of accumulators

Nominal volume [l] of the accumulators

Number of nitrogen bottles

Nominal volume [l] of the nitrogen bottles

Certification code

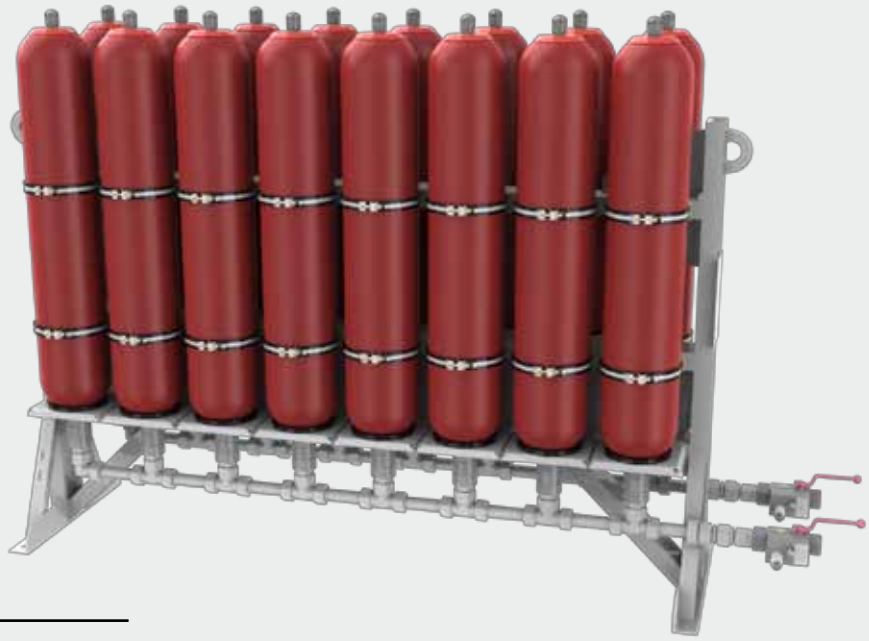
Piston accumulators and nitrogen bottles are connected up via a manifold block or pipework

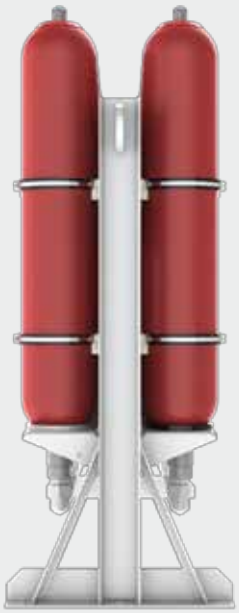
3. EXAMPLES OF ACCUMULATOR STATIONS

3.1. BLADDER ACCUMULATOR STATIONS

EXAMPLE: SS330B-16x32(U)

Technical specifications:
16 bladder accumulators, each with a volume of 32 l
Max. operating pressure: 330 bar





Dimensions		
Length [mm]	Width [mm]	Height [mm]
2780	660	1950

EXAMPLE: SS330B-5x50(U)

Technical specifications:
5 bladder accumulators, each with a volume of 50 l
Max. operating pressure: 330 bar

Dimensions		
Length [mm]	Width [mm]	Height [mm]
1640	600	2750

3.2. PISTON ACCUMULATOR STATIONS

EXAMPLE: SS350K-1x110/8x50(U)

Technical specifications:
1 piston accumulator, volume 110 l
8 N_2 bottles, each with a volume of 50 l
Max. operating pressure: 350 bar

Dimensions		
Length [mm]	Width [mm]	Height [mm]
1540	900	3300

EXAMPLE: SS220K-1x120/1x75(U)

Technical specifications:
1 piston accumulator, volume 120 l
1 N_2 bottle, volume 75 l
Max. operating pressure: 220 bar

Dimensions		
Length [mm]	Width [mm]	Height [mm]
520	800	3500

EXAMPLE: SS210K-1x110/2x50(U)

Technical specifications:
1 piston accumulator, volume 110 l
2 N_2 bottles, each with a volume of 50 l
Max. operating pressure: 210 bar

Dimensions		
Length [mm]	Width [mm]	Height [mm]
950	475	2840

EXAMPLE: SS350K-1x200/2x110(A9)

Technical specifications:
1 piston accumulator, volume 200 l
2 N_2 bottles, each with a volume of 110 l
Max. operating pressure: 350 bar

Dimensions		
Length [mm]	Width [mm]	Height [mm]
1250	550	2900

3.3. NITROGEN BOTTLES

Nitrogen bottles in modular construction:
up to 24 bottles can be assembled in this version on a frame.
For a larger number, a special model can be supplied.

See catalogue section:

- Hydraulic accumulators with back-up nitrogen bottles
  No. 3.553

EXAMPLE: SS350N-16x75(U)

Technical specifications:
16 N_2 bottles, each with a volume of 75 l
Max. operating pressure: 350 bar

Dimensions		
Length [mm]	Width [mm]	Height [mm]
2440	900	3000

4. 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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Hydraulic Accumulators with Back-Up Nitrogen Bottles

1. GENERAL

To complete the accumulator range, HYDAC provides a variety of useful accessory products. They guarantee correct installation and optimum functioning of HYDAC hydraulic accumulators. These include, amongst others, nitrogen bottles which can be used to back up bladder and piston accumulators. Nitrogen bottles used as back-ups increase the gas volume in the accumulator. This means that smaller accumulators can be used for the same gas volume and costs can be reduced. To assist selection the Simulation Program ASP can be downloaded from www.hydac.com.

For further information, please turn to the sections:

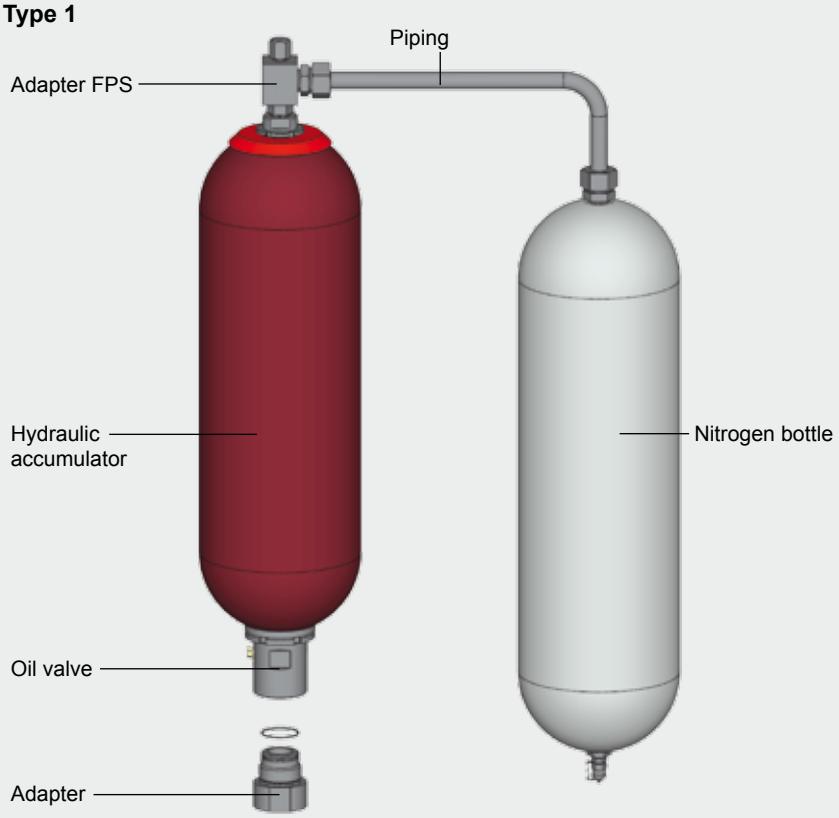
- Bladder Accumulators Standard No. 3.201
- Piston Accumulators No. 3.301

2. BACK-UP VERSIONS

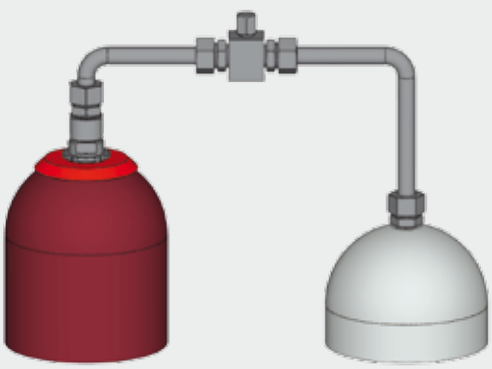
2.1. CONSTRUCTION

Based on bladder accumulator models 20 ... 50 l, the gas-side of these transfer accumulators is designed specially for connecting to nitrogen bottles. A diffuser rod prevents damage to the bladder when the accumulator is charged. This construction can also be used for the separation of fluids (taking into account the volume ratios which apply to bladder accumulators).

Type 1

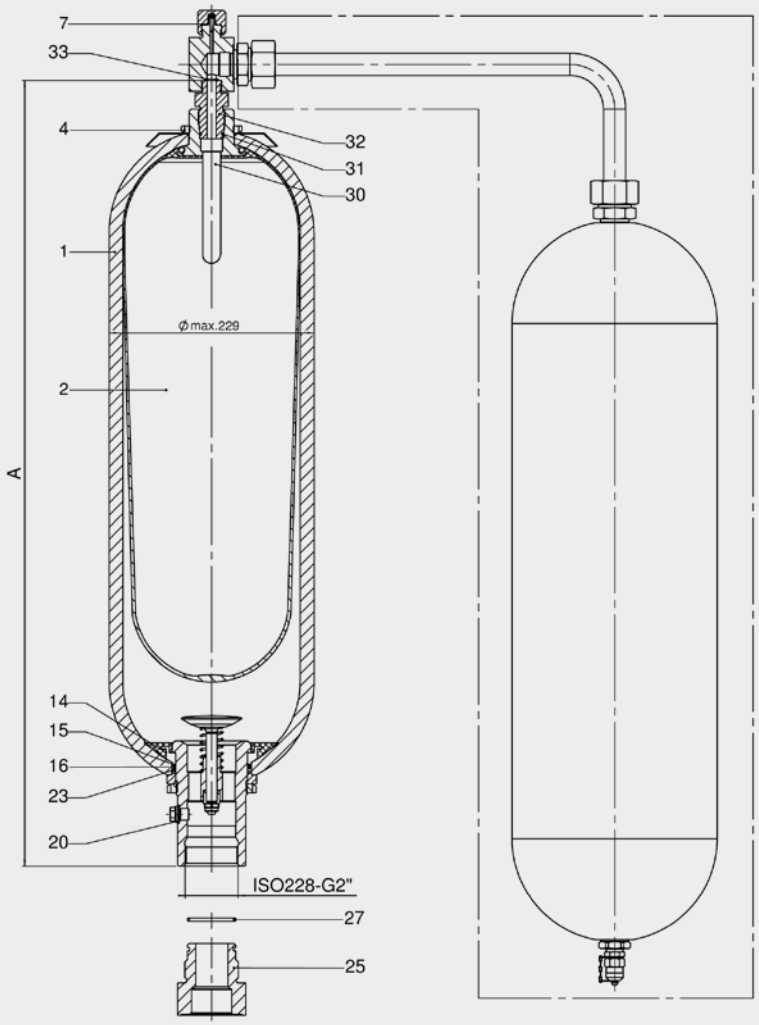


Type 2

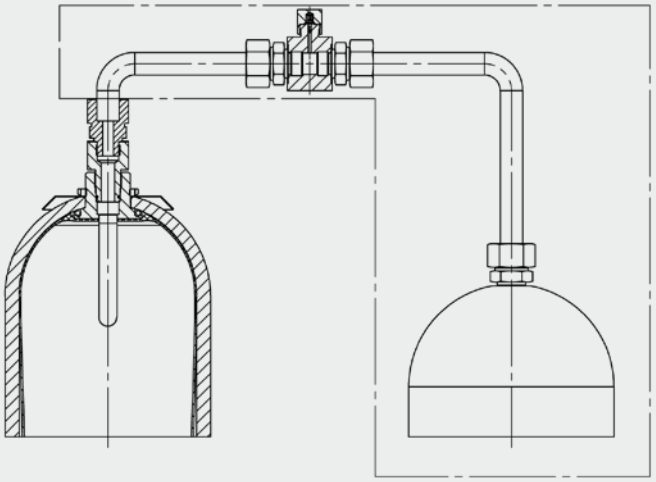


2.2. DIMENSIONS

Type 1



Type 2



Nominal volume [l]	Effect. gas volume [l]	Weight [kg]	A max. [mm]
20	17.5	53.5	905
24	24	72	1070
32	32.5	89	1420
50	47.5	119.5	1930

2.3. SPARE PARTS

Description	Item
Repair kit consisting of:	
Bladder	2
Retaining nut	4
O-ring 7.5x2.0 [1)]	7
Washer	15
O-ring 80x5 [1)]	16
Seal ring	20
Support ring	23
O-ring 48x3 [1)]	27
O-ring 22x2.5 [1)]	31
O-ring 11x2 [1)]	33
Diffuser rod	30
Anti-extrusion ring	14

Recommended spare parts

[1)] For code 663 and 665 different dimensions

Item 1 not available as a spare part.

Item 25 must be ordered separately, See Bladder Accumulators Standard, No. 3.201 (see Point 4.2.).

Item 32 Type 1 is standard.

For other spare parts, see Point 3.

2.4. REPAIR KITS

NBR, carbon steel

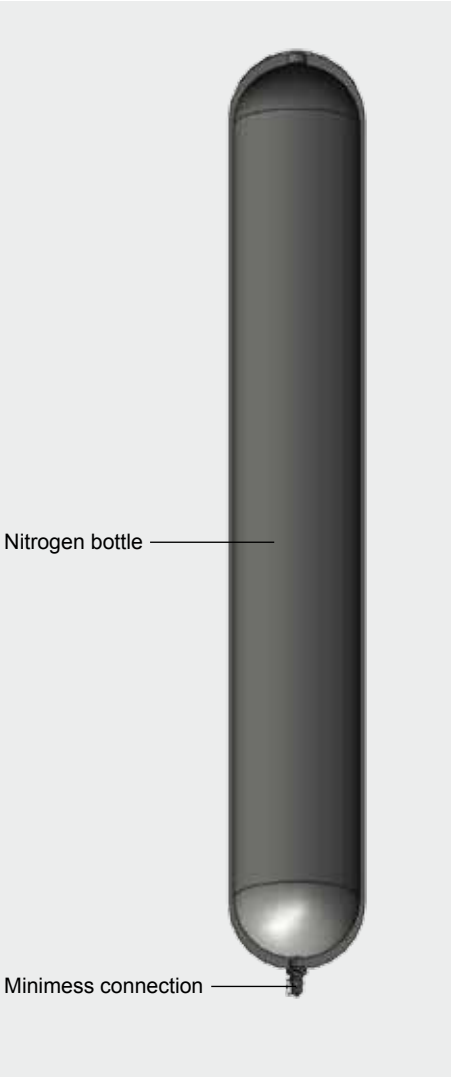
Nom. volumes: 20 ... 52 litres

Standard gas valve

Nominal volume [l]	Part no.
20	03119500
24	03119502
32	03119498
52	03119499

3. NITROGEN BOTTLES

3.1. DESCRIPTION AND CONSTRUCTION



HYDAC nitrogen bottles are used to take in and store nitrogen. HYDAC offers a wide selection of bottle types, such as forged vessels and bladder shells or piston cylinders.

3.2. ADVANTAGES

Using HYDAC nitrogen bottles provides the following benefits:

- Cost-effective increase of the accumulator volume and as a result
- smaller accumulators for the same gas volume.

3.3. TECHNICAL DATA

3.3.1 Model code

(also order example)

SN360 _ - 50 AA / 010 U - 360 D D

Series

Code letter
No details = standard
B = bladder accumulator shell [1)]
K = piston accumulator cylinder [2)]
M = diaphragm accumulator half-sections [3)]

Nominal volume [l]

Connection type

Connection type on connection side*
A = ISO 228 (BSP)
B = DIN 13 to ISO 965/1 (metric)
C = ANSI B1.1 (UNF seal SAE)
D = ANSI B2.1
F = flange

Drain side (condensate)*
A = ISO 228 (BSP)
B = DIN 13 to ISO 965/1 (metric)
C = ANSI B1.1 (UNF seal SAE)
D = ANSI B2.1
F = flange
1 = sealed with blanking plug
2 = with condensate drain, hex. socket cap screw
3 = with condensate drain valve
4 = with Minimess valve

Material code

Material (of connection)
0 = no components
1 = carbon steel
3 = stainless steel
4 = carbon steel with protective coating
6 = low temperature steel

Housing material
1 = carbon steel
2 = carbon steel with protective coating
4 = stainless steel
6 = low temperature steel

Seal material (elastomer)
0 = no elastomer used
2 = NBR (Perbunan)
4 = IIR (Butyl)
5 = TT-NBR
6 = FKM (fluoro rubber)

Certificate code
U = PED 97/23/EC [4)]

Permitted operating pressure [bar]

Size for connection side (see Table 3.3.2)

Size for drain side (see Table 3.3.2)
0 = for type 1-4

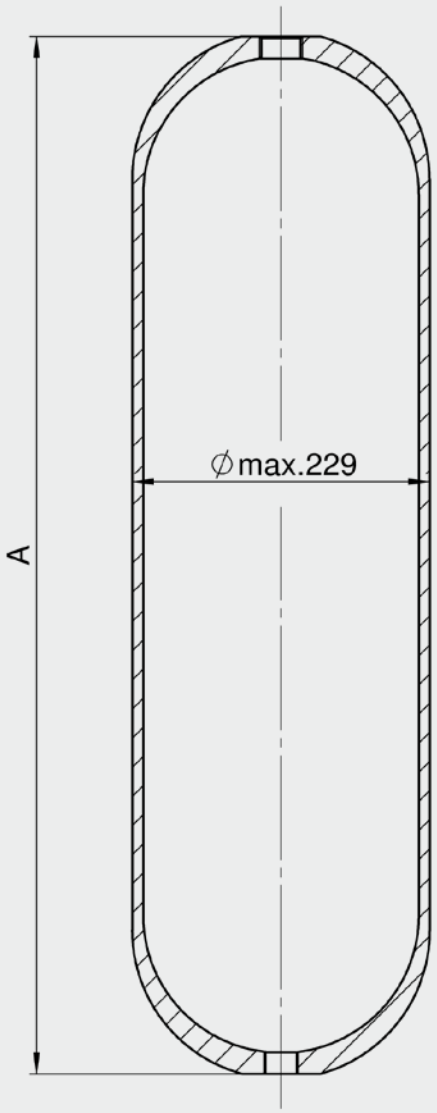
[1)] see catalogue section: Bladder Accumulators Standard, No. 3.201
[2)] see catalogue section: Piston Accumulators, No. 3.301
[3)] see catalogue section: Diaphragm Accumulators, No. 3.100
[4)] see catalogue section: Accumulators, No. 3.000, Point 3.

3.3.2 Connections*

Type / Size	**A** BSP ISO228	**B** metric DIN 13 ISO 965/1	**C** SAE ANSI B1.1	**D** NPT ANSI B2.1	**F** Flange connection
A	G 1/4"	M12x1.5	7/16"-20UNF	1/4"	1/2" 3000 PSI Code 61
B	G 3/8"	M18x1.5	9/16"-18UNF	3/8"	3/4"
C	G 1/2"	M22x1.5	3/4"-16 UNF	1/2"	1"
D	G 3/4"	M27x2	1 1/16"-12UN	3/4"	1 1/4"
E	G 1"	M33x2	1 5/16"-12UN	1"	1 1/2"
F	G 1 1/4"	M42x2	1 5/8"-12UN	1 1/4"	2"
G	G 1 1/2"	M48x2	1 7/8"-12UN	1 1/2"	1/2" 6000 PSI Code 62
H	G 2"	M14x1.5	2 1/2"-12UN	2"	3/4"
I	G 1 3/4"	M8			
K		M16x1.5			1 1/4"
L			7/8"-14 UNF	5/8"	1 1/2"
M					2"
S	Special model				

* not all combinations are possible, others on request

3.3.3 Dimensions of standard bottle



Designation	Volume [l]	Connections to ISO 228		A max. [mm]	Part no.
SN360-50AA/010U-360DD	50	G 3/4	G 3/4	1615	3176324
SN360-50AA/010U-360DG	50	G 3/4	G 1 1/2	1615	3418347
SN500-50AA/010U-500DD	50	G 3/4	G 3/4	1745	3107549
SN600-50AA/010S-345DD	50	G 3/4	G 3/4	1750	2105042
SN360-75AA/010U-360DE	75	G 1	G 3/4	2305	3233527
SN360-75AA/010U-360DG	75	G 1 1/2	G 3/4	2305	3561595

4. ACCESSORIES

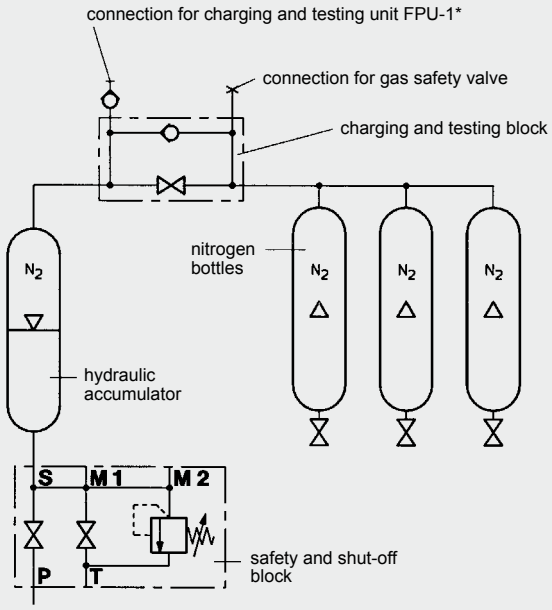
4.1. CHARGING AND TESTING BLOCK F + P

4.1.1 Description

The HYDAC charging and testing block F+P is used to charge and test back-up type hydraulic accumulators. It has connections for the charging and testing unit FPU-1 and for pressure gauges. As a safety function, a gas safety valve GSV6 (see catalogue section given below) can be fitted. In addition, it allows the back-up nitrogen bottles to be shut off from the hydraulic accumulator.

- Safety Equipment for Hydraulic Accumulators No. 3.552

4.1.2 Hydraulic circuit with charging and testing block

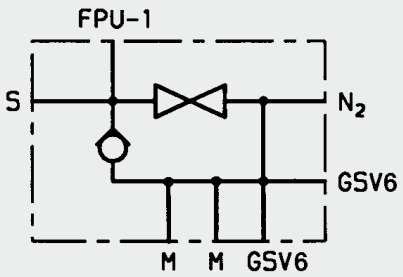


* For further information, see catalogue section: Universal charging and testing unit FPU-1 No. 3.501

4.1.3 Preferred types / Spare parts

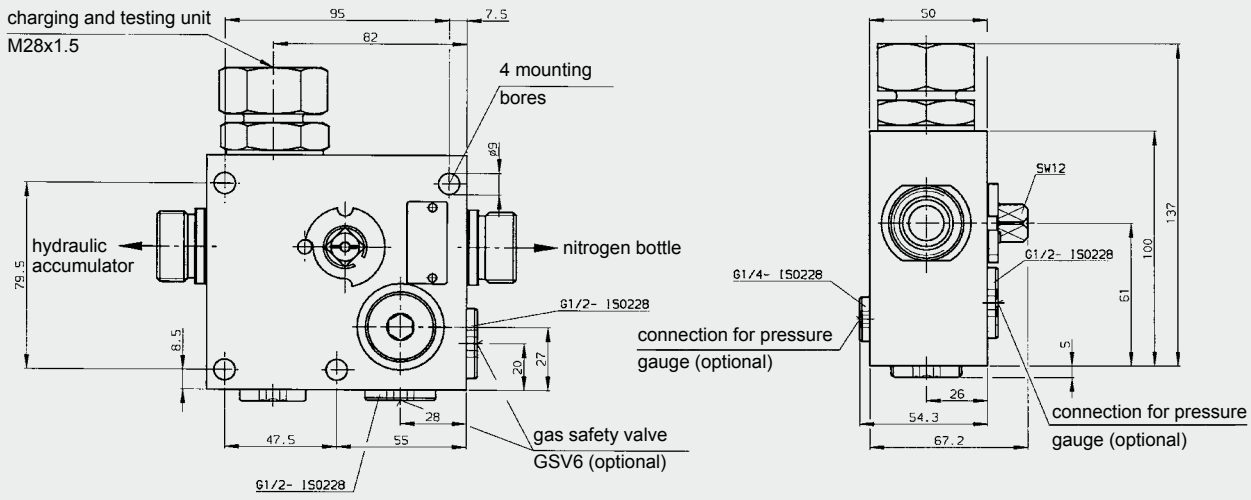
Designation	Max. operating pressure [bar]	Weight [kg]	Part no.	Seal kit [1]
F+P-16-20SR-6112-02X	400	4.3	850233	2115776
F+P-32-38SR-6112-02X	350	14	552193	2112088

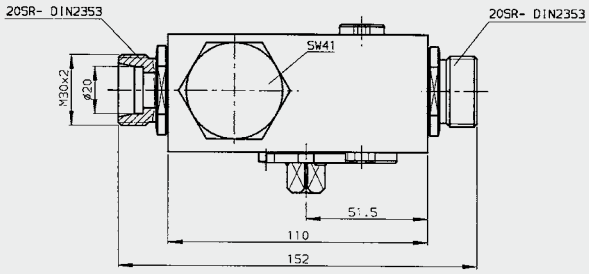
[1] recommended spare parts



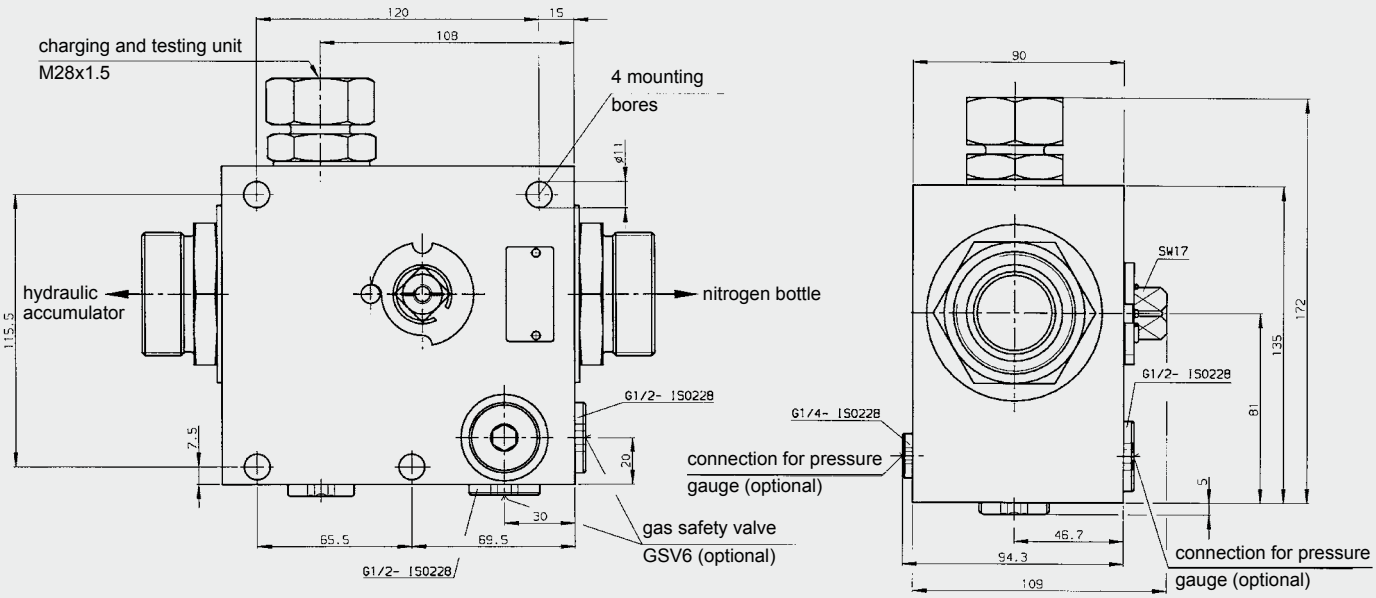
4.1.4 **Technical specifications / Dimensions**

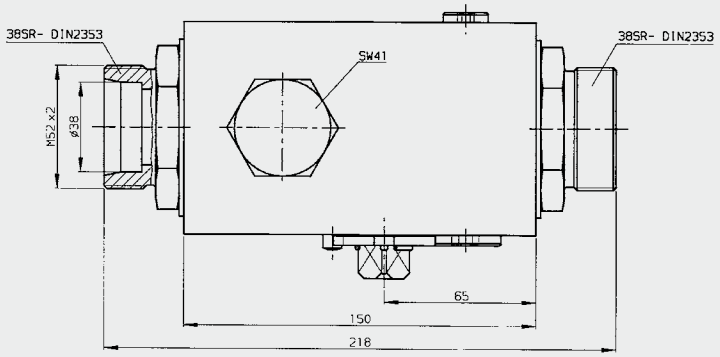
Charging and testing block DN 16





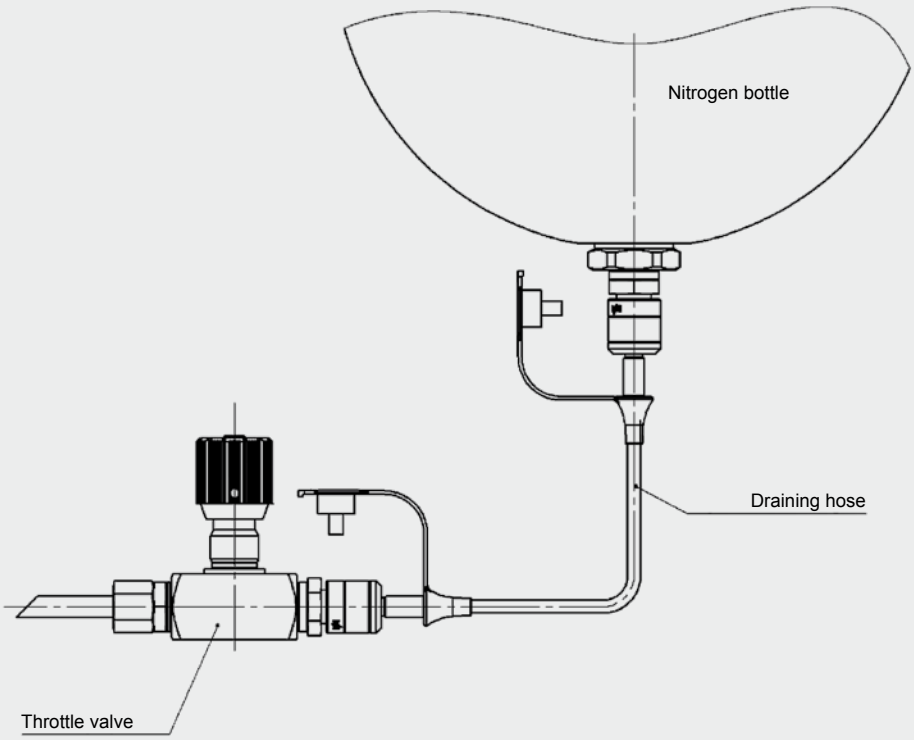
Charging and testing block DN 32





4.2. CONDENSATE DRAIN SET

The condensate drain set consists of a throttle valve and a suitable condensate draining hose.
It is used to drain any condensate from the nitrogen bottle, in a controlled way.



Description	Length [m]	Part no.
Condensate drain set	0.4	3472820
	1.0	3472823
	1.6	3472824

4.3. NITROGEN CHARGING UNIT

HYDAC nitrogen charging units facilitate fast and cost-effective charging or testing of the required pre-charge pressures in bladder, diaphragm and piston accumulators. They guarantee optimum use of standard nitrogen bottles up to a residual pressure of 20 bar and a maximum accumulator charging pressure of 350 bar. Portable, mobile and stationary types of N_2-Server are available.

For further information and technical specifications, see catalogue section:

- Nitrogen charging units N_2-Server No. 2.201

5. 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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Universal Charging and Testing Unit FPU-1

for Bladder, Piston and Diaphragm Accumulators

1. DESCRIPTION

1.1. FUNCTION

The HYDAC charging and testing unit FPU-1 is used to charge accumulators with nitrogen or to check or to change the existing pre-charge pressure in accumulators.
For this purpose the charging and testing unit is screwed onto the gas valve of the hydraulic accumulator and connected via a hose to a commercial nitrogen bottle.
If the nitrogen pressure is only to be checked or reduced, the charging hose does not need to be connected. The unit has a screw-type fitting with a built-in gauge, check valve and a spindle for opening the accumulator gas valve to control the pressure.

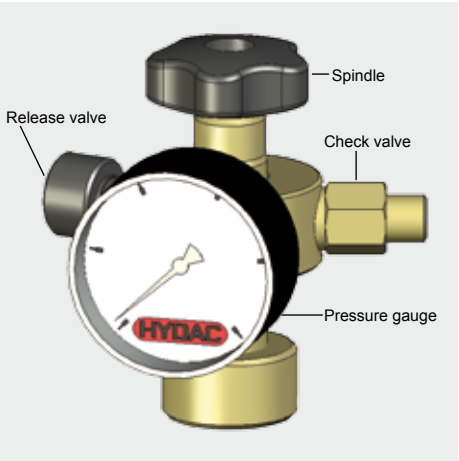
HYDAC piston and diaphragm accumulators can be charged and checked without the need for adapters. Bladder accumulators, however, require an A3 adapter.

Please read the Operating Manual! No. 3.501.CE

1.2. DESIGN

The HYDAC charging and testing unit for bladder, piston and diaphragm accumulators consists of:

- Valve body
- Spindle
- Check valve
- Release valve
- Pressure gauge
- Charging hose
- A3 adapter for bladder accumulators



1.3. SPECIAL MODELS

For higher pressures, the following special models are available:

- FPS 600
  for bladder accumulators up to 600 bar max. pre-charge pressure (see technical information 293715).
- FPK 600
  for piston, diaphragm and SB800-1.5 accumulators up to 600 bar max. pre-charge pressure (see technical information 297248).
- FPH 800
  for high pressure bladder accumulators up to 800 bar max. pre-charge pressure (see technical information 242948).

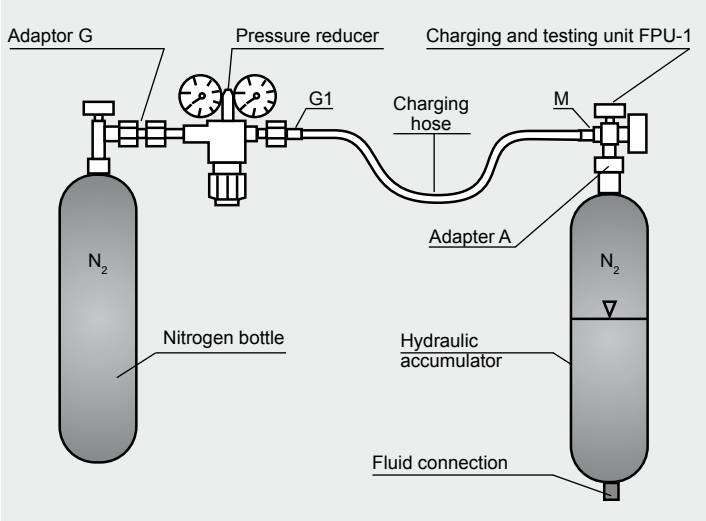
The photo top left shows a possible order option, including accessories.

1.4. TESTING INTERVALS

In general, nitrogen losses on HYDAC hydraulic accumulators are very low. However, a regular check of the gas filling pressure is recommended to prevent the piston from hitting the end cap, or the bladder or diaphragm from becoming too deformed if there is a drop in the pressure $p_{0.}$

The pre-charge pressure p_0 as shown on the label or the accumulator body, must be re-set after every new installation or repair and then checked at least once during the following week. If no nitrogen loss is detected, a further check should be made after approx. 4 months. If after this period no change in the pressure is found, a yearly check should be sufficient.

1.5. SCHEMATIC DRAWING



2. TECHNICAL SPECIFICATIONS

2.1. MODEL CODE

(also order example)

FPU-1 - 250 F 2,5 G2 A1 K

Universal charging and testing unit
p_{max} = 350 bar

Gauge indication range

0 -	10 bar	0 -	145 psi	10
0 -	25 bar	0 -	363 psi	25
0 -	100 bar	0 -	1450 psi	100
0 -	250 bar	0 -	3625 psi	250
0 -	400 bar	0 -	5800 psi	400

Charging hose
F = for 200 bar nitrogen bottle with connection W24.32x1/14 (DIN 477, Part 1)
FM = for 300 bar nitrogen bottle with connection M30x1.5 (DIN 477, Part 5 up to April 2002)
FW = for 300 bar nitrogen bottle with connection W30x2 (DIN 477, Part 5 from April 2002)

Length of charging hose
2.5 = 2.5 m
4.0 = 4 m
Special lengths on request

Adapter G for nitrogen bottles
See table, Point 3.6.

Adapter A
A1 = M16x1.5
A2 = 5/8 - 18 UNF
A3 = 7/8 - 14 UNF
A4 = 7/8 - 14 UNF
A5 = M8x1
A6 = G 3/4 A
A7 = G 1/4
A8 = G 3/4
A9 = Vg 8
A10 = 7/8 - 14 UNF
A11 = M16x2
A12 = M16x2
D4 = 5/8 - 18 UNF
(Part no. 366374)
other adapters on request

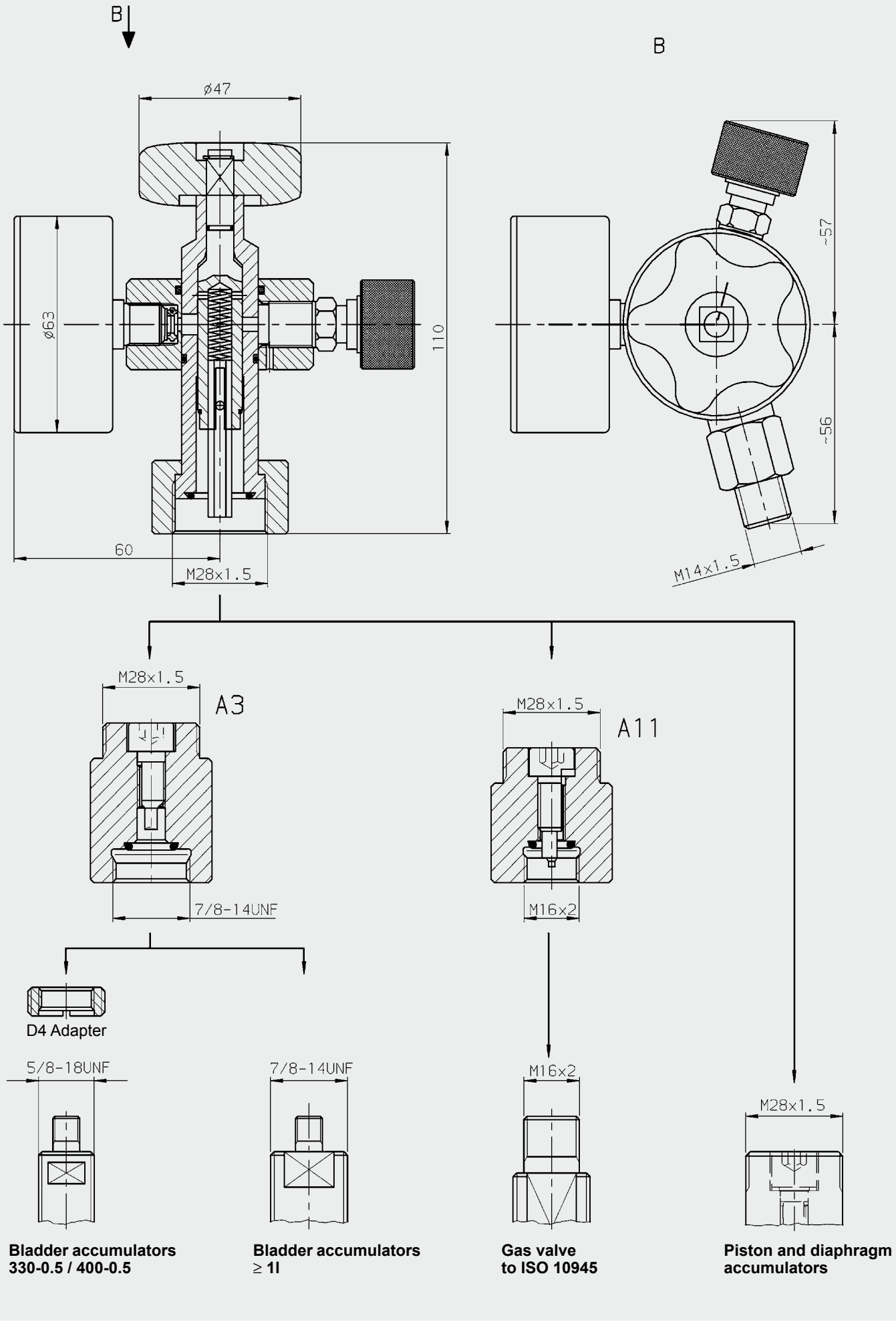
(A3 is supplied as standard)

Protective case

Accessories - please give full details when ordering (see Point 4.)

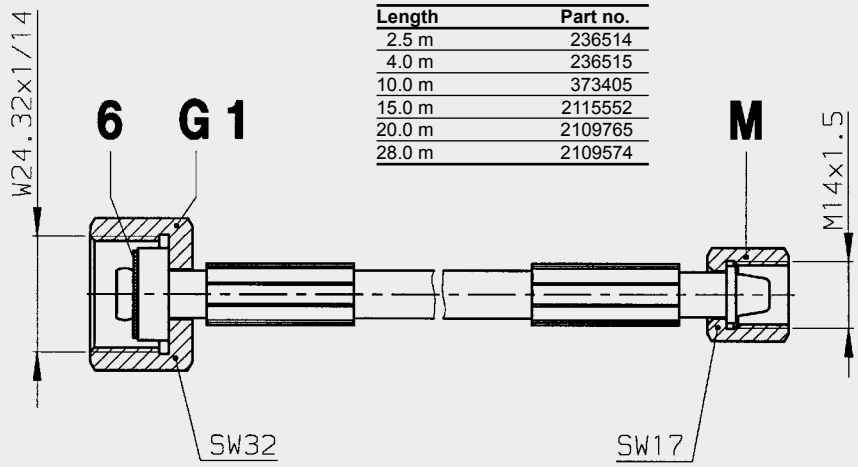
3. DIMENSIONS

3.1. CHARGING AND TESTING UNIT FPU-1 WITH ADAPTER FOR HYDAC ACCUMULATORS



3.2. CHARGING HOSE **F**

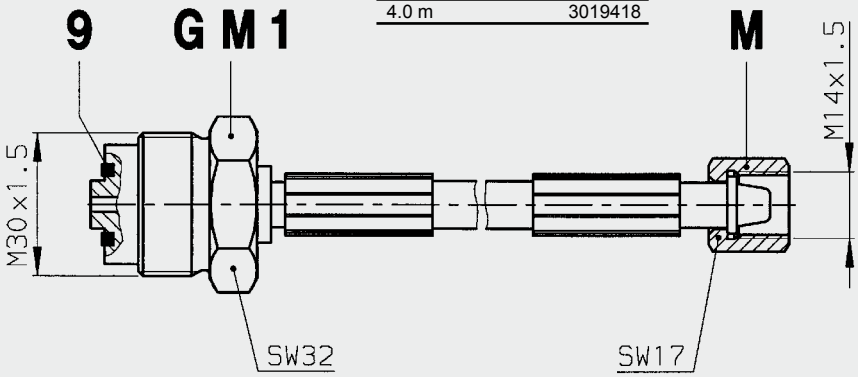
(200 bar nitrogen bottle - connection to DIN 477, Part 1)



Length	Part no.
2.5 m	236514
4.0 m	236515
10.0 m	373405
15.0 m	2115552
20.0 m	2109765
28.0 m	2109574

3.3. CHARGING HOSE **FM**

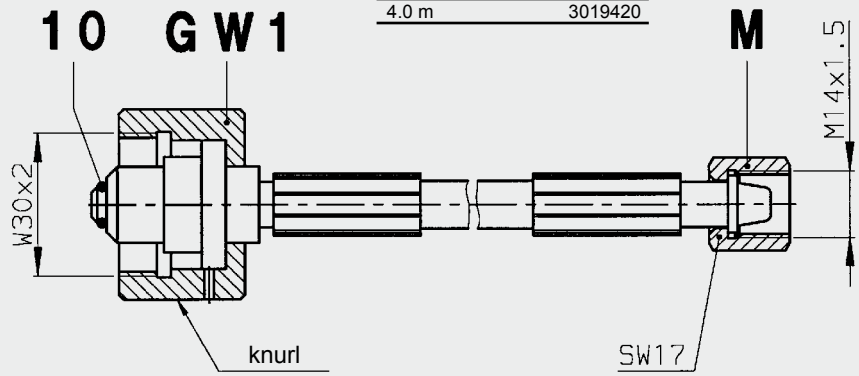
(300 bar nitrogen bottle - connection to DIN 477, Part 5 up to April 2002)



Length	Part no.
2.5 m	3019417
4.0 m	3019418

3.4. CHARGING HOSE **FW**

(300 bar nitrogen bottle - connection to DIN 477, Part 5 after April 2002)

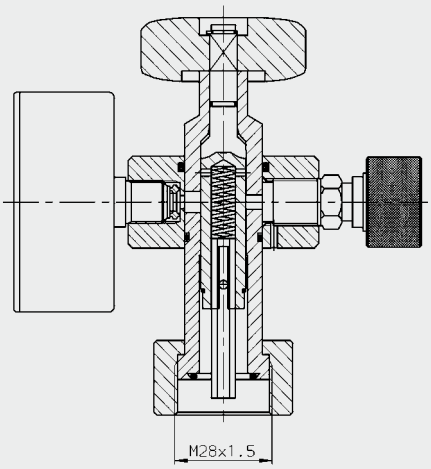


Length	Part no.
2.5 m	3019419
4.0 m	3019420

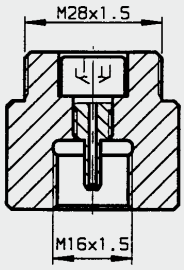
Charging hoses are suitable for the particular maximum permitted operating pressure marked on them and 10,000 charging processes.
(HYDAC charging hoses comply with the EC Machinery Directive and with DIN EN 982 and DIN EN 853 to 857)

3.3. ADAPTERS A1 TO A12

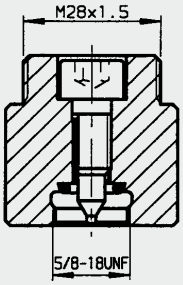
The universality of the FPU-1 is guaranteed because as well as HYDAC piston and diaphragm accumulators, bladder accumulators can also be charged and tested using the A3 adapter.
By using additional adapters other makes of accumulator can also be charged and tested.



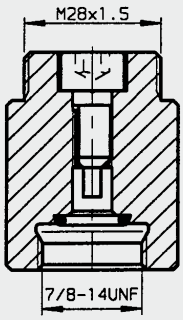
A1 (Part no. 361619)



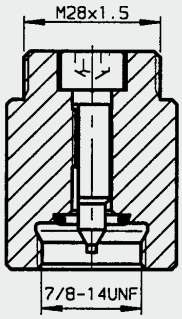
A2 (Part no. 361605)



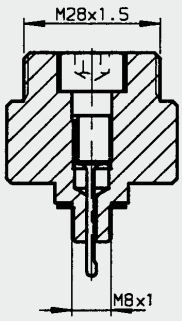
A3 (Part no. 291533)



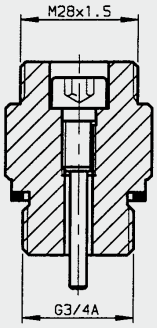
A4 (Part no. 291536)



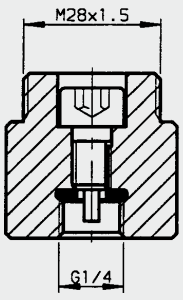
A5 (Part no. 291531)



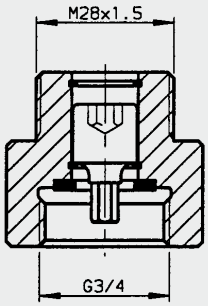
A6 (Part no. 2108819)



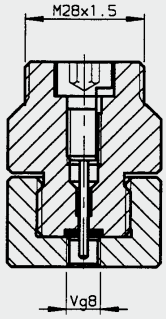
A7 (Part no. 2110629)



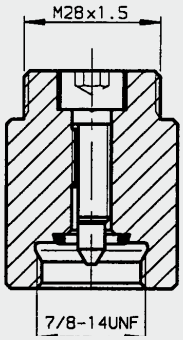
A8 (Part no. 2124524)



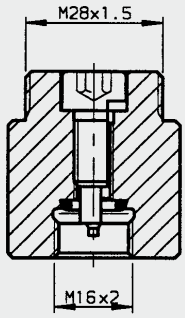
A9 (Part no. 2128638)



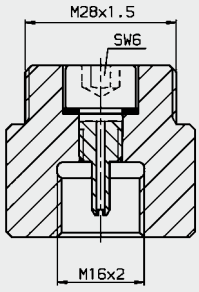
A10 (Part no. 2128849)



A11 (Part no. 3018210)

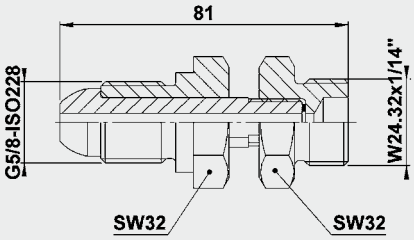


A12 (Part no. 3203185)

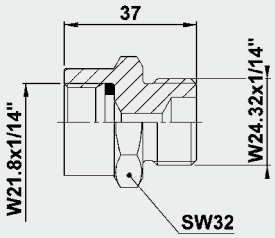


3.4. ADAPTERS G2 TO G12

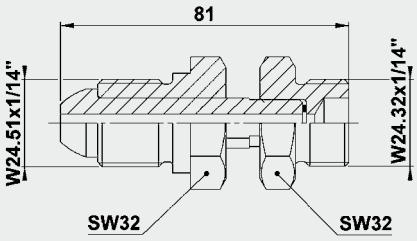
G 2 (Part no. 236376)



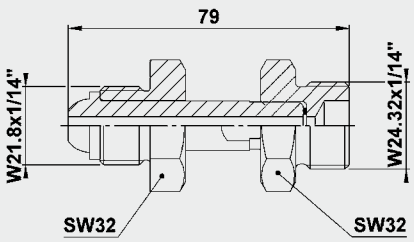
G 3 (Part no. 2103421)



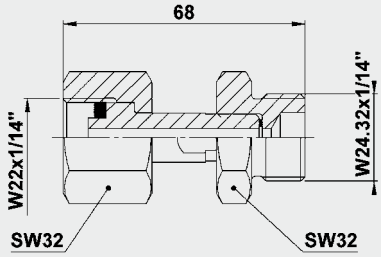
G 4 (Part no. 236374)



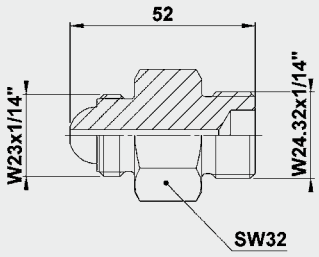
G 5 (Part no. 236373)



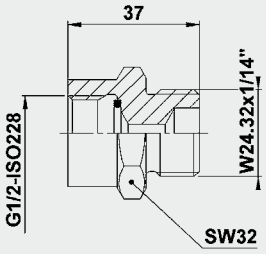
G 6 (Part no. 2103423)



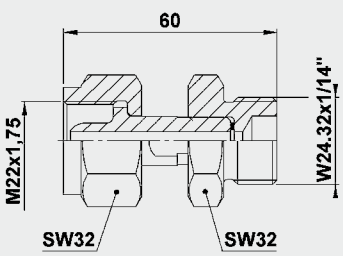
G 7 (Part no. 236377)



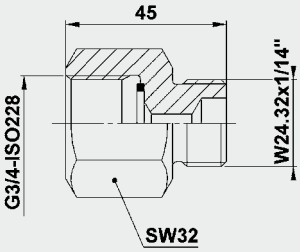
G 8 (Part no. 2103425)



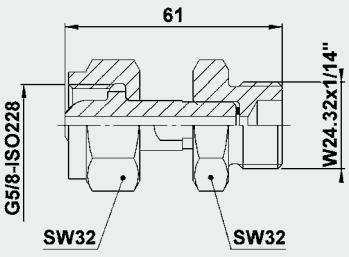
G 9 (Part no. 241168)



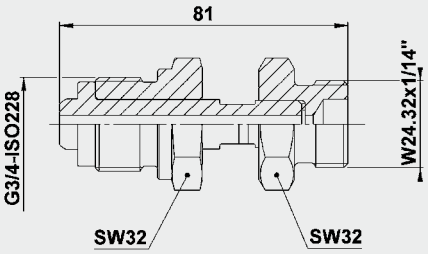
G 10 (Part no. 2103427)



G 11 (Part no. 3018678)



G 12 (Part no. 3195556)



3.4.1 **Schedule of countries**

G adapters for nitrogen bottles from different countries.

Country	Type / Part no.											
	G1 [1]	G2 236376	G3 2103421	G4 236374	G5 236373	G6 2103423	G7 236377	G8 2103425	G9 241168	G10 2103427	G11 3018678	G12 3195556
Albania										●		
Algeria			●									
Argentina		●										
Australia												●
Austria	●											
Bahamas		●										
Bahrain			●									
Bangladesh		●										
Barbados		●										
Belgium	●											
Bolivia								●				
Botswana		●										
Brazil				●								
Bulgaria			●									
Burma		●										
Canada				●								
Chile								●				
China											●	
Columbia								●				
Costa Rica		●										
Cyprus		●										
Czech Republic	●											
Denmark	●											
Djibouti			●									
Dominican Republic								●				
Ecuador								●				
Egypt			●									
Ethiopia		●										
Fiji		●										
Finland	●											
France			●									
Gabon			●									
Gambia		●										
Germany	●											
Ghana		●										
Great Britain		●										
Greece		●										
Guatemala								●				
Guinea			●									
Guyana								●				
Honduras								●				
Hong Kong		●										
Hungary			●									
India		●										
Indonesia		●										
Iran			●									
Iraq			●									
Ireland		●										
Israel			●									
Italy					●							
Ivory Coast			●									
Jamaica		●										
Japan						●						
Jordan			●									
Kenya		●										
Korea							●					
Kuwait			●									
Lebanon			●									
Libya			●									
Malawi		●										
Malaysia		●										
Malta		●										
Mauritius			●									
Mexico			●									
Morocco			●									
Mozambique			●									
Netherlands	●											
New Zealand		●										
Nigeria			●									
Norway	●											
Oman			●									
Pakistan		●										
Paraguay								●				
Peru								●				
Philippines		●										
Poland	●											
Portugal		●										
Puerto Rico				●								
Qatar			●									
Romania			●									
Russia										●		
Saudi Arabia			●									
Singapore		●										
South Africa		●										
Spain		●	●									
Sri Lanka		●										
Sudan		●										
Surinam		●										
Swaziland		●										
Sweden	●											
Switzerland	●											
Syria			●									
Taiwan									●			
Tanzania		●										
Thailand		●										
Trinidad/Tobago										●		
Tunisia			●									
Turkey		●										
United Arab Emirates			●									
Uruguay								●				
USA				●								
Venezuela										●		
Vietnam		●										
Yugoslavia [2]										●		
Zambia		●										

● = suggestion
[1] = already fitted to hose
[2] = Bosnia, Herzegovina, Croatia, Macedonia, Slovenia

4. ACCESSORIES

4.1. PROTECTIVE CASE

For storing the charging and testing unit and adapters.

Different types of case are available, depending on customer requirement.

FPU-1, standard model,
without case: approx. 1.4 kg

FPU-1, standard model,
with case: approx. 3.0 kg

4.2. GAS SAFETY VALVE

Provides protection by reducing the pressure in a controlled way if pressure exceeds the permitted level unexpectedly, see catalogue section:

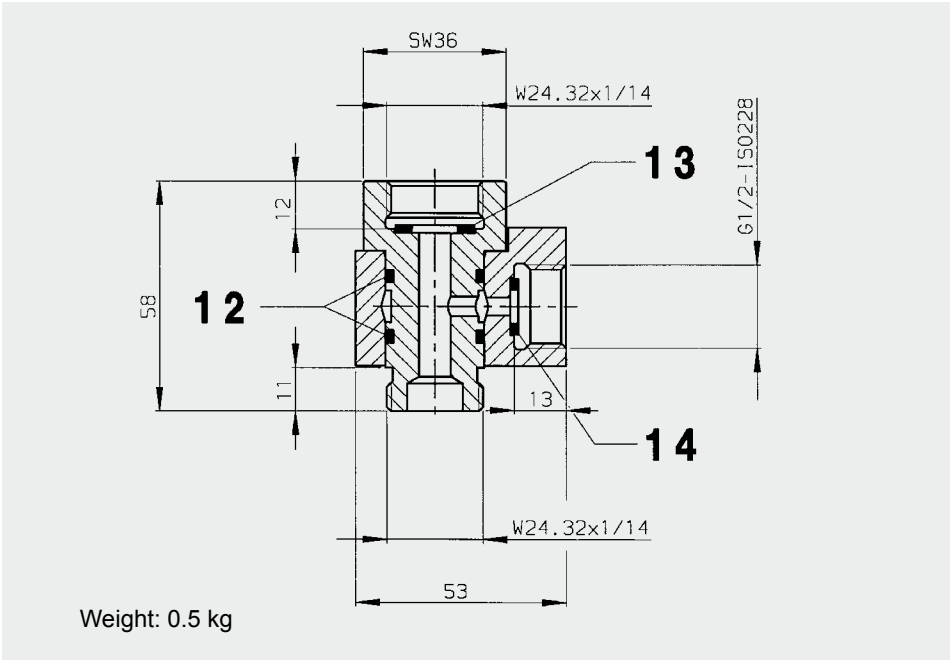
- Safety Equipment for Hydraulic Accumulators No. 3.552

4.3. ADAPTER D4

For screw connector D on bladder accumulators < 1 l (see Point 3.)

4.4. INTERMEDIATE PIECE GSV6-10-CE

Intermediate piece for installing the gas safety valve GSV6 between the 200 bar nitrogen bottle and the charging and testing unit FPU-1.



Weight: 0.5 kg

Item	Quantity	Description	Dimension	Part no.
		Intermediate piece GSV6-10-CE		242558
12	2	O-ring	20x2.5x2	601058
13	1	Seal ring	20x11.5x2	614706
14	1	Seal ring	14x8.5x2	612735
		Seal kit for intermediate piece		2117287

4.5. PRESSURE REDUCER

For adjusting the required pre-charge pressure between the nitrogen bottle and the accumulator.

4.5.1 **Pressure reducer for 200 bar nitrogen bottles**

Inlet: connection W24.32x1/12-DIN 477, Part 1

Outlet: male thread W24.32x1/14-DIN 477, Part 1

Bottle pressure [bar]	Pressure after reducer [bar]	Part no.
200	20	635409
200	100	635411
200	200	635412

4.5.2 **Pressure reducer for 300 bar nitrogen bottles**

Inlet: connection W30x2-DIN 477, Part 5

Outlet: male thread W24, 32x1/14-DIN 477, Part 5

Bottle pressure [bar]	Pressure after reducer [bar]	Part no.
300	20	6004020
300	100	6004021
300	200	6004022
300	270*	6004023

* if pressure after reducer > 200 bar, the outlet has a male thread W30x2-DIN 477, Part 5

5. SPARE PARTS, ADAPTERS AND TOOLS

5.1. SPARE PARTS

CHARGING AND TESTING UNIT FPU-1				
Item	Quantity	Description		Part no.
1	1	O-ring 6x1		601032
2	1	Seal ring		612730
3	1	Pressure gauge	0 - 10 bar 0 - 25 bar 0 - 100 bar 0 - 250 bar 0 - 400 bar	635139 635140 635141 635142 635143
5	1	O-ring 15x2		601049
6	1	Seal ring		601456
7	1	O-ring 11x2		601043
8	1	O-ring 9x2		601040
9	1	O-ring 11x2.5		603681
10	1	O-ring 5.7x1.9		6004009
		Seal kit FPU-1		2117669

5.2. ADAPTERS

Description	Part no.
Seal kit for adapters A1-12	3269153

5.3. TOOLS

Description	Part no.
Wrench 14x15	1011065
Allen key SW6	1005164
Torque wrench	3136470
Valve tool for gas valve	616886

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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Safety and Shut-off Block
SAF/DSV

1. DESCRIPTION

1.1. GENERAL

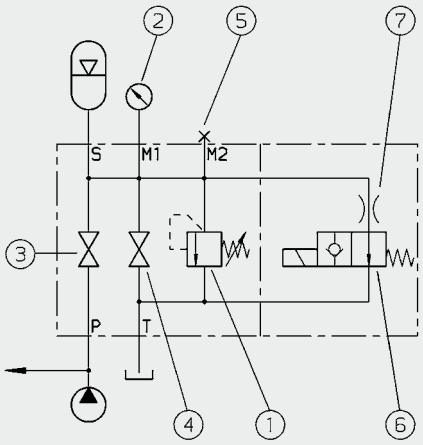
The HYDAC safety and shut-off block is used to shut off and discharge hydraulic accumulators or consumers.
It complies with the relevant safety standards in accordance with DIN EN 982 and the German industrial safety regulations BetrSichV.

The Hydac pressure relief valve DB12 is used on the SAF series. This is a direct-operated pressure relief valve in poppet valve construction with excellent opening and closing characteristics. This version of the DB12 complies with the requirements of the Pressure Equipment Directive 97/23/EC with CE marking and is supplied with a declaration of conformity and an operating manual.

Please read the Operating Manual!
No. 5.169.B

1.1.1 Key to the circuit diagram

Circuit diagram

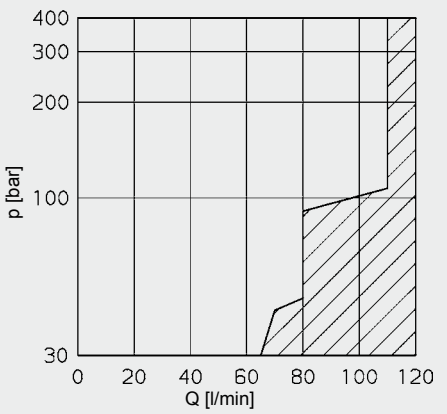


① Safety valve to prevent overpressure to PED 97/23/EC
② Pressure gauge
③ Shut-off valve
④ Pressure release valve
⑤ Connection for test gauge

These devices are combined in a compact, space-saving HYDAC safety and shut-off block. The following devices are also available:

⑥ Solenoid-operated pressure release valve
⑦ Throttle

DB12-CE p-Q graph, see ① above



This valve cannot be set to values in the shaded area

1.1.2 Product benefits

The compact combination of components considerably simplifies the connection of an accumulator or consumer to the hydraulic system and provides the following benefits:

- Minimum of space, maintenance and installation required. As all the individual units are combined in one block, considerably fewer pipe fittings are necessary for installation.
- Considerable reduction in installation time.
- All types of connections for various accumulator designs and makes are available - imperial and metric connections as well as manifold mounted and weld nipple.
- Additional valves such as pilot-operated check valves, flow control valves and combined flow control and check valves can be fitted to the system connection P.

1.2. CONSTRUCTION

The SAF safety and shut-off block consists of a valve block, an integral HYDAC pressure relief valve, a main shut-off valve and a manually operated pressure release valve, and the necessary gauge connections are provided in addition to the tank connection.
In addition, an optional solenoid-operated 2-way directional valve allows automatic discharge of the accumulator or consumer and therefore of the hydraulic system in an emergency or for shut-down.

1.3. PORTS

The safety and shut-off block has the following ports:

S – Accumulator port
P – Inline port (pump)
T – Tank port
M1 – Test gauge port
G 1/2-ISO 228
(G 1/4 at SAF 10)
M2 – Gauge connection
G 1/4-ISO 228

1.4. SPECIFICATIONS

1.4.1 **Operating fluids**
Mineral oil to DIN 51524
Part 1 and part 2
(other fluids on request)

Viscosity range:
Min. 10 mm²/s
Max. 380 mm²/s

Filtration
Max. permitted contamination level of the operating fluid to SAE AS 4059 Class 11. We therefore recommend a filter with a minimum retention rate of $ß_{20} \geq 100$. The fitting of filters and regular replacement of filter elements guarantees correct operation, reduces wear and tear and extends the service life.

1.4.2 **Permitted operating temperature**
-10 °C ... +80 °C
(ambient temperature on E version limited to -10 °C ... +60 °C)

1.4.3 **Max. operating pressure**
400 bar

1.4.4 **Model with solenoid-operated pressure relief**

Type
Solenoid-operated by means of pressure-tight, oil-immersed, single-stroke solenoids in accordance with VDE 0580. Actuating solenoid with male connector to DIN 43650, standard for general industrial applications, available for 24 V DC and 230 V AC.

Type of current
DC solenoid
When connected to AC voltage, the necessary DC voltage is produced by means of a bridge rectifier connector.

VOLTAGE TOLERANCE:
±15% of nominal voltage

Nominal current
Dependent on the nominal voltage
24 V DC 0.80 A
230 V AC 0.11 A

Power consumption:
p_{20} = 18 W

DUTY: Continuous

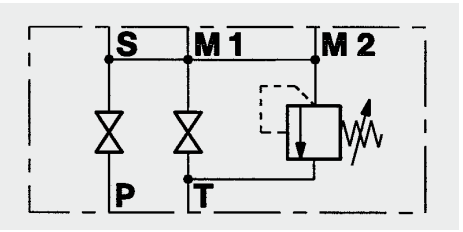
Switching time
Depending on symbol, pressure across the individual ports and flow rate:

WSM06020Y:
on: 50 ms, off: 35 ms

WSM06020Z:
on: 35 ms, off: 50 ms.

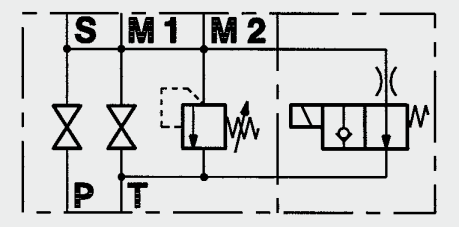
1.5. STANDARD TYPES

1.5.1 **Model with manually operated pressure release valve**
The basic model Safety and Shut-off Block has a manually operated pressure release valve, code "M", and a direct-acting pressure relief valve.



Sizes: SAF10M
SAF20M
SAF32M

1.5.2 **Model with solenoid-operated pressure relief**
The E version of the safety and shut-off block has a solenoid-operated 2-way directional valve for automatic pressure release of the accumulator and the hydraulic system in an emergency or for shut-down.



Sizes: SAF10E
SAF20E
SAF32E

1.6. Δp-Q GRAPHS FOR SAF

measured at

ν = 32 mm²/s

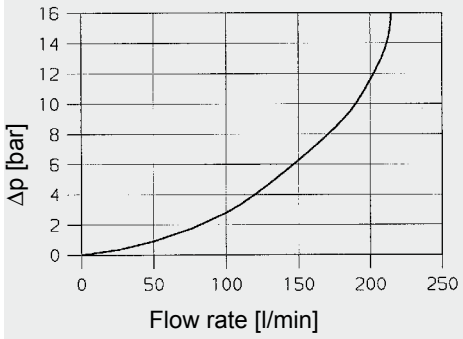
t_{oil} = 40 °C

Operating pressure = 400 bar

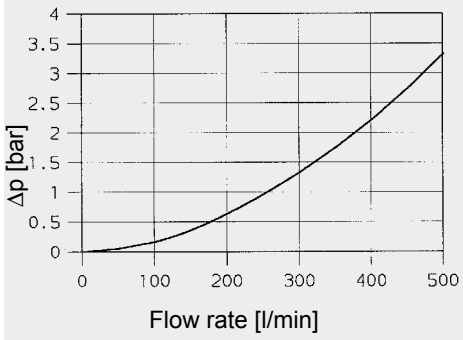
with DB12 pressure relief valve

1.6.1 Flow from the pump to the accumulator

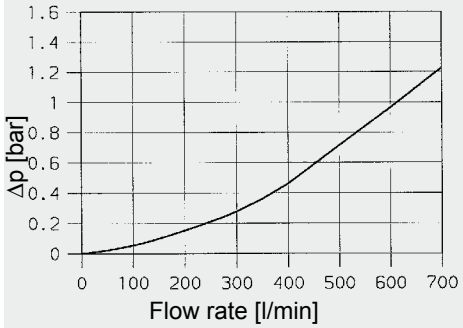
SAF10M/E



SAF20M/E

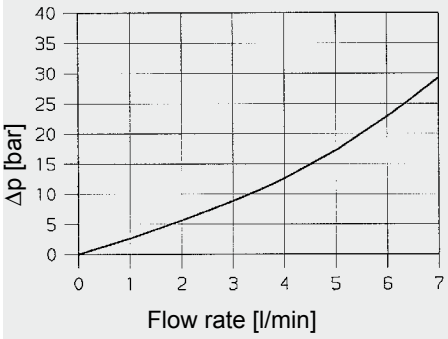


SAF32M/E

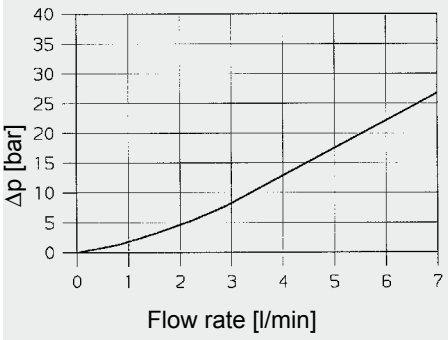


1.6.2 Flow from the accumulator via the solenoid-operated release valve to the tank

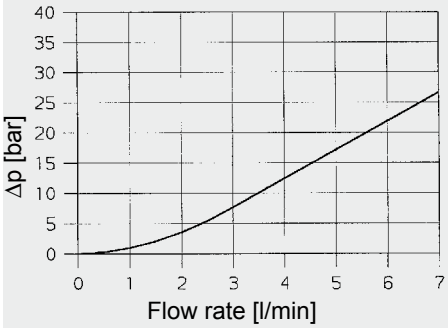
SAF10E



SAF20E

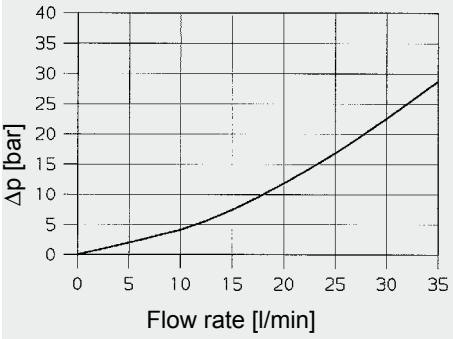


SAF32E

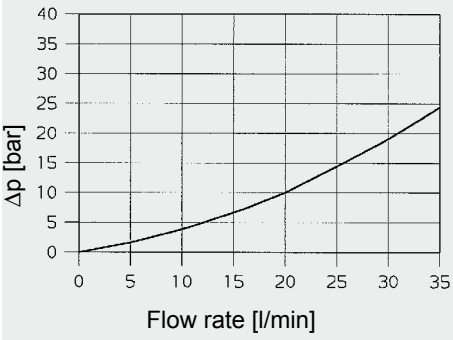


1.6.3 Flow from the accumulator via release valve to the tank

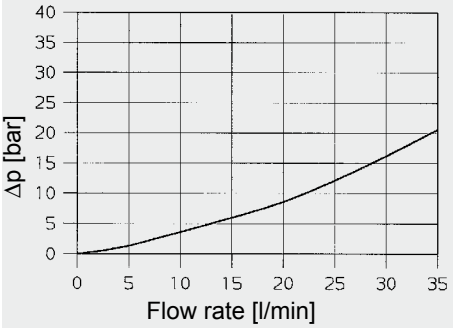
SAF10M/E



SAF20M/E



SAF32M/E



2. MODEL CODE FOR SAF

(also order example)

SAF 20 E 1 2 Y 1 T 210 A – S 13 – LPI

Safety and shut off block
Series SAF

Size of main shut-off valve
10 = DN10
20 = DN20
32 = DN32
32-3 = DN32 with 3 pressure relief valves NG12
50 = DN50

Type of discharge
M = manual discharge
E = solenoid-operated and manual discharge

Block material
1 = carbon steel
other materials [1)]

Material of seals (elastomer)
2 = NBR (Perbunan)
5 = EPDM
6 = FKM (Viton®)
7 = others

Type of directional poppet valve
Y = open when de-energised (2/2 directional valve WSM06020Y)
Z = closed when de-energised (2/2 directional valve WSM06020Z, only up to 350 bar)

Type of voltage - directional poppet valve
1 = 24 V DC
2 = 115 V AC
3 = 230 V AC
6 = 120 V AC
7 = others

Pressure relief valve
T... = pressure-set and lead-sealed by TÜV
N... = pressure-set without TÜV [1)]

Pressure setting
e.g. 210 bar

Threaded connection to
A = ISO 228 (BSP)
B = DIN 13, to ISO 965/1 (metric) [1)]
C = ANSI B1.1 (UNF, O-ring seal to SAE) [1)]

Adapter
to accumulator (see Point 7.)
e.g. S13 = ISO 228 - G 2A

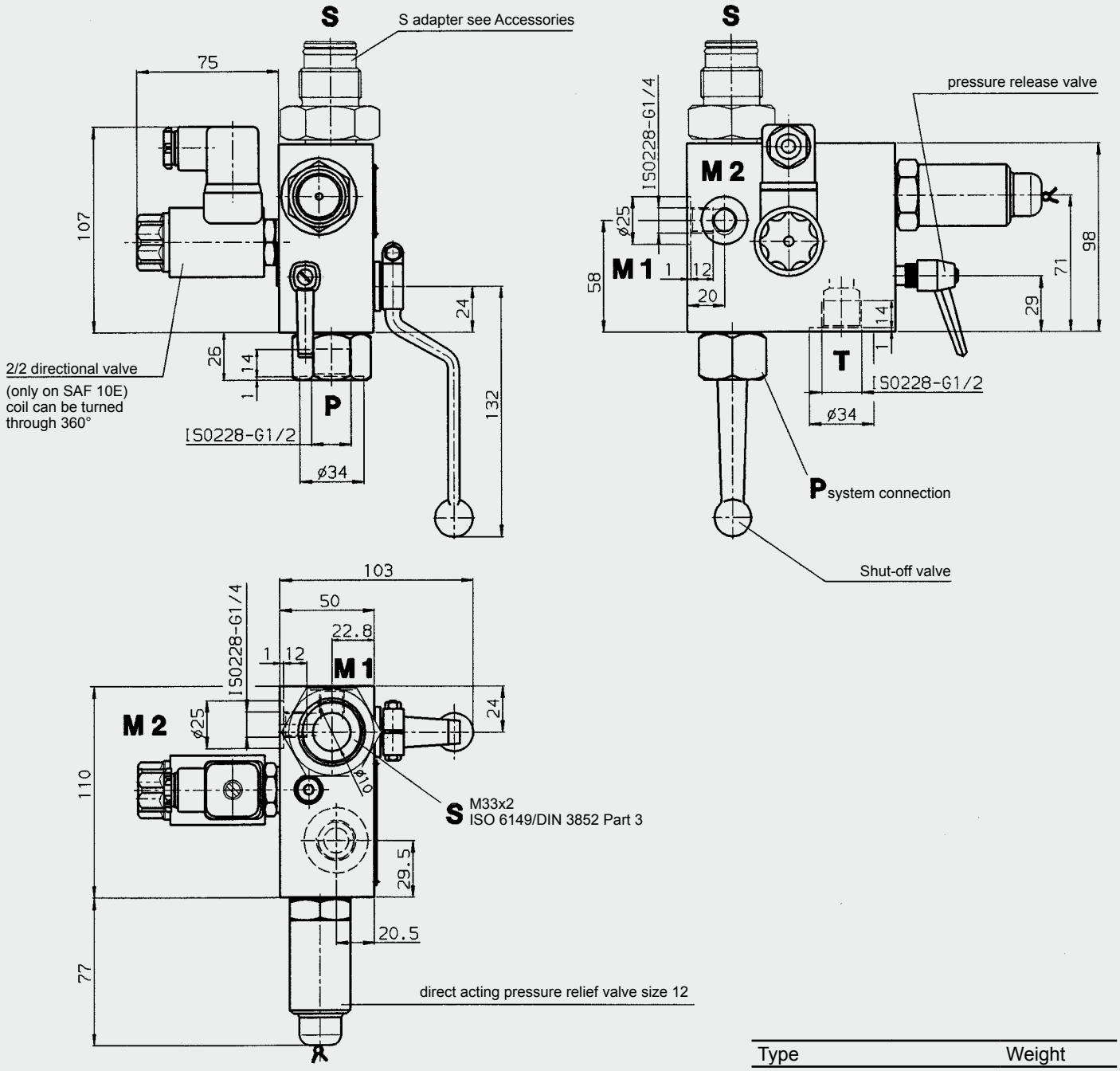
Additional equipment (see Point 5.4)
L = lockable main shut-off valve (for use with padlock)
LPI = model L with additional position monitoring (inductive proximity switch)
LPM = model L with additional position monitoring (mechanical limit switch with roller lever)
LS = lockable release valve

Accessories
(Please give full details when ordering: see Point 7. Accessories)

[1)] On request

3. DIMENSIONS

3.1. SAF10 SAFETY AND SHUT-OFF BLOCK SIZE 10

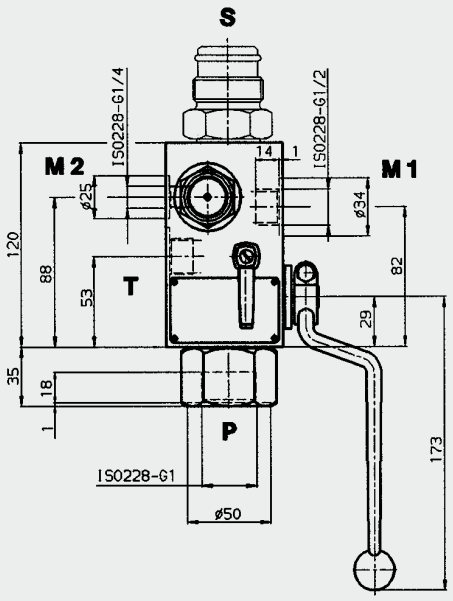


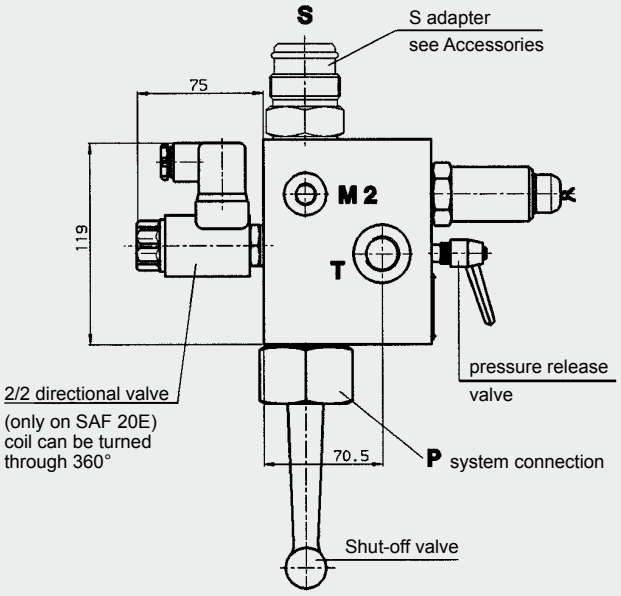
Type	Weight
SAF10M...	4.2 kg
SAF10E...	4.6 kg

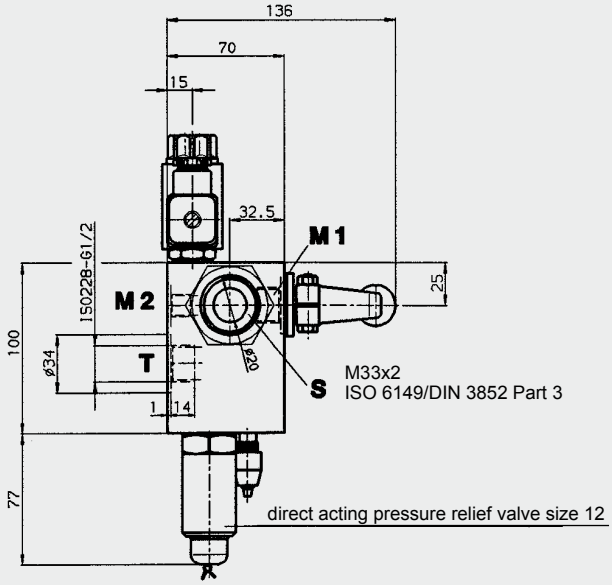
SAF10 Preferred models

Type	Part no.	Type	Part no.
SAF10M12T400A	2121582	SAF10E12Y1T400A	2125858
SAF10M12T350A	2122208	SAF10E12Y1T350A	2122210
SAF10M12T330A	2121236	SAF10E12Y1T330A	2122211
SAF10M12T315A	2121121	SAF10E12Y1T315A	2122212
SAF10M12T300A	2121354	SAF10E12Y1T300A	2122213
SAF10M12T250A	2121353	SAF10E12Y1T250A	2122214
SAF10M12T210A	2121346	SAF10E12Y1T210A	2121662
SAF10M12T200A	2121351	SAF10E12Y1T200A	2122215
SAF10M12T150A	2121345	SAF10E12Y1T150A	2122216
SAF10M12T100A	2121344	SAF10E12Y1T100A	2122041
SAF10M12T070A	2121350	SAF10E12Y1T070A	2122217
SAF10M12T050A	2122207	SAF10E12Y1T050A	2122218
SAF10M12T035A	2121349	SAF10E12Y1T035A	2122219

3.2. SAF20 SAFETY AND SHUT-OFF BLOCK SIZE 20





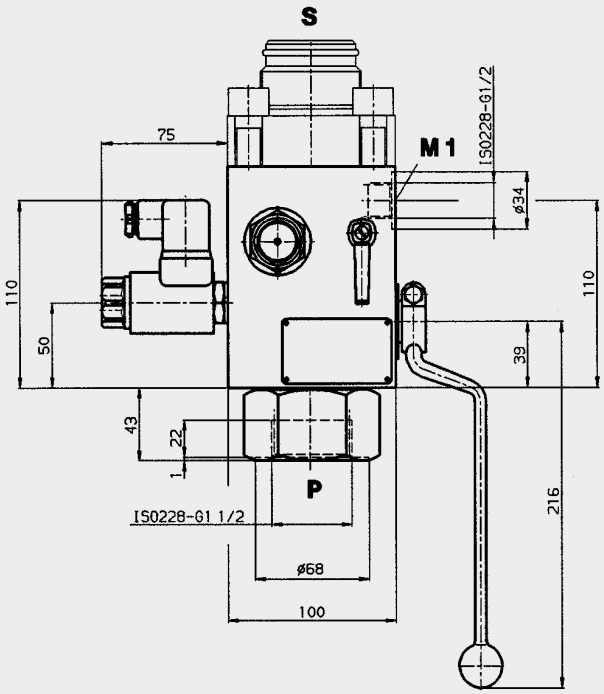


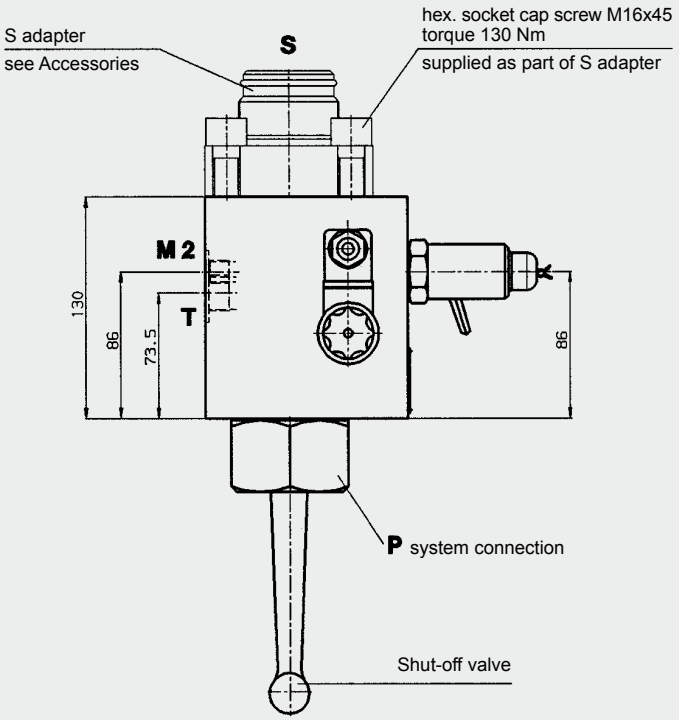
Type	Weight
SAF20M...	6.8 kg
SAF20E...	7.2 kg

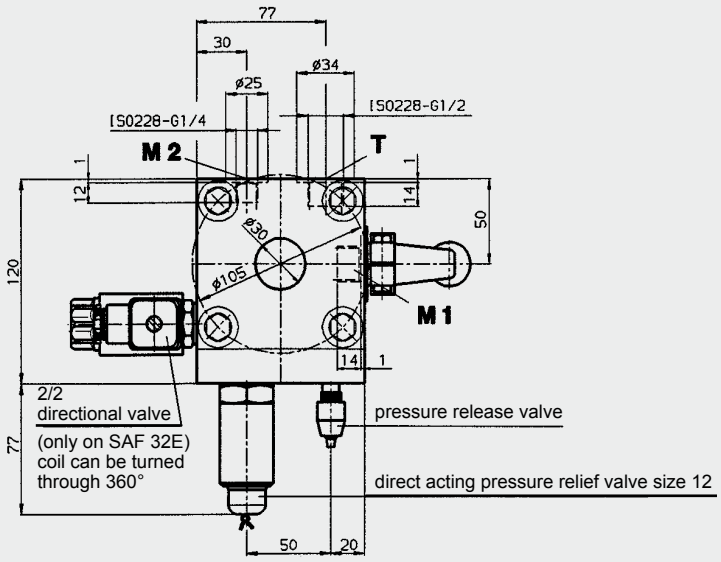
SAF20 Preferred models

Type	Part no.	Type	Part no.
SAF20M12T400A	2120317	SAF20E12Y1T400A	2121022
SAF20M12T350A	2120434	SAF20E12Y1T350A	2121979
SAF20M12T330A	2120323	SAF20E12Y1T330A	2120394
SAF20M12T315A	2120324	SAF20E12Y1T315A	2120833
SAF20M12T300A	2120332	SAF20E12Y1T300A	2120836
SAF20M12T250A	2120432	SAF20E12Y1T250A	2120851
SAF20M12T210A	2120319	SAF20E12Y1T210A	2120320
SAF20M12T200A	2120325	SAF20E12Y1T200A	2120835
SAF20M12T150A	2120330	SAF20E12Y1T150A	2120832
SAF20M12T100A	2120401	SAF20E12Y1T100A	2120369
SAF20M12T070A	2120326	SAF20E12Y1T070A	2120849
SAF20M12T050A	2122172	SAF20E12Y1T050A	2121000
SAF20M12T035A	2120281	SAF20E12Y1T035A	2122220

3.3. SAF32 SAFETY AND SHUT-OFF BLOCK SIZE 32





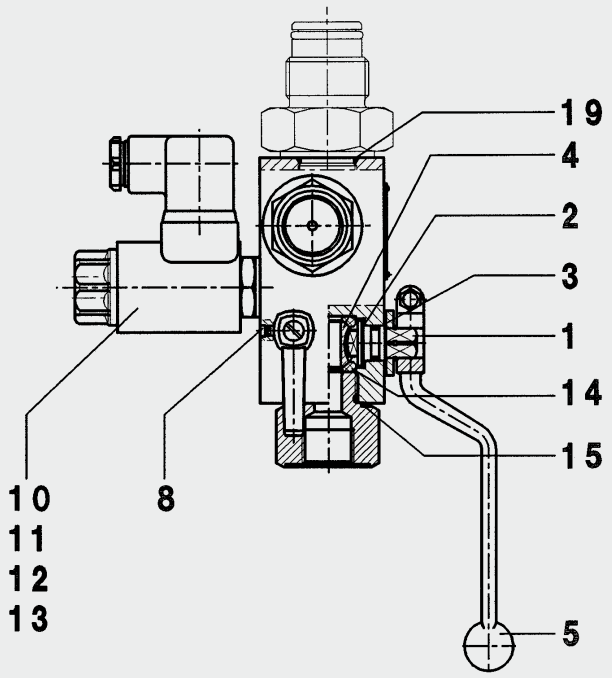


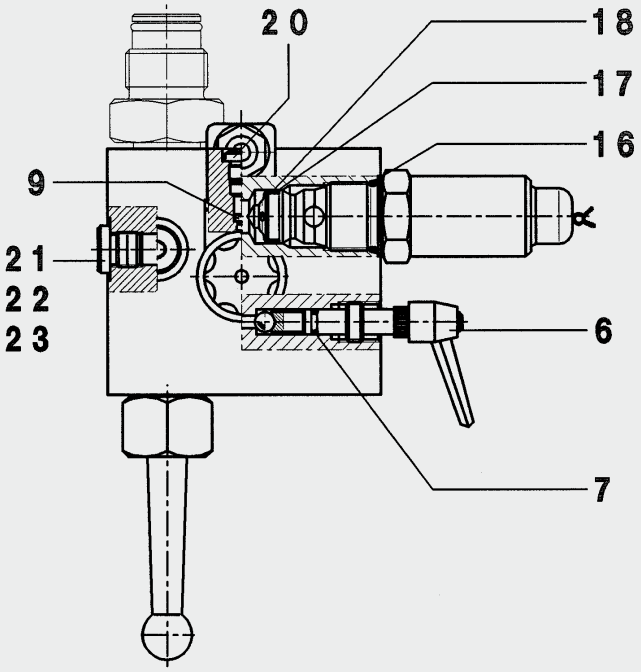
Type	Weight
SAF32M...	12.0 kg
SAF32E...	12.4 kg

SAF32 Preferred models

Type	Part no.	Type	Part no.
SAF32M12T400A	2125856	SAF32E12Y1T400A	2123123
SAF32M12T350A	2122230	SAF32E12Y1T350A	2122221
SAF32M12T330A	2122231	SAF32E12Y1T330A	2120371
SAF32M12T315A	2121136	SAF32E12Y1T315A	2122222
SAF32M12T300A	2120837	SAF32E12Y1T300A	2120834
SAF32M12T250A	2122233	SAF32E12Y1T250A	2122223
SAF32M12T210A	2120321	SAF32E12Y1T210A	2120318
SAF32M12T200A	2121135	SAF32E12Y1T200A	2122224
SAF32M12T150A	2121134	SAF32E12Y1T150A	2122225
SAF32M12T100A	2121129	SAF32E12Y1T100A	2122226
SAF32M12T070A	2122234	SAF32E12Y1T070A	2122227
SAF32M12T050A	2121137	SAF32E12Y1T050A	2122228
SAF32M12T035A	2121125	SAF32E12Y1T035A	2122229

4. SPARE PARTS



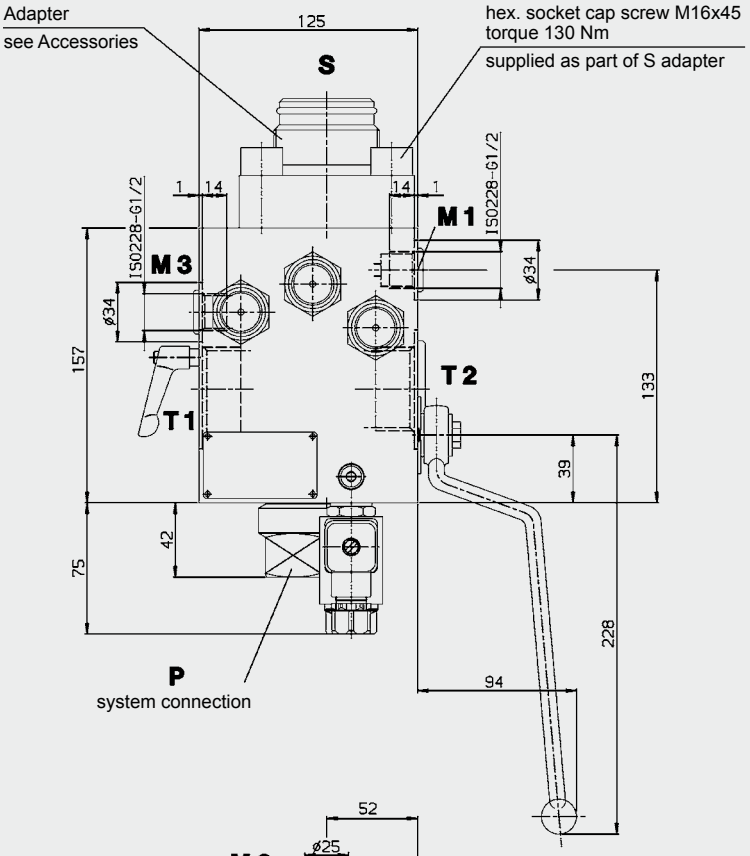


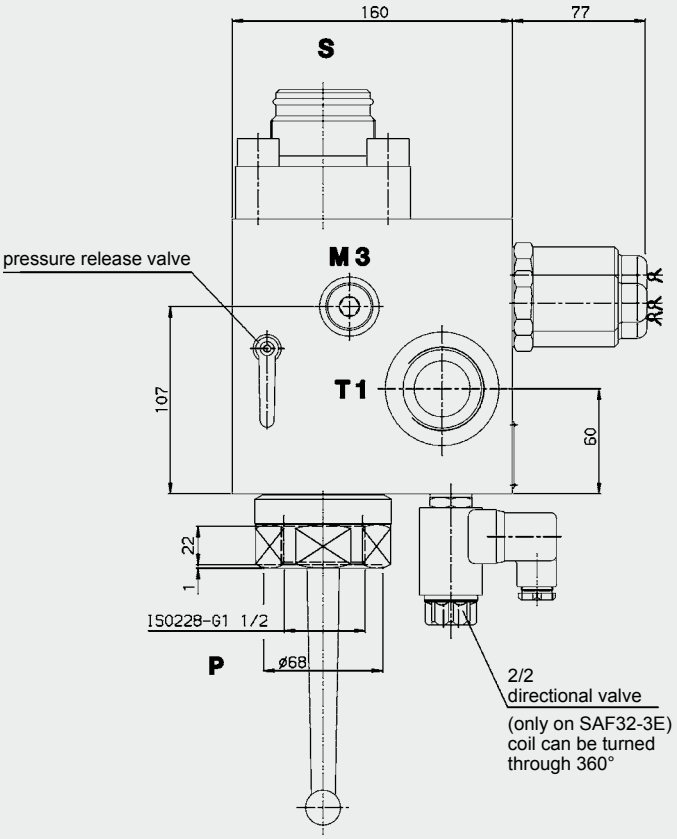
SAF Block		SAF10M SAF10E	SAF20M SAF20E	SAF32M SAF32E
Description	Item	Dimensions		
Repair kit consisting of:		Part no. 2122238 (NBR) 2122240 (FPM)	Part no. 2122242 (NBR) 2122244 (FPM)	Part no. 2122246 (NBR) 2122248 (FPM)
Spindle	1			
Disc	2			
O-ring	3	10x2	15x2.5	20x3
Ball	4			
Switching handle	5			
Spindle	6			
O-ring	7	6x2		
Set screw	8	M4x6	M4x10	
Slip-in orifice	9	Ø1.5 mm (Q_{max} - 25.5 l/min)		
O-ring	11	17x2		
Back-up ring	12	11.7x15x1		
O-ring	13	11x2		
Sealing cup	14			
O-ring	15	21x2	34x2.5	56.7x2.8
O-ring	16	23.47x2.62		
Back-up ring	17	18.3x21.5x1		
O-ring	18	18x2		
O-ring	19	29.7x2.8	29.7x2.8	37.2x3
Blanking plug	20 21 22 23	G 1/8 G 1/4 – –	G 1/8 G 1/4 G 3/8 G 1/2	G 1/8 G 1/4 G 3/8 G 1/2
2/2 directional valve assembly (only for E-version) **Blanking plug assembly** (converts "E" version to "M" version)	10	Part no. 3156869 (WSM 06020Y - open when de-energised) 3156873 (WSM 06020Z - closed when de-energised) 277645		
Seal kit consists of: Items 3, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23		Part no. 2121699 (NBR) 2121701 (FPM)	Part no. 2121703 (NBR) 2121705 (FPM)	Part no. 2121707 (NBR) 2121709 (FPM)
Spindle repair kit consists of: Items 6, 7, 8		Part no. 2115648 (NBR) 2115649 (FPM)		

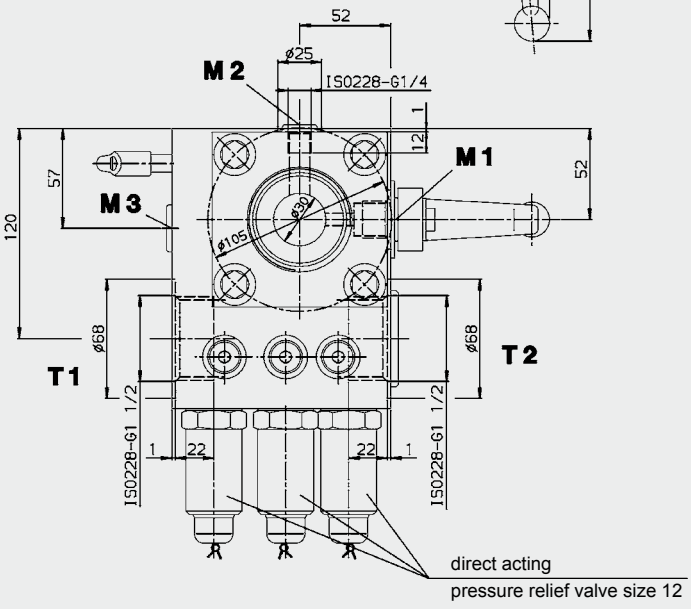
5. SPECIAL MODELS

5.1. TYPE SAF32-3M(E)

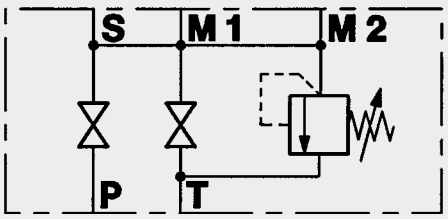
With 3 direct acting pressure relief valves size 12
(max. operating pressure 400 bar)



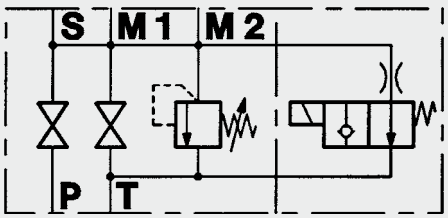




SAF32-3M



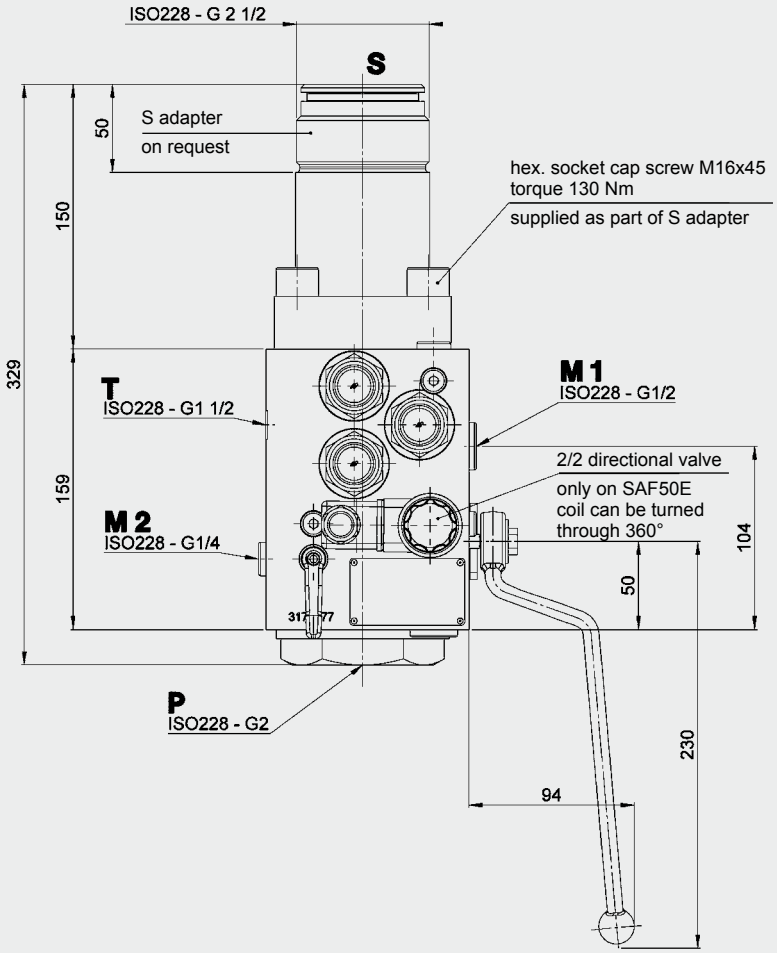
SAF32-3E

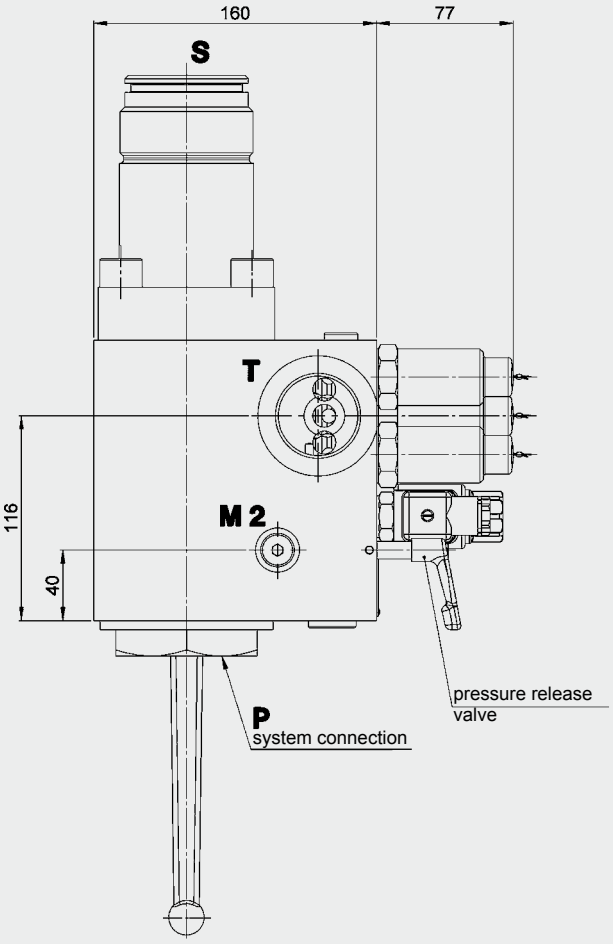


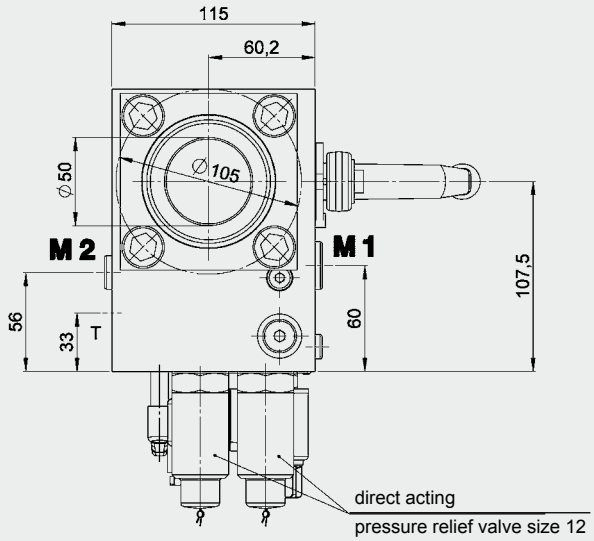
Type	Weight
SAF32-3M...	24 kg
SAF32-3E...	25 kg

5.2. TYPE SAF50M(E)

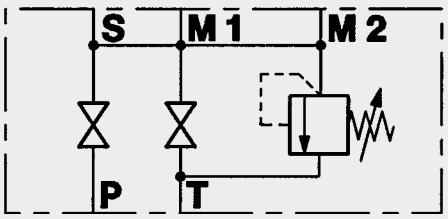
for large flows
with 3 direct acting pressure relief valves size 12
(max. operating pressure 400 bar)



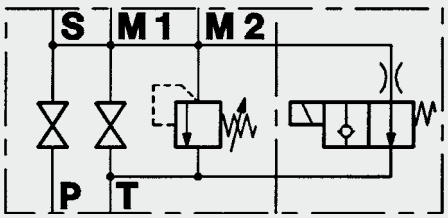




SAF50M



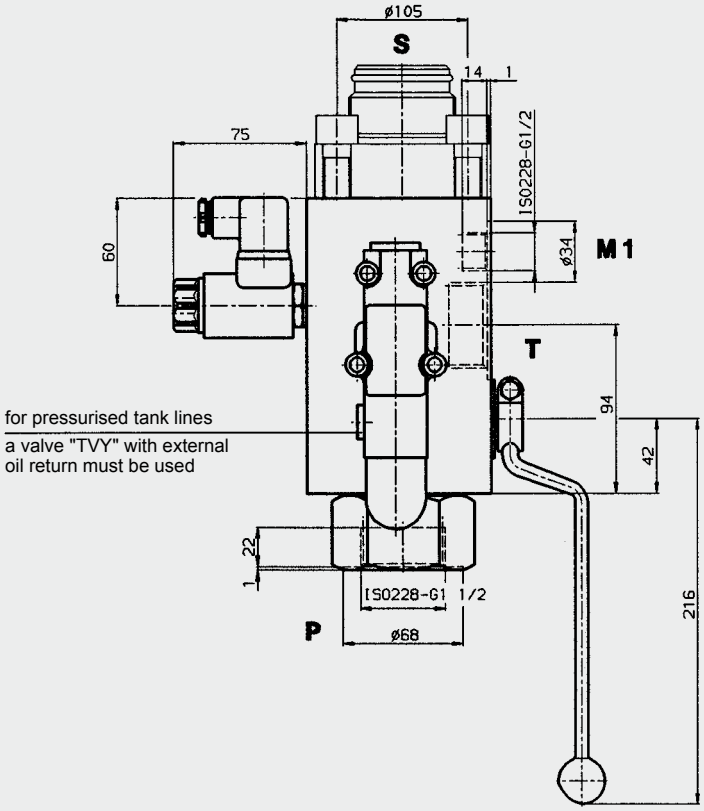
SAF50E

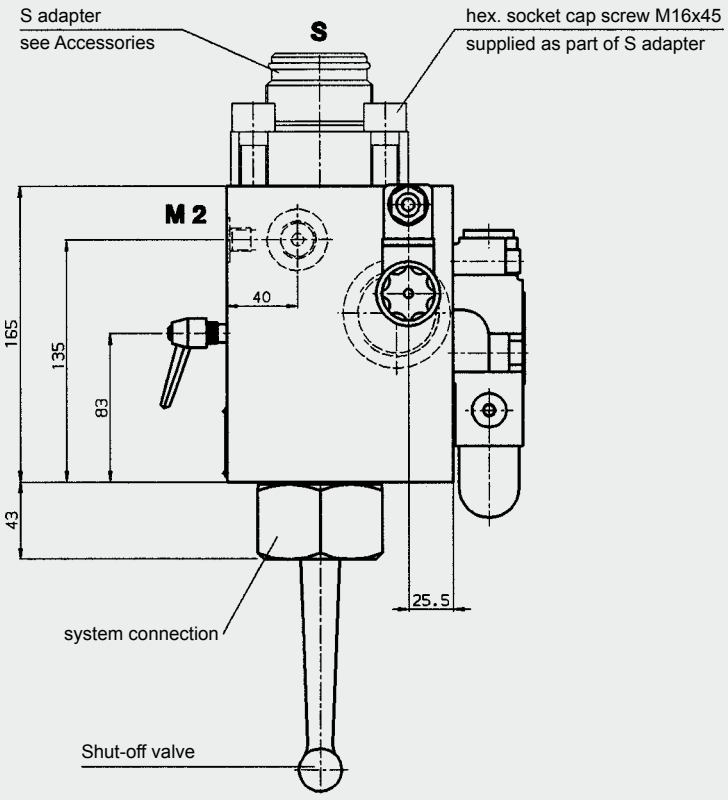


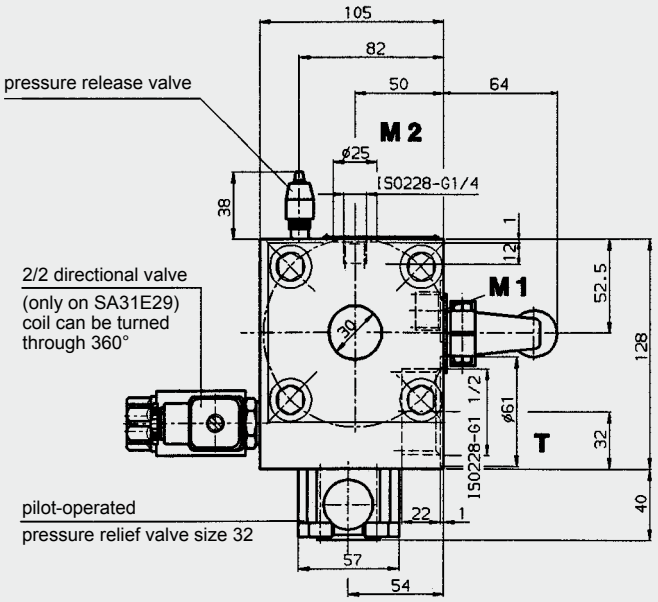
Type	Weight
SAF50M...	25 kg
SAF50E...	26 kg

5.3. TYPE SA32M(E)29

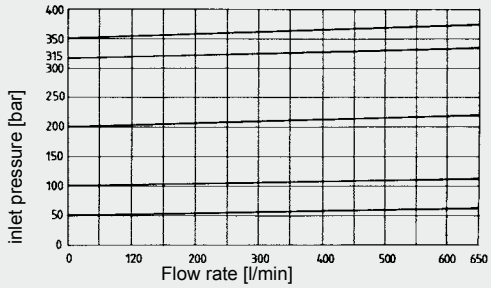
with pilot-operated pressure relief valve (Q_{max} = 600 l/min)
(max. operating pressure 330 bar)



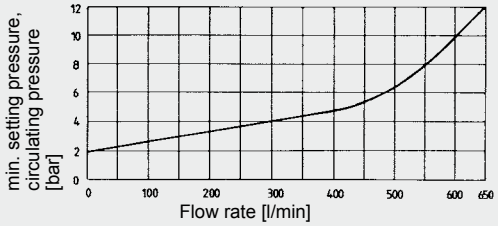




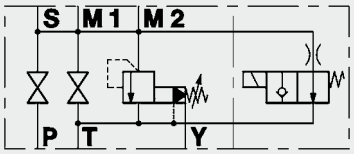
Pilot-operated pressure relief valve seize 32



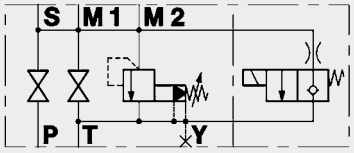
Lowest setting pressure [bar]



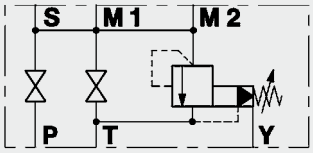
SA32E29TVY



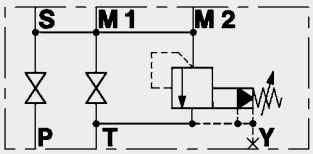
SA32E29TV



SA32M29TVY



SA32M29TV



The safety and shut-off block SA32M(E)29 is equipped with a pilot-operated pressure relief valve size 32 for high flow rates up to 600 l/min.

The E version of the safety and shut-off block has a solenoid-operated 2-way directional valve for automatic pressure release of the accumulator and the hydraulic system in an emergency or for shut-down.

For unpressurized tank lines, valve type "TV" must be used (with internal oil return to tank).

For pressurised tank lines, valve type "TVY" is recommended (with external oil return to tank).

Two different models of the 2-way directional valve are available:

– WSM06020Y (open when de-energised)

– WSM06020Z (closed when de-energised)

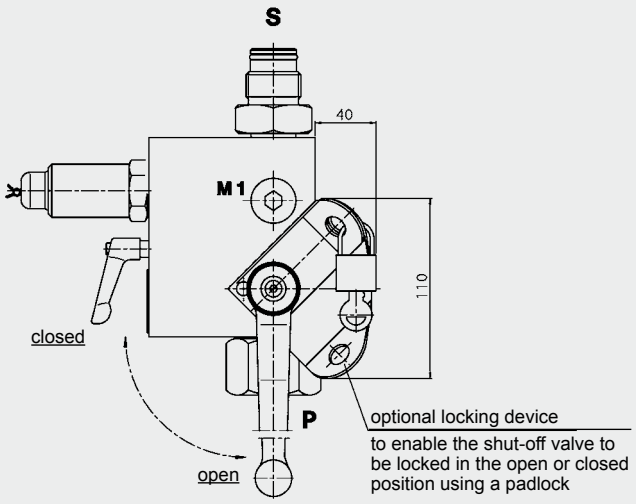
Type	Weight
SA32M29...	22.5 kg
SA32E29...	23.5 kg

5.4. SAFETY AND SHUT-OFF BLOCK WITH ADDITIONAL EQUIPMENT

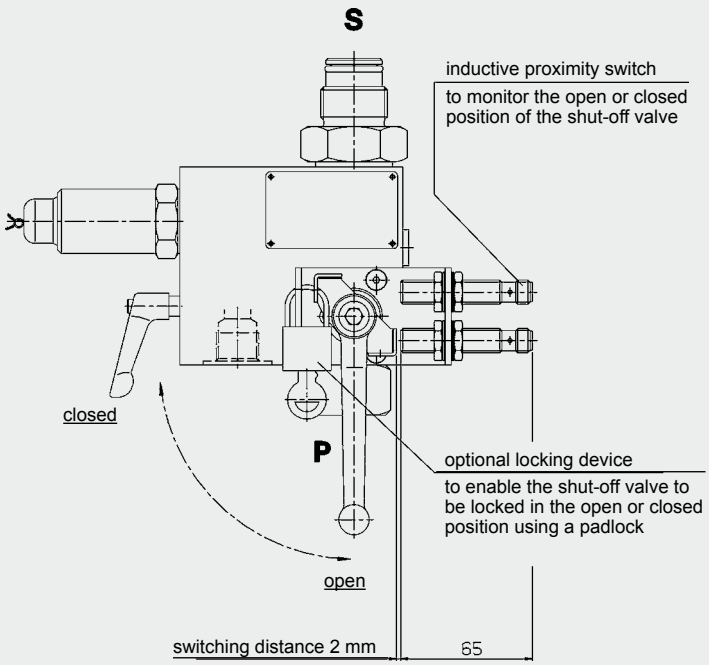
Safety and shut-off blocks are available with a device to enable the shut-off valve to be locked in the open or closed position using a padlock.

It is also possible to fit inductive proximity switches or roller-actuated limit switches to control the open and closed position of the shut-off valve.

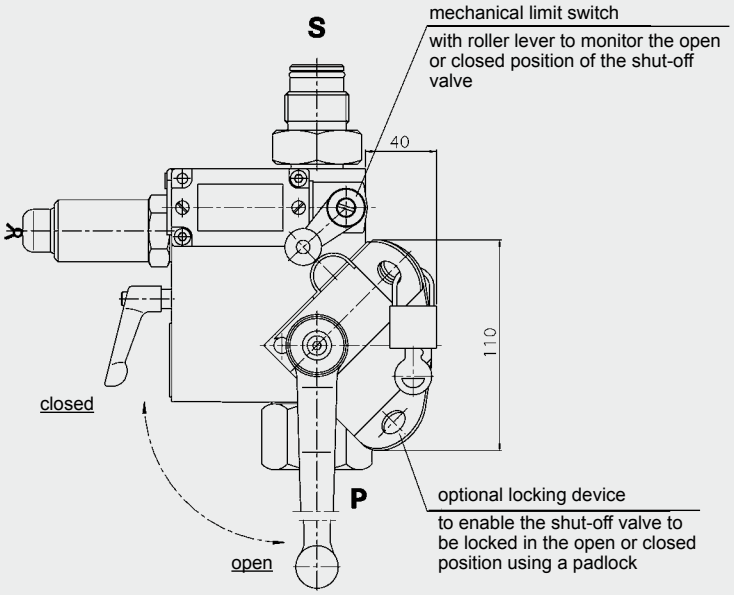
Supplementary equipment L



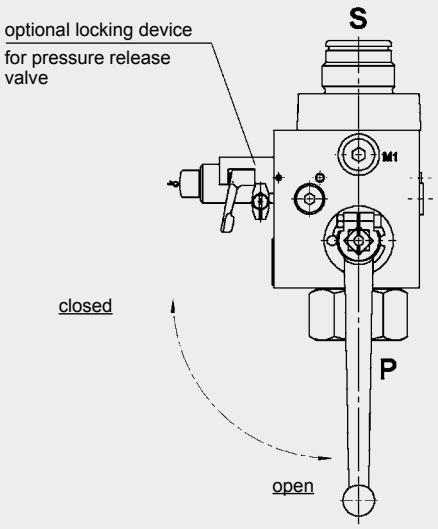
Supplementary equipment LPI



Supplementary equipment LPM



Supplementary equipment LS



5.5. SAFETY AND SHUT-OFF BLOCK FOR FRONT PANEL MOUNTING

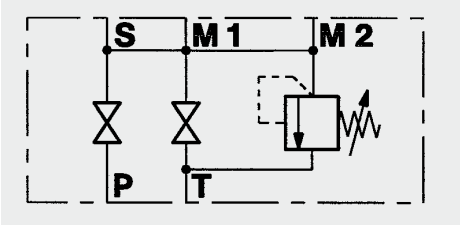
The safety and shut-off block consists of a valve block, a built-in pressure relief valve, a main shut-off valve and a manually operated pressure release valve.

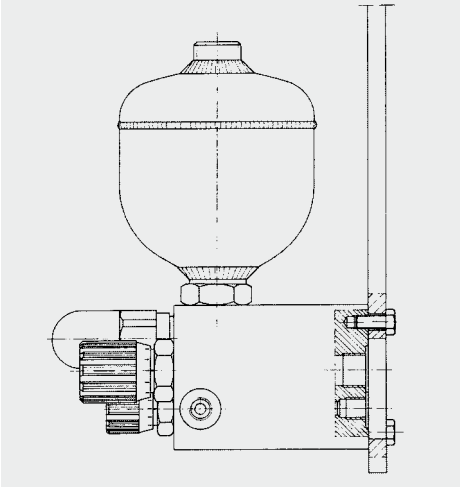
This block is mounted on a front panel with 3 M8 screws. Ports "P" and "T" are located on the mounting side.

Advantages:
The compact design means that the block occupies a minimum of space and ensures minimum maintenance.

Specifications:

Type:	SA6M10T...
Size:	DN10
Max. operating pressure:	350 bar
Direct acting pressure relief valve:	NG6





5.6. SAFETY AND SHUT-OFF BLOCK WITH 2-WAY CARTRIDGE VALVE (LOGIC ELEMENT)

This safety and shut-off block consists of a valve block, an integral pressure relief valve and a solenoid-operated 2-way cartridge valve which replaces the main shut-off valve.

Advantages:
In addition to its compact construction, this model is capable of rapid switching to control the oil flow.

5.6.1 Function when using 4/2 directional valve

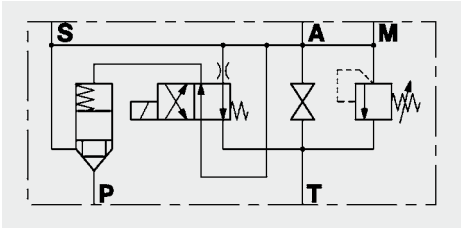
When the 4/2 directional valve is in the switching position shown (open when de-energised), the spring chamber of the logic element is pressurised via the accumulator pressure; the path from P to S is blocked and the hydraulic accumulator is automatically shut off from the system. By connecting the accumulator via the slip-in orifice in the pilot valve to the tank, it will slowly discharge.

When the 4/2 directional poppet valve is in the discharge position (energised) the spring chamber of the logic element is discharged, the path from P to S is open and the accumulator is charged.

Technical specifications:

Type	Size	Max. operating pressure	Pressure relief valve [1]
SA20A50T...	DN20	400 bar	NG12 (2)
SA32A50T...	DN30	400 bar	NG12 (3)
SA40A50T...	DN40	400 bar	NG12 (3)

[1] number of pressure relief valves



5.6.2 Function when using 3/2 directional poppet valve

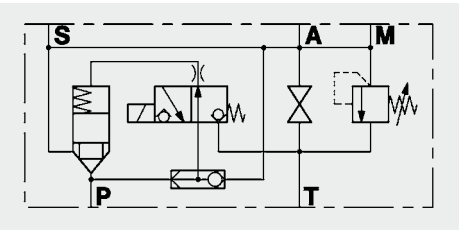
When the 3/2 directional poppet valve is in the switching position shown (open when de-energised), the spring chamber of the logic element is pressurised via the system pressure; the path from P to S is blocked and the accumulator is shut off from the system. When the 3/2 directional poppet valve is in the discharge position (energised) the spring chamber of the logic element is discharged, the path from P to S is open and the accumulator is charged.

If the pump breaks down or if it is switched off, the 3/2 directional poppet valve reverts to the "open when de-energised" position; the accumulator pressure shuts off the logic element via the shuttle change-over valve and shuts off the accumulator from the system.

Technical specifications:

Type	Size	Max. operating pressure	Pressure relief valve [1]
SA20A51T...	DN20	400 bar	NG12 (2)
SA32A51T...	DN30	400 bar	NG12 (3)
SA40A51T...	DN40	400 bar	NG12 (3)

[1] number of pressure relief valves



6. DESCRIPTION OF DSV10

6.1. GENERAL

DSV10 as a "Low Cost Alternative" to SAF10

The three-way safety block DSV10 is used to isolate and discharge hydraulic pressure accumulators and consumers. It complies with the relevant safety standards in accordance with DIN EN 982 and the German industrial safety regulations BetrSichV.
The HYDAC pressure relief valve DB12 is used with the DSV series.This is a direct-operated pressure relief valve in poppet valve construction with excellent opening and closing characteristics.
This version of the DB12 complies with the requirements of the Pressure Equipment Directive 97/23/EC with CE marking. There are four different models:

- DSV10M
  Manual discharge,
  Standard L-ball
- DSV10M-T-ball
  Manual discharge,
  T-ball
- DSV10EY
  Manual/solenoid-operated discharge,
  open when de-energised
- DSV10EZ
  Manual/solenoid-operated discharge,
  closed when de-energised

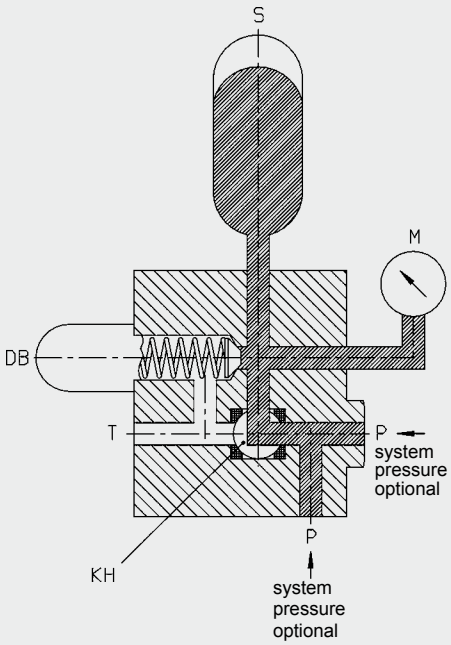
The essential difference compared to the SAF10 lies in the shut-off and discharge function of the DSV10. On request we can supply other models to cover almost all applications, e.g. for aggressive media.

On request we can supply test certificates to EN10204 and quality test certificates to DIN 55350, Part 18.

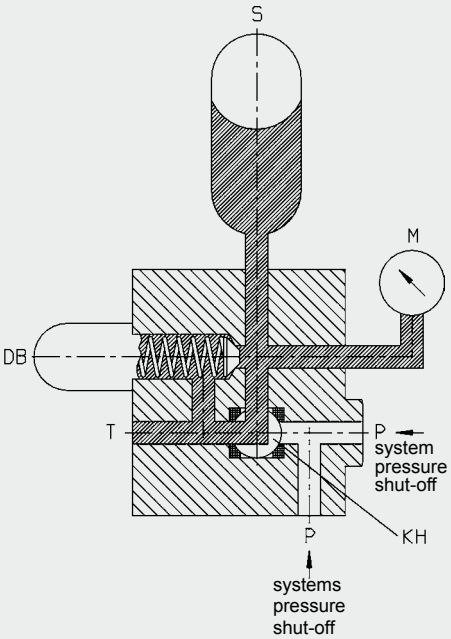
6.2. CONSTRUCTION

The DSV three-way safety block consists of a valve block with an integrated pressure relief valve and the shut-off valve. It has ports for the pump, pressure gauge, tank and accumulator.
In addition, an optional solenoid-operated 2-way directional valve allows automatic discharge of the accumulator or consumer.

Accumulator operation



Shutting off the system pressure and simultaneously discharging of the accumulator



P - pump connection
S - accumulator
KH - change-over ball valve
DB - pressure relief valve
M - pressure gauge
T - tank connection

The DSV10 can be used as a cost-effective alternative to the SAF10. Unlike the SAF10, the DSV10 shuts off when discharging simultaneously to the tank.

6.3. PORTS

The DSV has the following ports:

S – Accumulator port
(M33x2 DIN 3852 part 3)

P – Inline port
(G 3/8 and G 1/2)

T – Tank port
(G 1/4)

M – Pressure gauge port
(G 1/4)

6.4. FUNCTION

When the accumulator is in operation the change-over ball valve connects the pump port with the accumulator. At the same time the accumulator is monitored for pressure via the built-in pressure relief valve.
By switching over the ball valve, the pump port is shut off leakage-free on the inlet side and the accumulator is discharged simultaneously to the tank.

During switching all three ports (P, S and T) are momentarily interconnected (negative switching overlap). If a solenoid-operated 2/2 directional poppet valve is fitted, automatic discharge is possible (e.g. in the event of a power failure or shut-down)

6.5. NOTES

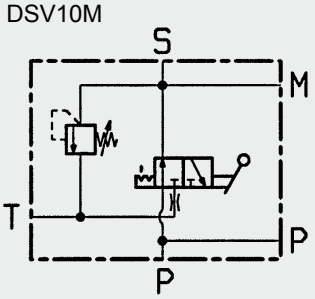
Ball valves are not designed to be used as flow control valves; therefore they should always be either fully open or fully closed, to avoid damaging the sealing cups.

To ensure correct functioning, pressure and temperature specifications must be observed.

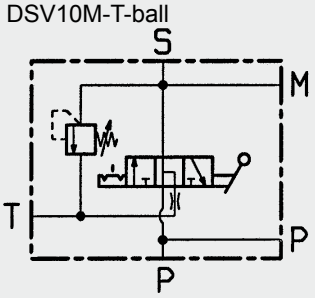
6.6. SPECIFICATIONS

6.6.1 **Symbols**

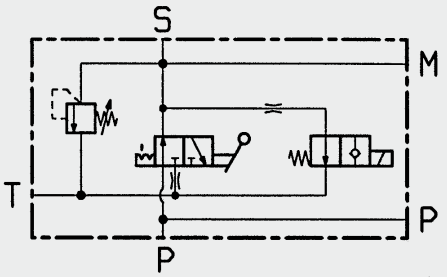
DSV10M



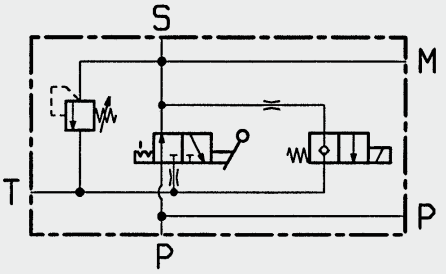
DSV10M-T-ball



DSV10EY



DSV10EZ



6.6.2 **Type of construction**

Ball valve isolating device

Pressure relief valve is a direct-acting poppet valve

Poppet valve is pilot-operated

6.6.3 **Materials**

Housing and blanking plug in steel, surface protection: phosphated.
Ball in steel, hard-chromed.
Pressure relief valve and poppet valve in high tensile steel, closing element in hardened and ground steel, wear-resistant, surface protection: phosphated.
Ball seal in high quality synthetic material (POM) soft seals in Perbunan (NBR).
Cranked handle SW09 in red anodised aluminium.

6.6.4 **Installation position**

optional

6.6.5 **Operating fluids**

Mineral oil to DIN 51524 Part 1 and part 2
(other fluids on request)

Viscosity range:
Min. 10 mm²/s
Max. 380 mm²/s

Filtration:
Max. permitted contamination of the operating fluid to SAE AS 4059 Class 11. We therefore recommend a filter with a minimum retention rate of $ß_{20} \geq 100$. The fitting of filters and the regular replacement of filter elements guarantees correct operation, reduces wear and tear and increases the service life.

6.6.6 **Permitted operating temperature**

-10 °C ... +80 °C

(ambient temperature for E version limited to -10 °C ... +60 °C)

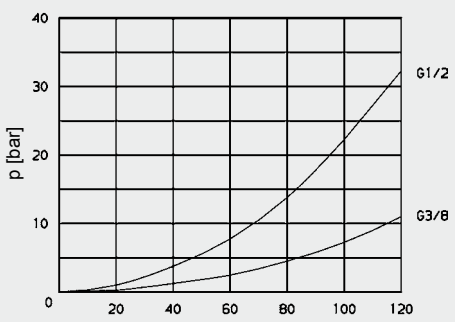
6.6.7 **Maximum operating pressure**

350 bar

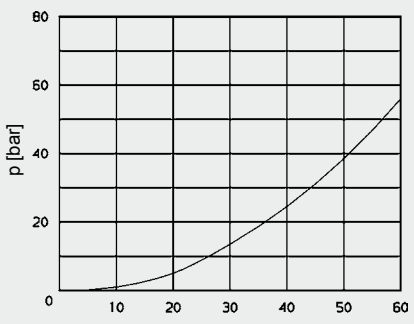
6.6.8 **Δp - Q graph**

measured at
t_{oil} = 50 °C
ν = 30 mm²/s

Flow rate from P to S



Flow rate from S to T



6.6.9 **Model with solenoid-operated pressure relief**

Type
Solenoid-operated by means of pressure-tight, oil-immersed, single-stroke solenoids in accordance with VDE 0580. Actuating solenoid with male connector to DIN 43650, standard for general industrial applications, available for 24 V DC and 230 V AC.

Type of current
DC solenoid
When connected to AC voltage the necessary DC voltage is produced by means of a bridge rectifier connector.

Voltage tolerance
±15% of nominal voltage

Nominal current
dependent on the nominal voltage
24 V DC 0.80 A
230 V AC 0.11 A

Power consumption:
p_{20} = 18 W

Duty
Continuous

Switching time
Dependent on symbol, pressure across the individual ports and flow rate.
WSM06020Y:
on: 50 ms, off: 35 ms
WSM06020Z:
on: 35 ms, off: 50 ms

6.7. SPARE PARTS

Please see brochure:

- 3-way safety block DSV No. 5.251

6.8. MODEL CODE FOR DSV10

(also order example)

DSV 10 M . – 4 . 1 / 1 / X / T ... – G 24 – Z4 ...

3-way safety block

Nominal bore
10

Discharge
M = manual discharge
E = solenoid-operated and manual discharge

For manual/ solenoid-operated discharge, also indicate
Y = open when de-energised
Z = closed when de-energised

Type of pressure relief valve
4 = DB12

With/without fitted pressure relief valve
1 = with pressure relief valve
0 = without pressure relief valve

Accumulator connection
1 = M33x2

Series
(determined by manufacturer)

Setting of pressure relief valve
T = pressure-set and lead-sealed by TÜV
V = adjustable using tool
F = preset by manufacturer
x = no details (for model without relief valve cartridge)

Pressure setting
... = pressure setting
... = pressure range
xxx = no details (for model without relief valve cartridge)

Pressure setting range
DB12 – 150 bar
DB12 – 250 bar
DB12 – 350 bar

Type of voltage for solenoid
G = DC voltage
W = AC voltage

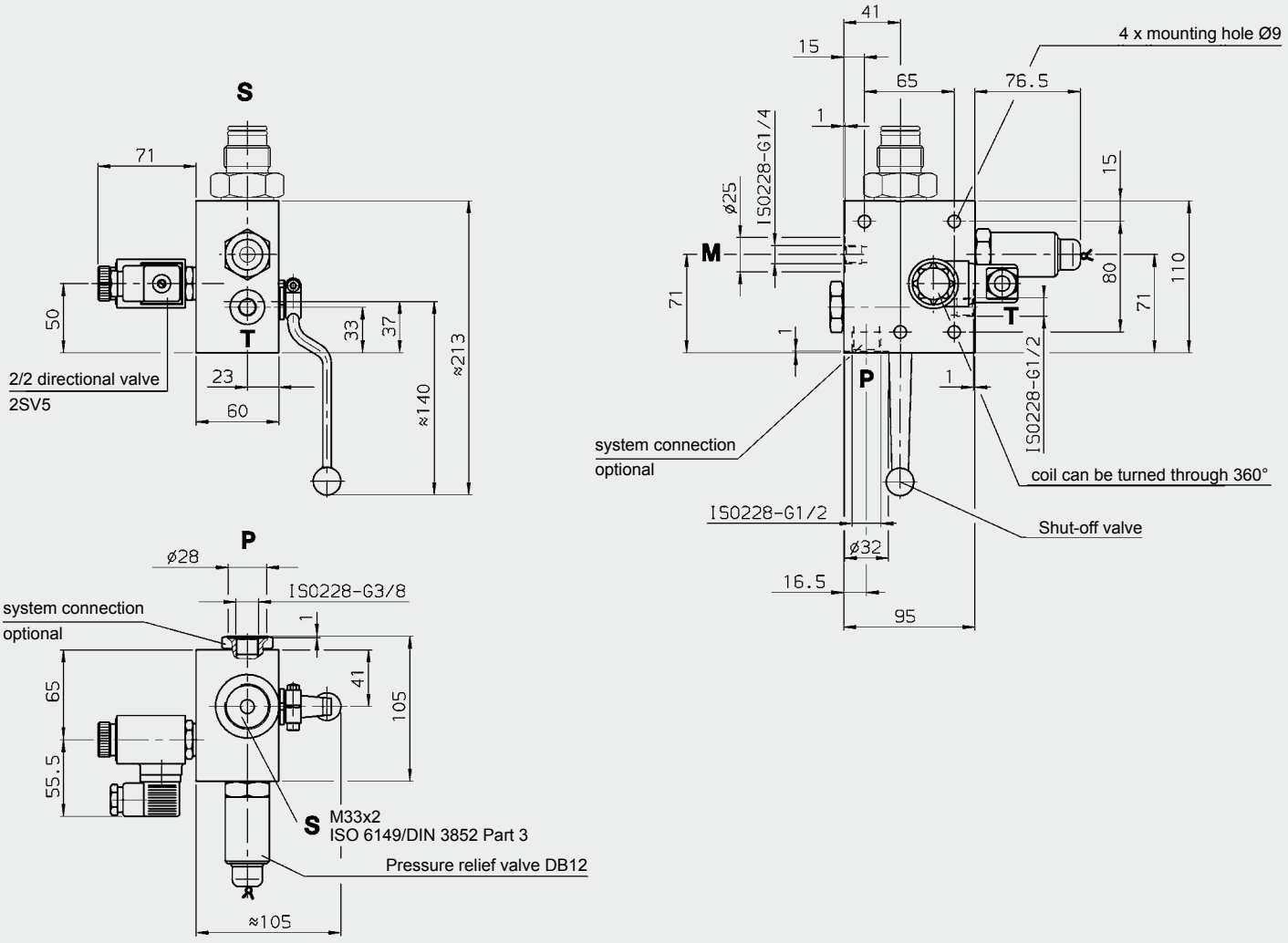
Nominal voltage for solenoid
24 = 24 Volt for type G voltage (DC)
230 = 230 Volt for type W voltage (AC)

Type of connection for solenoid
Z4 = connector to DIN 43650 - AF2 - PG11

Supplementary details
T-Ball = ball bore (180° switch)
FKM (Viton®) = O-ring seal

6.9. DIMENSIONS

DSV10 3-way safety block



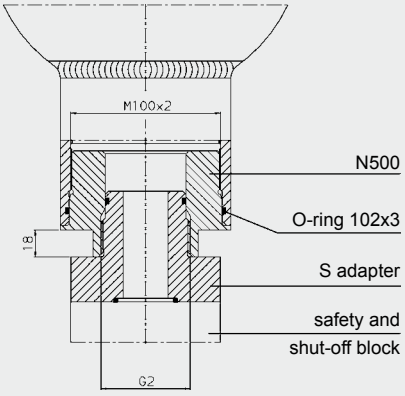
Type	B [mm]	Weight
DSV10M...	45	3.5 kg
DSV10E...	60	3.9 kg

DSV10 Preferred models

Type	Part no.	Type	Part no.
DSV-10-M-4.0/1/X/XXXX	555999	DSV-10-EY-4.0/1/X/XXXX-G24-Z4	557367
DSV-10-M-4.1/1/X/T035	555968	DSV-10-EY-4.1/1/X/T035-G24-Z4	555980
DSV-10-M-4.1/1/X/T050	555969	DSV-10-EY-4.1/1/X/T050-G24-Z4	555981
DSV-10-M-4.1/1/X/T070	555970	DSV-10-EY-4.1/1/X/T070-G24-Z4	555982
DSV-10-M-4.1/1/X/T100	555971	DSV-10-EY-4.1/1/X/T100-G24-Z4	555983
DSV-10-M-4.1/1/X/T150	555972	DSV-10-EY-4.1/1/X/T150-G24-Z4	555984
DSV-10-M-4.1/1/X/T200	555973	DSV-10-EY-4.1/1/X/T200-G24-Z4	555985
DSV-10-M-4.1/1/X/T210	555974	DSV-10-EY-4.1/1/X/T210-G24-Z4	555986
DSV-10-M-4.1/1/X/T250	555975	DSV-10-EY-4.1/1/X/T250-G24-Z4	555987
DSV-10-M-4.1/1/X/T300	555976	DSV-10-EY-4.1/1/X/T300-G24-Z4	555988
DSV-10-M-4.1/1/X/T315	555977	DSV-10-EY-4.1/1/X/T315-G24-Z4	555989
DSV-10-M-4.1/1/X/T330	555978	DSV-10-EY-4.1/1/X/T330-G24-Z4	555990
DSV-10-M-4.1/1/X/T350	555979	DSV-10-EY-4.1/1/X/T350-G24-Z4	555991

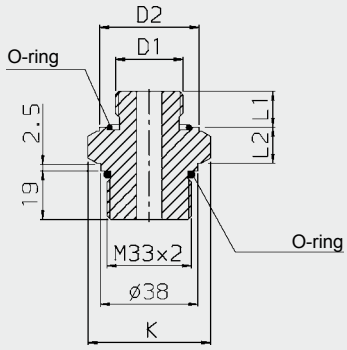
7. ACCESSORIES: ADAPTERS FOR SAF/DSV10

7.1. ADAPTERS FOR LOW PRESSURE BLADDER ACCUMULATORS



Type	Accumulator type	Volume [l]	Adapter	Part no. [1] NBR/Carbon steel	Corresponding S adapter	Part no. [1] NBR/Carbon steel
SAF10/20 and DSV10	SB35	2.5 ... 50	N500	367229	S 13	369481
SAF32					S 309	366715

7.2. ADAPTERS FOR DIAPHRAGM ACCUMULATORS



Type	Accumulator type	Volume [l]	D1 Thread	Part no. [1] NBR/Carbon steel	Adapter	K SW	L1 [mm]	L2 [mm]	D2 [mm]	O-ring
SAF10/20 DSV10	SBO...E-	0.075 ... 1.4	G 1/2 A	369485	S 30	41	14	17.5	33	22x3
	SBO...A6-	0.1 ... 210-1.3								
	SBO...E-	2.0 ... 3.5	G 3/4 A	369486	S 31		16		40	28x3
	SBO...A6-	1.3 ... 4								

[1] others on request

7.3. ADAPTERS FOR PISTON ACCUMULATORS

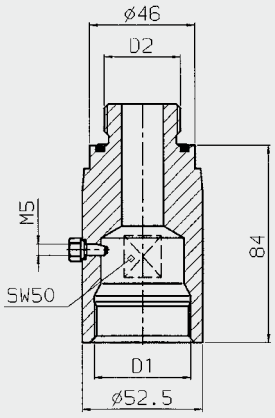


Diagram 1

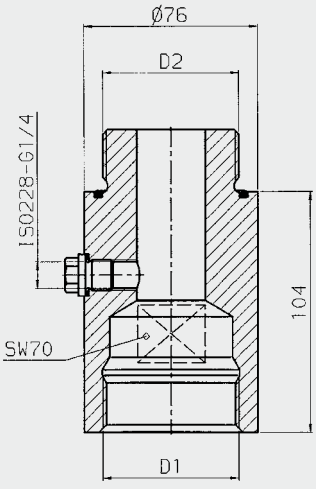
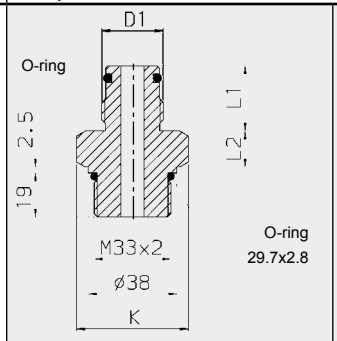
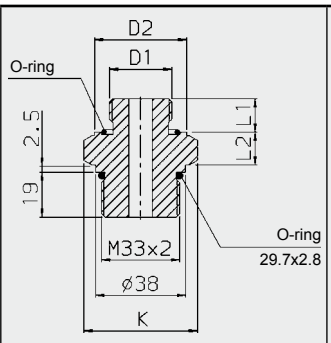
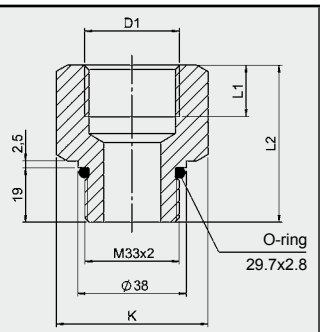
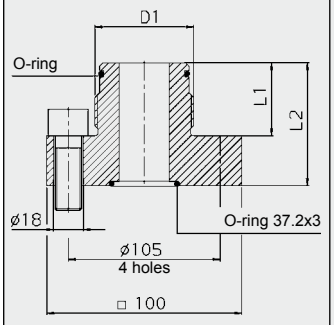
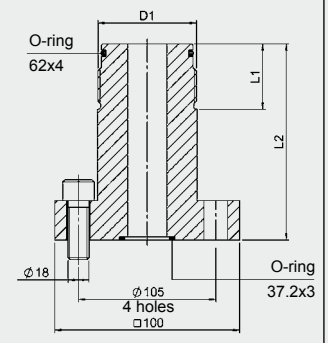
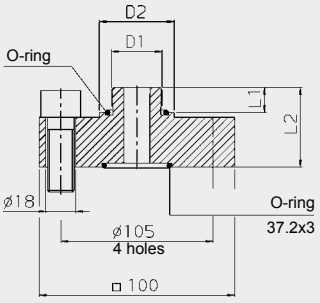
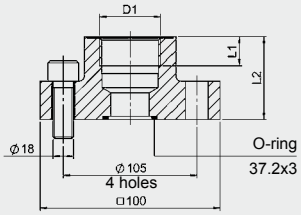


Diagram 2

Type	Accumulator type	Volume [l]	Adapter	Part no. [1] NBR/Carbon steel	Diag.	D1 [mm]	D2 [mm]	O-ring	Corresponding S adapter	Part no. [1] NBR/Carbon steel
SAF10/20 DSV10	SK210/350 -	2.5 ... 7.5	K 406	374929	1	G 1 1/4	G 1	35x3	S 12	369480
	SK210/350 -	10 ... 45	K 408	374931	2	G 2	G 1 1/2	53x3	S 13	369481
SAF32	SK210/350 -	50 ... 120	K 409	374933			G 2	62x3	S 309	366715

[1] others on request

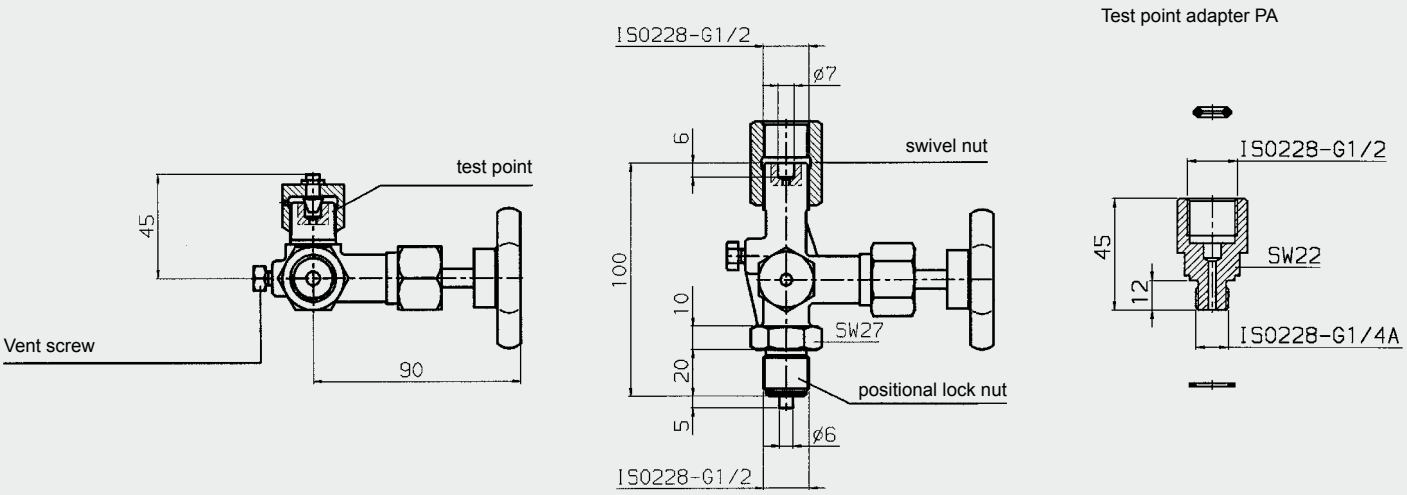
7.4. TO CONNECT THE SAFETY AND SHUT-OFF BLOCK WITH THE ACCUMULATOR

Type	Adaptor for standard bladder accumulator			
SAF10 SAF20 DSV10	 Diagram 1	 Diagram 2	 Diagram 3	
SAF32	 Diagram 4	 Diagram 5	 Diagram 6	 Diagram 7

Type	Accumulator type	Volume [l]	D1 Thread	Adapter	Part no. [2] NBR/Carbon steel	K SW [mm]	L1 [mm]	L2 [mm]	D2 [mm]	O-ring [mm]	Diag.
SAF10 SAF20 DSV10	SB330/400-	0.6 ... 1	G 3/4A	S 10	00369479	41	28	16	–	17x3	1
	SB550/600-	1 ... 5	G 1A	S 11	00372750	46	34	17	–	22x3	
	SB330/400-	2.5 ... 6	G 1 1/4A	S 12	00369480		37		–	30x3	
	SB330/400-	10 ... 50	G 2A	S 13	00369481	65	44	21	–	48x3	
	SB550/600-	10 ... 50									
	Connection with metric fine thread	–	M30x1.5	S 20	00369482	41	15	18	40	32x2	2
		–	M40x1.5	S 21	00369483	55	20	21	54	43x3	
		–	M50x1.5	S 22	00369484	65			64	53x3	
	SB330/400-	2.5 ... 50	G 3/4	S 367861	00369489	41	18	50	–	–	3
			G 1	S 379766	00369490	46	20	55	–	–	
			G 1 1/4	S 379767	00369498	65	22	60	–	–	
SAF32	SB330/400-	0.6 ... 1	G 3/4A	S 305 [1]	00366723	–	28	58	–	17x3	4
	SB550/600-	1 ... 5	G 1A	S 306 [1]	02102855	–	34	64	–	22x3	
	SB330/400-	2.5 ... 6	G 1 1/4A	S 307 [1]	00366724	–	37	67	–	30x3	
	SB330/400-	10 ... 50	G 2A	S 309 [1]	00366715	–	44	74	–	48x3	
	SB550/600-	10 ... 50		S 308 [1]	00376813	–		115	–		
	SB330H-	10 ... 50	G 2 1/2A	S 365922	00377283	–	50	150	–	62x4	5
	Connection with metric fine thread	–	M30x1.5	S 330 [1]	00366735	–	15	47	45	32x2	6
		–	M40x1.5	S 340 [1]	00366736	–	20	51	60	43x3	
		–	M50x1.5	S 350 [1]	00366737	–			75	53x3	
	SB330/400-	10 ... 50	G 1	S 365637	02106583	–	20	60	–	–	7
			G 1 1/4	S 369658	02106578	–	22		–	–	
			G 1 1/2	S 237838	02103869	–	24	65	–	–	

[1] Adapter supplied with 4 off hex. socket cap screws M16x45 (part no. 6032726) Torque 130 Nm
[2] others on request

7.5. GAUGE ISOLATOR VALVE



Consisting of: Isolator valve AG (Part no. 611903) with bleed valve swivel nut, positional lock nut and test point to DIN 16271 and test point adapter PA with seals (Part no. 370754)

8. 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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Safety Equipment for Hydraulic Accumulators

1. DESCRIPTION

1.1. GENERAL

Hydraulic accumulators are pressure vessels, as defined by PED 97/23/EC, and as such their manufacture is subject to the statutory pressure equipment regulations.

For safety in the workplace, system manufacturers and operators must draw up a risk assessment for the particular site.

These must take into account possible risks at the installation site, particularly in combination with external factors.

Fundamental risks affecting hydraulic accumulators are:

- Excessive pressure and
- Temperature increase (e.g. in the event of an external fire).

HYDAC provides the appropriate safety equipment to protect accumulators from excessive values on the gas and fluid side; see also catalogue section:

- Accumulators No. 3.000

2. PROTECTION ON THE GAS SIDE

2.1. TEMPERATURE FUSE

HYDAC offers two different kinds of temperature fuse.

In addition to the proven temperature fuse in carbon steel and stainless steel, HYDAC also offers a temperature fuse of the type GMP6, which is approved according to PED 97/23/EC.

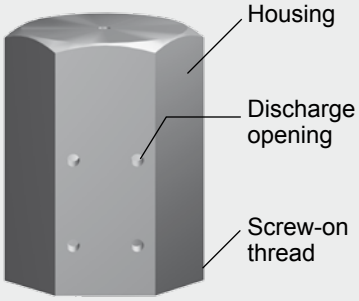
It is made of stainless steel and has a CE mark.

2.1.1 Mode of operation

Temperature fuses are "devices with a safety function" and are used to release the gas pressure by discharging the nitrogen completely when a rise in temperature reaches unacceptable levels (e.g. in the case of fire).

2.1.2 Design / Technical specifications

Temperature fuse design



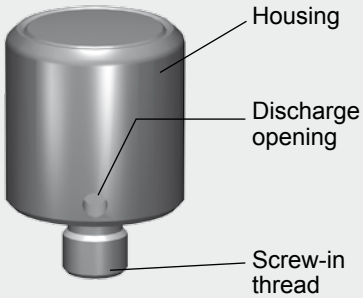
Technical specifications

Permitted operating pressure:
≤ 450 bar

Temperature range:
-10 °C ... +80 °C

Melting point:
between +160 °C and +170 °C

Temperature fuse GMP6 design



Technical specifications

Permitted operating pressure:
50 ... 350 bar

Temperature range:
-40 °C ... +80 °C

Melting point:
between +160 °C and +180 °C

2.1.3 Preferred models

Part no.	Description
363501	Temperature fuse 7/8-14UNF
3114417	Temperature fuse 7/8-14UNF with crane hook
3517438	GMP6-10-CE1637... for piston accumulators
3521196	GMP6-10-CE1637... for bladder and diaphragm accumulators

2.1.4 Installing the temperature fuse

Simple to retrofit by replacing the sealing cap with the temperature fuse.

Gas side of the accumulator shown with sealing cap

Gas side of the accumulator shown with temperature fuse

Installing the temperature fuse GMP6

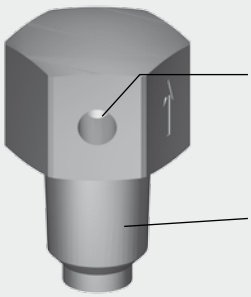
Please read the Operating Manual!

- GSV/GMP No. 3.504.CE

2.2. BURSTING DISC

2.2.1 **Design**

Protection by discharging the nitrogen completely when the pressure exceeds the permitted level.



2.2.2 **Function**

If the pressure exceeds the permitted level, the bursting disc shatters, permanently opening the port. This reduces the gas pressure by discharging the nitrogen completely.

Bursting discs are designed for different burst pressures and are supplied with a certificate of conformity.

Bursting discs are made either entirely of stainless steel, or from an alloy based on stainless steel and nickel.

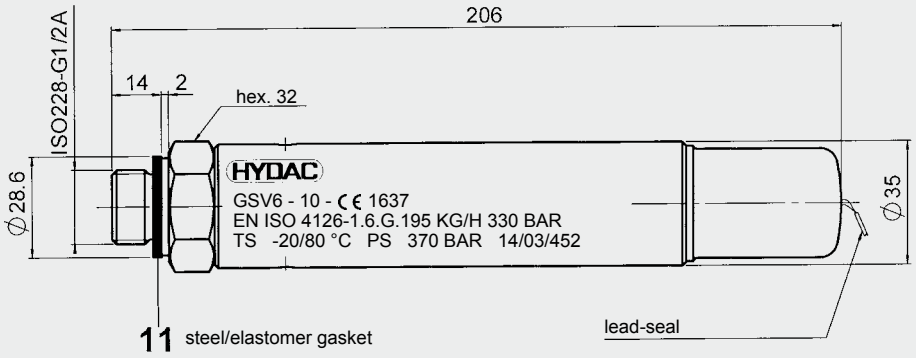
2.2.3 **Preferred models**

Part no. [1]	Description	Burst pressure ± 10% at 50 °C
3156148	Bursting disc plug 1/4"NPT	210 bar
3156152	Bursting disc plug 1/4"NPT	350 bar
3156155	Bursting disc plug 1/4"NPT	450 bar

[1] higher pressures, different threads and burst pressure tolerances on request

2.3. GAS SAFETY VALVE

2.3.1 **Assembly and dimensions**



2.3.2 **Function**

The gas safety valve provides protection by reducing the pressure in a controlled way if pressure exceeds the permitted level unexpectedly. It is pre-set on the pressure side and lead-sealed by the authorised representative. It is also supplied with a certificate of conformity and a type approval.

2.3.3 **Model code**

(also order example)

GSV6-10 – CE1637.ENISO4126-1.6.G. 195. 330

Gas safety valve

Component code

Flow rate Q [kg/h]
(see table, Point 2.3.5)

Pressure setting p [bar]
(see table, Point 2.3.5)

2.3.4 **Technical specifications**

Design
PED 97/23/EC, EN ISO4126-1, EN 13445-6, others on request

Module category
IV to PED 97/23/EC
Module B + D (EC prototype testing)
Module G (EC individual testing) on request

Nominal size
6 mm

Material
Stainless steel, closing element with flexible seat seal

Medium
Nitrogen (N_2)

Operating pressure range
30 ... 370 bar

Temperature range
-20 °C ... +80 °C

Weight
1.1 kg

2.3.5 **Preferred models**

Q [kg/h]	p [bar] ± 10 %	Part no. [1)]
15	30	3123965
20	40	3123966
28	50	3123967
35	60	3124028
40	70	3124029
45	80	3124030
50	90	3124031
58	100	3124032
65	110	3124033
70	120	3124034
75	130	3124035
83	140	3124036
88	150	3124037
95	160	3124038
100	170	3124039
105	180	3124040
110	190	3124041
118	200	3124042
125	210	3124043
130	220	3124044
135	230	3124045
140	240	3124046
148	250	3124047
155	260	3124048
160	270	3124049
165	280	3124050
170	290	3124051
178	300	3124052
185	310	3124053
190	320	3124054
195	330	3124055
200	340	3124056
205	350	3124057
210	360	3153706
216	370	3143015

[1)] others on request.

> 350 bar = surcharge for individual EC testing

2.3.6 **Installing the gas safety valve GSV**

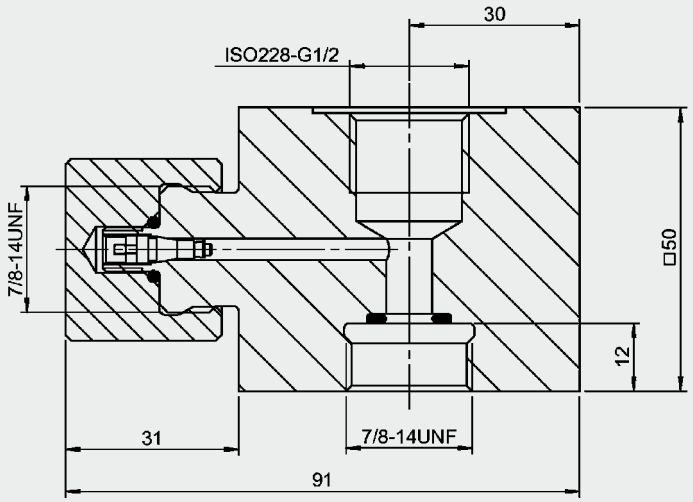
The self-centring gasket means that this valve can be installed simply and securely in any position.

Please read the Operating Manual!

- GSV/GMP
  No. 3.504.CE

2.3.7 **Adapter for gas safety valve GSV6**

To protect standard and low pressure bladder accumulators, the adapter shown below must be ordered with the gas safety valve GSV6.

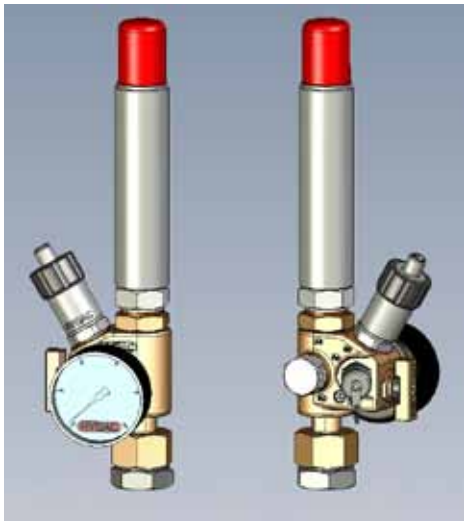


Pressure range Gas safety valve	Adapter body* Part no.	Adapter, complete Part no.
30- 350 bar	00363713	02103381

* p_{max} = 400 bar

2.4. GAS SAFETY BLOCK

2.4.1 **Design**



The gas safety block GSB450 consists of a block made of brass (other materials on request) with integrated breather and shut-off valve plus ports for:

- Pressure gauge
- Gas safety valve (GSV6)
- Gas charging valve (e.g. Minimess)
- Pressure transmitter or pressure switch
- Bursting disc or temperature fuse

The connection for the gas safety valve is designed as a check valve. Therefore the valve can be changed, even if the system is pressurized.

2.4.2 **Function**

The GSB450 is an adapter block, which is mounted on an accumulator on the gas side and which can be fitted with various pressure devices, charging equipment, safety valves and other safety components.

2.4.3 **Advantages**

- Compact construction
- Flexible connection options
- Variable indication options: bar, MPa or psi, analogue or digital (optional)
- Pressure indication according to customer requirement
- Accumulator can be charged with nitrogen, directly via Minimess valve
- Pre-charge pressure can be checked without using FPU-1

2.4.4 **Model code**

(also order example)

GSB450 – 1 – 1 – 5 – 1 – 1 – 350

Series

Material
1 = Standard
2 = Stainless steel

Accumulator connection
1 = Connection for SK / SBO
2 = Connection for SB
9 = Special connection

Monitoring options
0 = None
1 = 0 – 25 bar
2 = 0 – 100 bar
3 = 0 – 160 bar
4 = 0 – 250 bar
5 = 0 – 400 bar
9 = Special pressure gauge

Gas charging connection
0 = None
1 = Standard Minimess series 1620
2 = Minimess gas charging valve series 1615
9 = Special

Safety equipment
0 = None
1 = GSV
2 = Bursting disc
3 = Temperature fuse

Pressure range of the safety equipment

2.4.5 Technical specifications

Medium
Nitrogen (N_2)

Permitted operating temperature
-20 °C ... +80 °C

Max. operating pressure
400 bar / 5800 psi

Accumulator connection
Bladder accumulator:
7/8-14UNF with adapter

For bladder accumulators, the appropriate adapter is supplied. All other connections are sealed with blanking plugs.

Piston and diaphragm accumulators:
M28x1.5

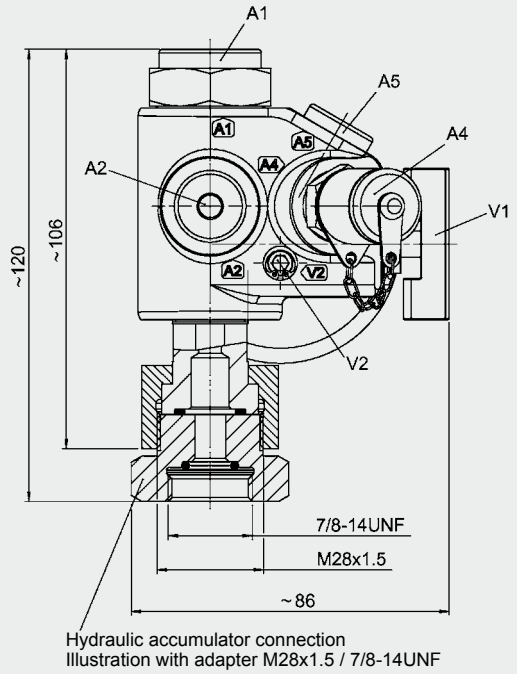
For piston and diaphragm accumulators the connection is a lock-nut with a M28x1.5 thread as standard.

2.4.6 Installation of gas safety block GSB

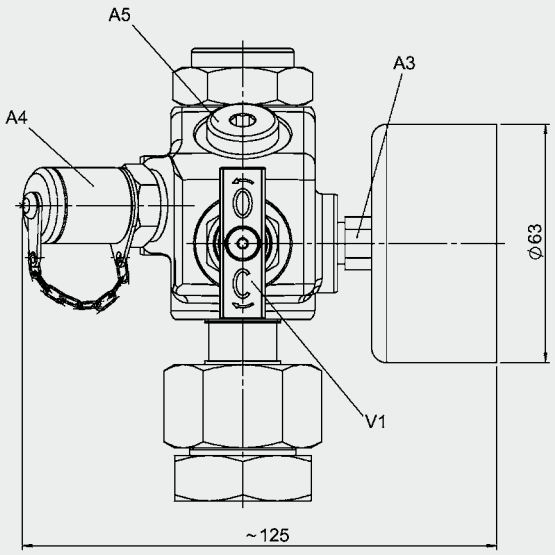
Please read the Operating Manual!

- GSB
  No. 3.505.CE

2.4.7 Models



Hydraulic accumulator connection
Illustration with adapter M28x1.5 / 7/8-14UNF



Basic version
In the basic version, the GSB450 is supplied with shut-off valve, air bleed valve, pressure gauge (0 - 400 bar, Ø 63 mm) and gas charging connection in Minimess screw coupling series 1620 (M16x2).

Options The GSB450 can be supplied with the following options*:

- Pressure gauge with different display ranges (Ø 63 mm - at no additional cost) and different displays: bar, MPa or psi; analogue or digital
- Pressure gauges of various accuracy classes and glycerin-filled pressure gauges
- Minimess gas charging valve series 1615 (M16x1.5) in stainless steel version
- Version for lower and higher temperatures
- Version where all steel parts are stainless steel (A4)
- Gas safety valve GSV6
- Safety devices (bursting disc, temperature fuse)
- Pressure transmitter (e.g. HDA)
- Pressure switch (e.g. EDS)

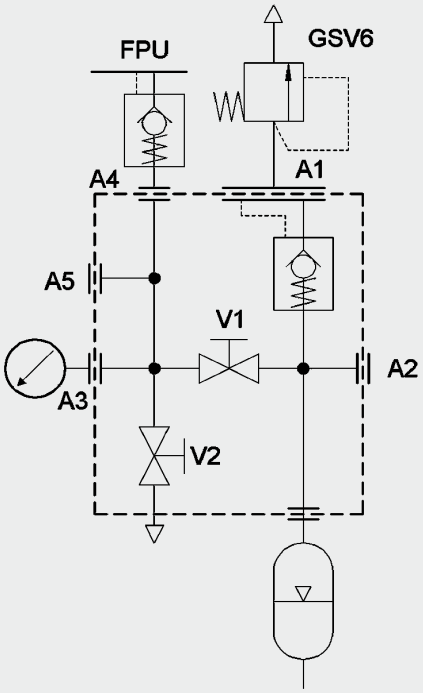
* on request and must be ordered separately and at additional cost

2.4.8 **Block connections**

Connections	Size	Description	Options available as accessories
A1	G 1/2-ISO228	GSV6 connection, incl. pilot-operated check valve	Sealing plug
A2	G1/4-ISO228	Connection for charging and safety devices	Charging connection for remote charging Bursting disc, temperature fuse
A3		Connection for pressure gauge	Pressure gauge in various models and various different indication ranges (0 - 400 bar, 0 - 5714 PSI)
A4		Gas charging connection	Minimess M16x2; M16x1.5 gas-tight
A5		General connections	Pressure transmitter e.g. HYDAC HDA, EDS

2.4.9 **Valves**

Type	Description
V1	Shut-off valve
V2	Air bleed valve (internal hex SW4)



2.4.10 **Connecting hoses**

Connecting hoses are suitable for the particular maximum permitted operating pressure printed on them and for 10,000 charging processes.
(HYDAC charging hoses comply with the EC Machinery Directive, DIN EN 982 and DIN EN 853 to 857.)

Gas connection of nitrogen bottles	Minimess port	Length [m]	Part no.
W30x2	M16x2	2.5	3434454
		4	3434457
W24.32x1/14	M16x2	2.5	3434424
		4	3434451
		10	3526858

Suitable adapters for foreign nitrogen bottles can be found in the following catalogue section:

- Universal Charging and Testing Unit FPU-1
  No. 3.501

3. PROTECTION ON THE FLUID SIDE

3.1. GENERAL

The fluid side must be protected against pressures which exceed the permitted operating pressures by fitting approved and appropriate safety valves.

HYDAC offers pressure relief valves (DB12) which have a pressure setting of up to 400 bar (set by HYDAC). The valve carries the CE mark and is built into Safety and Shut-off Blocks in the series DSV10 and SAF in nominal sizes DN10 and DN50 and is lead-sealed.

Further information is available from the following catalogue section:

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

4. 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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Supports for Hydraulic Accumulators

1. DESCRIPTION

1.1. GENERAL

HYDAC supports are used to mount all types of hydraulic accumulator safely and simply, irrespective of the installation position and location. Clamps, consoles and complete accumulator sets are available.

1.2. USE

The supports are designed for static use. For dynamic stresses, specially designed clamps are available on request.

2. SELECTION TABLES FOR SUPPORTS

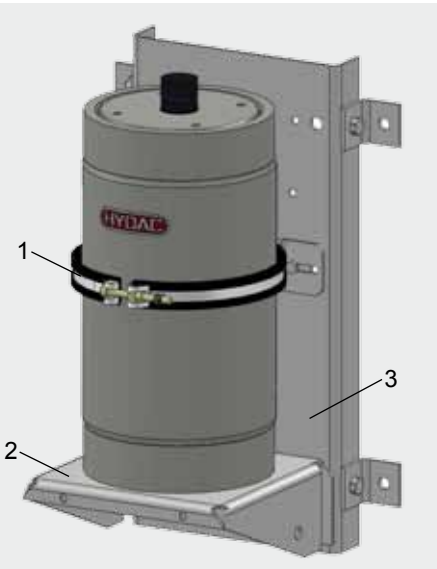
2.1. BLADDER ACCUMULATOR

1	Clamp
2	Console
3	Rubber support ring
4	Back plate

Type	Nominal volume [l]																								
	SB330					SB400				SB 550		SB500 / SB600		SB35			SB40			SB35H		SB35HB		SN
	1	2.5+5	4+6	10-24	32-50	0.5	4	10-20	32-50	1	2.5-5	10-20	32-50	2.5-5	10-20	32-50	2.5-5	10-20	32-50	20	32-50	20	32-50	50
Clamps*																									
HyRac 89-92 ST						1																			
HyRac 106-114/115 H3 ST														2			2								
HyRac 110-118/124 H10 ST	1	2																							
HyRac 121-129/133 H8 ST										1	2														
HyRac 167-175/178 H5 ST			1				1																		
HyRac 202-210/214 H8 ST															1	2				1	2				
HyRac 216-224/226 H5 ST																		1	2			1	2		
HyRac 223-230/231 H3 ST				1	2																			2	
HyRac 225-234/234 H3 ST								1	2																
HSS 242												1	2												
Consoles																									
KBK 167 / G			1				1																		
KBK 222 / G				1	1			1	1			1	1		1	1		1	1						1
KHF 210 / G																				1	1	1	1		
Accumulator set																									
SEB		1	1	1	1		1	1	1																
SEH											1	1	1												
SEN														1	1	1									
SEM																	1	1	1						
SEHF																				1	1				
SEHB																						1	1		

* The number of clamps can vary depending on the requirements and on the length of the accumulator. These are recommendations.

2.2. PISTON ACCUMULATOR

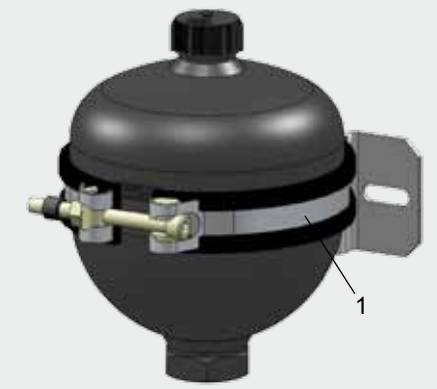


1 Clamp
2 Console
3 Back plate

Type	Piston diameter [mm] 50	60	80	100	150	180	250	> 250
	Accumulator external diameter [mm] 60	70	95	100	120	125	180	210	220	286	300	> 300
Clamps SK280*												
HRGKSM 0 R 58-61/62 ST	●											on request
HRGKSM 0 R 70-73/73 ST		●										
HRGKSM 0 R 92-95/96 ST			●									
HRGKSM 1 R 119-127/124 ST					●							
Clamps SK Standard*												
HyRac 96-100/100 ST				●								on request
HyRac 121-129/133 H8 ST						●						
HyRac 176-185/187 H5 ST							●					
HyRac 209-217/223 H10 ST								●				
HyRac 216-224/226 H5 ST									●			
HSS 286										●		
HSS 310											●	
Consoles												
KBK 126						1						on request
KBK 219								1	1			
KBK 310										1	1	

* Selecting the correct clamp depends on the external diameter of the accumulator. Depending on the application and length of the accumulator, we recommend that several clamps are used. Clamps must be mounted near the end caps in order to prevent deformation of the cylinder.

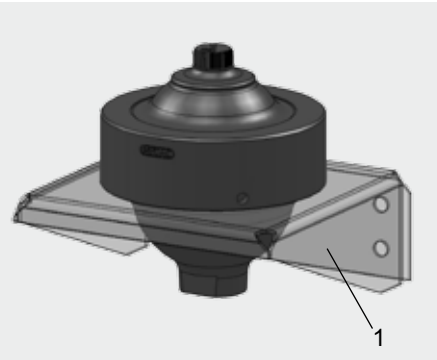
2.3. DIAPHRAGM ACCUMULATOR (WELD TYPE)



1 Clamp

Accumulator type	Clamps
SBO250-0.075E	HyRac 62-65 ST
SBO210-0.16E	HyRac 73-76 ST
SBO210-0.32E	HyRac 92-95/96 ST
SBO210-0.5E	HyRac 100-105/106 H3 ST
SBO100-0.7E	HyRac 106-114/115 H3 ST
SBO330-0.6E	HyRac 110-118/124 H10 ST
SBO330-0.7E	
SBO210-0.75E	HyRac 121-129/133 H8 ST
SBO330-0.75E	
SBO200-1E	HyRac 133-142/142 H3 ST
SBO140-1.4E	HyRac 143-151/151 H3 ST
SBO210-1.4E	
SBO330-1.4E	HyRac 152-159/160 H3 ST
SBO100-2E	HyRac 160-167/169 H5 ST
SBO210-2E	HyRac 167-175/178 H5 ST
SBO210-2.8E	
SBO250-3.5E	
SBO330-2E	
SBO330-2.8E	
SBO330-3.5E	

2.4. DIAPHRAGM ACCUMULATOR (SCREW TYPE)

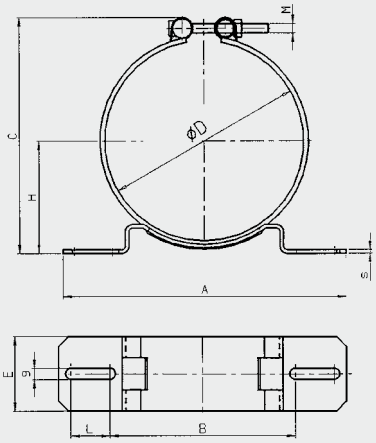


1 Console

Accumulator type	Console
SBO210-1.3A6	KMS 200
SBO400-1.3A6	KMS 210
SBO100-2.0A6	KMS 220
SBO250-2.0A6	
SBO210-2.8A6	KMS 250
SBO400-2.8A6	KMS 280
SBO210-4.0A6	KMS 300
SBO400-4.0A6	KMS 310

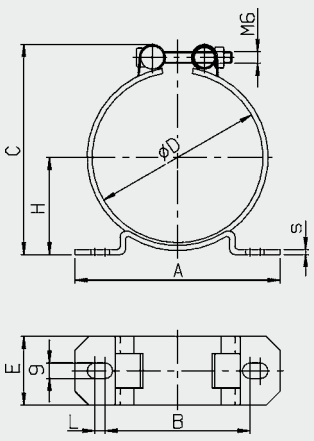
3. CLAMPS

HRGKSM



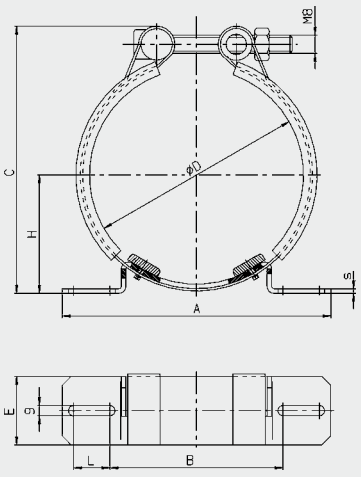
Fastening, Foot — zinc-plated
Clamping band — stainless steel
Insert — LDPE

HyRac (ØD ≤ 100 mm)



Fastening, Foot — zinc-plated
Clamping band — stainless steel
Insert — PE

HyRac (ØD ≥ 100 mm)



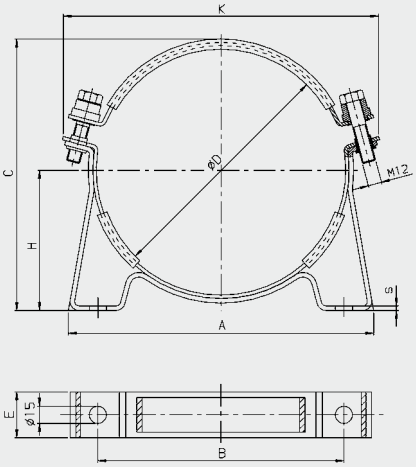
Fastening, Foot — zinc-plated
Clamping band — stainless steel
Insert — PE, NBR

Designation	Part no.	A [mm]	B [mm]	C max [mm]	ØD (from - to) [mm]	H (from - to) [mm]	E [mm]	L [mm]	S [mm]	K max. [mm]	Weight [kg]
HRGKSM 0 R 58-61/62 ST	3018442			83	58 - 61	37.3 - 38.8					0.16
HRGKSM 0 R 70-73/73 ST	3018444	120	85	93	70 - 73	42.0 - 43.5	40	6	3	–	0.21
HRGKSM 0 R 92-95/96 ST	444995			115	92 - 95	52.5 - 54.0					0.24
HRGKSM 1 R 119-127/124 ST	444505	158	100	154	119 - 127	66.8 - 70.8	50	18			0.36
HyRac 62-65 ST	445037			85	62 - 65	38 - 39.5					0.16
HyRac 73-76 ST	445038			96	73 - 76	43.5 - 45					0.16
HyRac 89-92 ST	445039	120	85	112	89 - 92	51 - 52.5	40	8	3	–	0.17
HyRac 92-95/96 ST	445040			115	92 - 95	52.5 - 54					0.17
HyRac 96-100/100 ST	445041			120	96 - 100	54.5 - 56.5					0.17
HyRac 100-105/106 H3 ST	444904			135	100 - 105	59 - 62					0.40
HyRac 106-114/115 H3 ST	444905			143	106 - 114	62.5 - 66					0.41
HyRac 110-118/124 H10 ST	445042			156	110 - 118	72.5 - 77					0.42
HyRac 121-129/133 H8 ST	444906	156	100	165	121 - 129	75.5 - 80	60	18	3	–	0.43
HyRac 133-142/142 H3 ST	444907			174	133 - 142	76.5 - 82.5					0.44
HyRac 143-151/151 H3 ST	444908			182	143 - 151	83 - 86.5					0.45
HyRac 152-159/160 H3 ST	444909			191	152 - 159	87 - 91					0.46
HyRac 160-167/169 H5 ST	444910			197	160 - 167	89 - 93					0.70
HyRac 167-175/178 H5 ST	445043			207	167 - 175	92.5 - 96.5					0.72
HyRac 176-185/187 H5 ST	445044			241	176 - 185	97 - 102.5					0.75
HyRac 202-210/214 H8 ST	445045	236	152	245	202 - 210	116 - 120	60	32	4	–	0.76
HyRac 209-217/223 H10 ST	445046			255	209 - 217	122.5 - 126.5					0.77
HyRac 216-224/226 H5 ST	445047			256	216 - 224	120 - 124					0.77
HyRac 223-230/231 H3 ST	445048			259	223 - 230	120.5 - 123.5					0.78
HyRac 225-234/234 H3 ST	445049			265	225 - 234	123 - 127.5					0.79

Model/order code (example):

HyRac 167-175/178 H5 ST	445043

HSS



Clamp	zinc-plated
Insert	NBR

Description	Part no.	A [mm]	B [mm]	C max [mm]	ØD (from - to) [mm]	H (from - to) [mm]	E [mm]	L [mm]	S [mm]	K max. [mm]	Weight [kg]
HSS 222/229	235224	270	216	244	226	123	40	Ø15	4	295	1.70
HSS 242	362712	268	216	265	242	136				305	1.70
HSS 286	237395	332	280	314	286	163				355	2.10
HSS 310	237389	332	280	333	310	170				380	2.10
HSS 360	355592	427	365	383	360	195				424	2.50

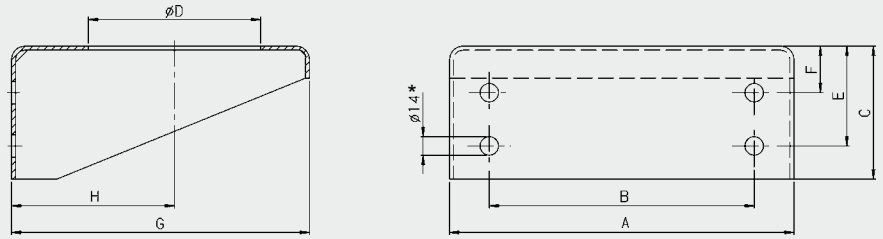
Model/order code (example):

HSS 222/229	235224

4. CONSOLES

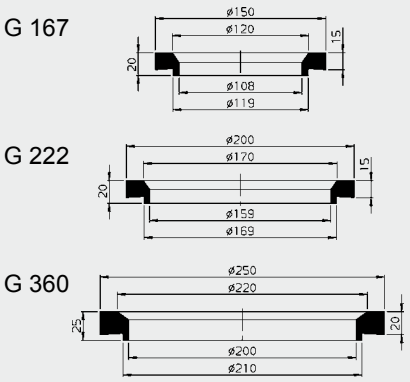
4.1. CONSOLE KBK FOR BLADDER AND PISTON ACCUMULATOR

Console KBK



* Ø22 on KBK 310 and KBK 360

Rubber support ring G



Type	Mat.	Part no.	A [mm]	B [mm]	C [mm]	ØD [mm]	E [mm]	F [mm]	G [mm]	H [mm]	Weight [kg]
126	STZN	290530	175	100	60	65	36	–	150	77	1.1
167		238526	260	200	100	120	75	35	225	92	2.5
219		238042	270	180		135	80	40	250	123	6.5
222		3002160	260	200		170	75	35	225		2.4
310		238043	330	220	200	190	140	60	340	170	18.3
360		357959	390	270	240	211	180		390	195	20.1

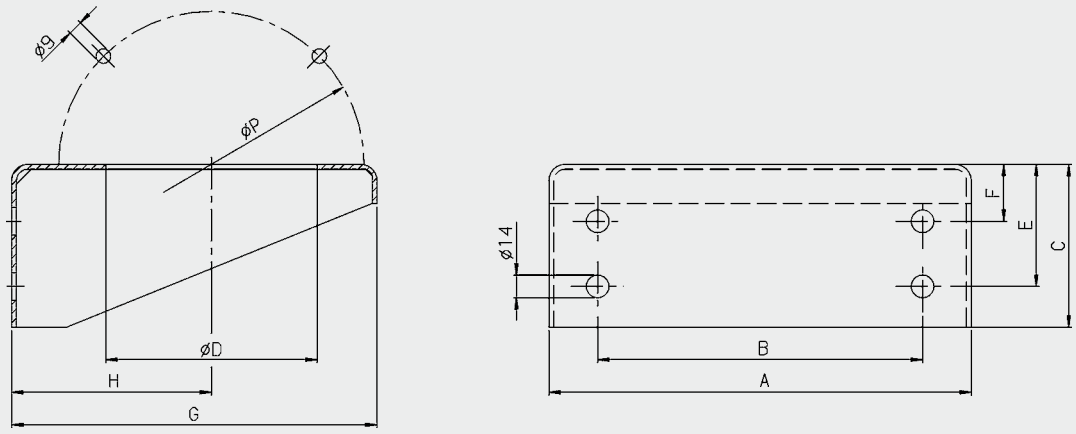
Type	Material	Part no.
–	NBR	–
167		236997
–		–
222		236996
–		–
360		355966

Model/order code (example):

KBK	167	STZN	238526

G	167	NBR	236997

4.2. CONSOLE KMS FOR SCREW TYPE DIAPHRAGM ACCUMULATOR



The screw type diaphragm accumulator has threaded bores M8 in the lock nut for fixing to the KMS console.

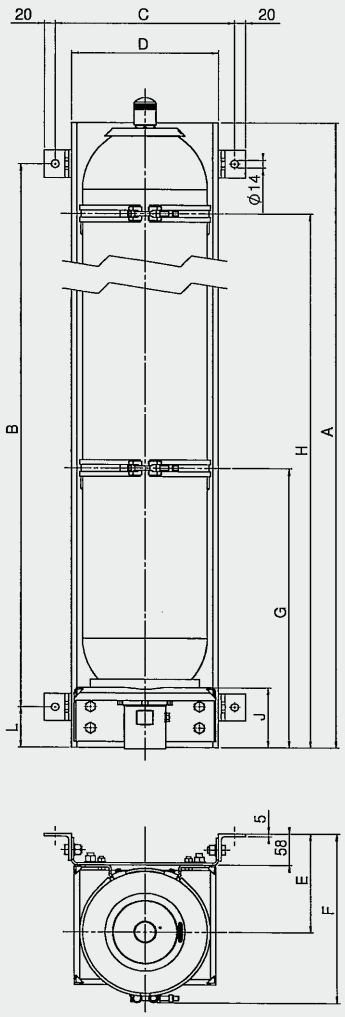
Type	Mat.	Part no.	A [mm]	B [mm]	C [mm]	ØD [mm]	ØP [mm]	E [mm]	F [mm]	G [mm]	H [mm]	ØI [mm]	Weight [kg]
200	STZN	359931	270	180	100	148	160	80	40	250	123	14	6.5
210		358989	260	200		170	180	75	35	225			2.4
220		359922				170	188						
250		359924				192	204						
280		359925	330	220	200	215	230	140	60	340	170	22	18.3
300		359926				220	235						
310		359927				245	265						
320		359928				290	305						

Model/order code (example):

KMS	200	STZN	359931

5. ACCUMULATOR SET FOR BLADDER ACCUMULATORS

SEB, SEH, SEM



5.1. SEB FOR SB330/440

Accumulator set	Part no.	Vol. [l]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	L [mm]	J [mm]
SEB 2.5	290787	2.5	460	310	198	138	133	214	220	410	75	–
SEB 4	238403	4	410	320	330	270	152	265	–	270	45	95
SEB 6	2115851	6	570	420	330	270	180	317	–	415	75	111
SEB 10	238407	10								330		
SEB 20	240598	20								500		
SEB 32	238409	32	1340	1190					500	1160		
SEB 50	240599	50										

This accumulator set SEB is also available with a SAF and SB330 as a compact unit (ACCUSET SB330).
See catalogue section:

- ACCUSET SB
  No. 3.503

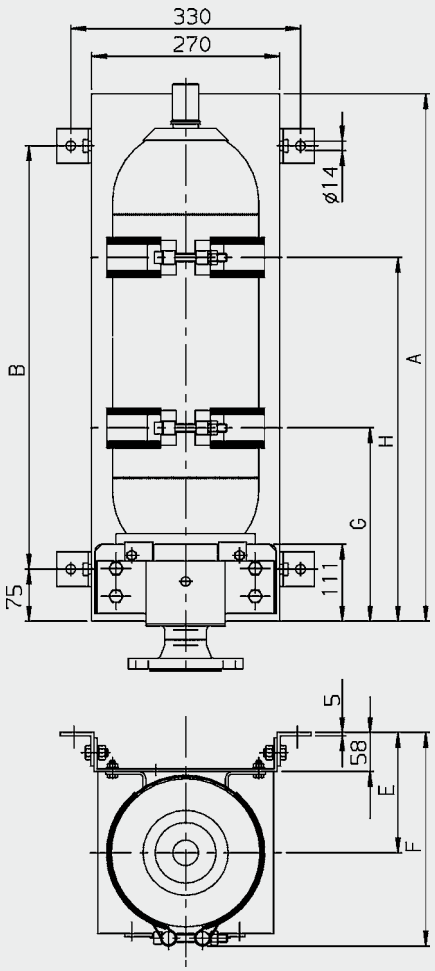
5.2. SEH FOR SB500/550/600

Accumulator set	Part no.	Vol. [l]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	L [mm]	J [mm]
SEH 2.5	2105194	2.5	460	310	198	138	133.5	223	220	410	75	–
SEH 5	2105195	5	750	600						650		
SEH 10	378952	10	570	420	330	270	194	323	–	330		111
SEH 20	298181	20								500		
SEH 32	298182	32	1340	1190					500	1160		
SEH 50	298183	50										

5.3. SEM FOR SB40

Accumulator set	Part no.	Vol. [l]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	L [mm]	J [mm]
SEM 2.5	3007402	2.5	460	310	198	138	121.5	201	220	410	75	–
SEM 5	3007423	5	750	600						650		
SEM 10	3007424	10	570	420	330	270	172	310	–	330		111
SEM 20	3007425	20								500		
SEM 32	3007426	32	1340	1190					500	1160		
SEM 50	3007427	50										

SEHB



5.4. SEHB FOR SB35HB

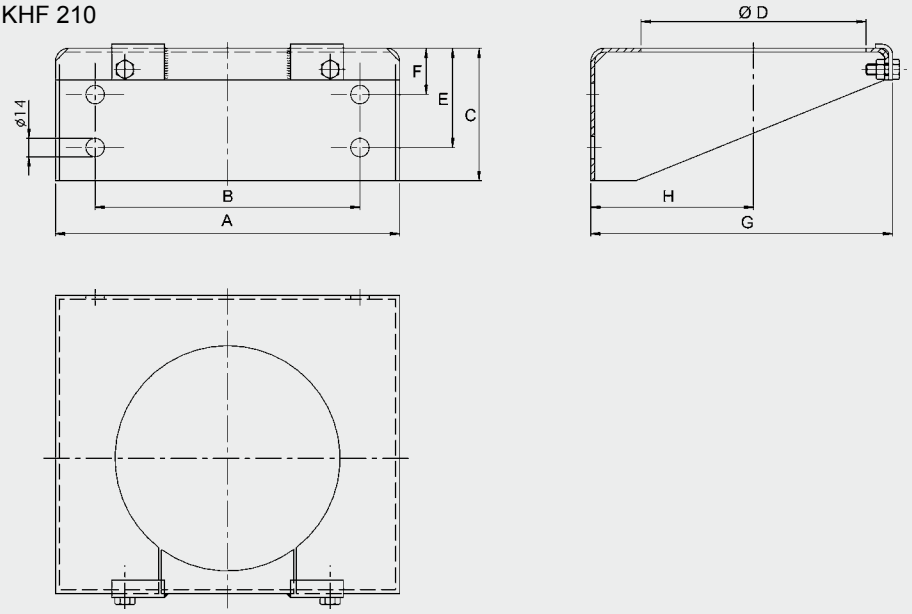
Accum-ulator set	Part no.	Vol. [l]	A [mm]	B [mm]	E [mm]	F [mm]	G [mm]	H [mm]	L [mm]	J [mm]
SEHB 20	3007431	20	570	420	172	310	–	500	75	111
SEHB 32	3007432	32	1340	1190			500	1160		
SEHB 50	3007433	50	1340	1190			500	1160		

Console	Mat.	Part no.	A [mm]	B [mm]	C [mm]	ØD [mm]	E [mm]	F [mm]	G [mm]	H [mm]	Weight [kg]
KHF 210	STZN	239965	260	200	100	170	75	35	230	123	2.5

Model/order code (example):

SEB 10	238407

KHF 210



The accumulator sets SEHF/SEHB are supplied with console KHF 210 / G which can be opened at the front for easier mounting of the bladder accumulator.

6. NOTE

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For applications and operating conditions not described, please contact the relevant technical department.
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ACCUSET SB

1. DESCRIPTION

The HYDAC accumulator unit ACCUSET SB consists of a bladder accumulator SB, a safety and shut-off block SAF and the appropriate accumulator set SEB. The parts are designed for optimum compatibility and provide a compact, ready-to-install unit.

This space-saving combination simplifies the connection of the accumulator to the hydraulic system, reduces maintenance costs and considerably reduces assembly costs.

Advantages:

- Simple and secure mounting of the accumulator at the installation site,
- Connection of the accumulator with a hydraulic system via a safety and shut-off block,
- Protects the accumulator from excessive pressure,
- Discharge of the accumulator to the tank via a pressure release valve,
- Separation of the accumulator from the system,
- Two additional hydraulic connections on the shut-off block for accessories (e.g. pressure gauge).

1.1. STANDARD BLADDER ACCUMULATOR SB330

with a nominal volume of 1 ... 50 litres.

Special accumulators available on request.

See catalogue section:

- Bladder Accumulators Standard No. 3.201

Please read the Operating Manual! No. 3.201.CE

1.2. SAFETY AND SHUT OFF BLOCK SAF

in nominal sizes 10, 20 and 32, with manual or solenoid-operated/ manual discharge and with the direct-operated pressure relief valve DB12 with CE marking, in accordance with the regulations of DIN EN 14359 “Accumulators for hydraulic applications” and the European Pressure Equipment Directive PED 97/23/EC.

See catalogue section:

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

1.3. ACCUMULATOR SET SEB

for mounting the bladder accumulator with clamps, back plate, console and rubber support ring.

See catalogue section:

- Supports for Hydraulic Accumulators No. 3.502

2. TECHNICAL SPECIFICATIONS

Design:
Pressure Equipment Directive PED 97/23/EC [1)]

Permitted operating pressure:
330 bar [1)]

Permitted temperature range:
-10 ... +80 °C (NBR) [1)]

Temperatures exceeding this range (e.g. in the event of an external fire) can result in the accumulator bursting. To prevent this, HYDAC can provide additional temperature fuses and bursting discs.

Operating medium:
Hydraulic fluids of types HL, HLP, HFA, HFB, HFC (NBR)

Pressure limit:
DB12 set to 330 bar [1)]

Release valve:
Operating voltage 24 V DC [1)]

Fluid connection P:
See table at point 5.

Surface:
Accumulator primed, SAF block phosphate-plated, accumulator set zinc-plated.

The accumulator is supplied with 5 ... 8 bar protective storage pressure. Before commissioning, the accumulator must be pre-charged using the FPU-1.

Recommendation: approx. 0.9 • p_{min} at t_{max}

See catalogue section:

- Accumulators No. 3.000

For selection of gas pre-charge pressure, see Operating Manual:

- Charging and Testing Unit FPU-1 No. 3.501

[1)] others on request

3. MODEL CODE

(also order example)

ACCUSET SB 330 – 10 A 1 / 1 1 2 U – 10 Y 1 – 330

Type of accumulator
SB = bladder accumulator

Accumulator series

Nominal volume [l]

Fluid connection
A = standard connection

Gas valve
1 = standard model

Material of fluid connection / block
1 = carbon steel
2 = stainless steel

Shell material
1 = carbon steel

Accumulator bladder/seal material
2 = NBR / NBR
3 = ECO / NBR
4 = IIR / EPDM
6 = FKM / FKM

Certification code

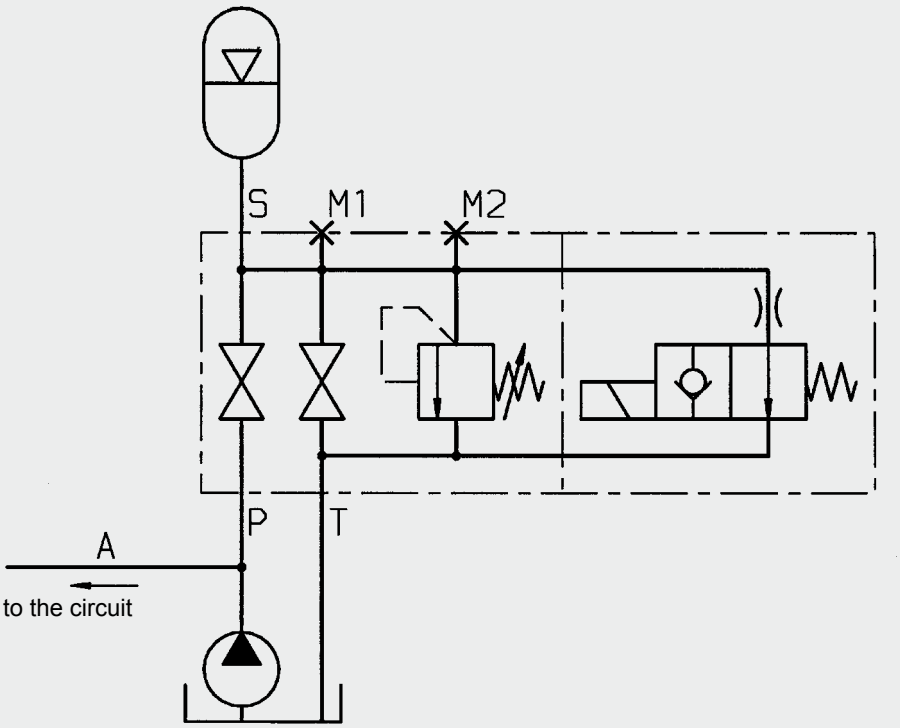
SAF block series

Type of directional poppet valve
M = manual discharge
Y = solenoid-operated and manual discharge (open when de-energised))
Z = solenoid-operated and manual discharge (closed when de-energised)

Type of voltage - directional poppet valve
1 = 24 V DC (only on Y or Z model)

Permitted operating pressure/ cracking pressure of the pressure relief valve [bar]

Circuit diagram



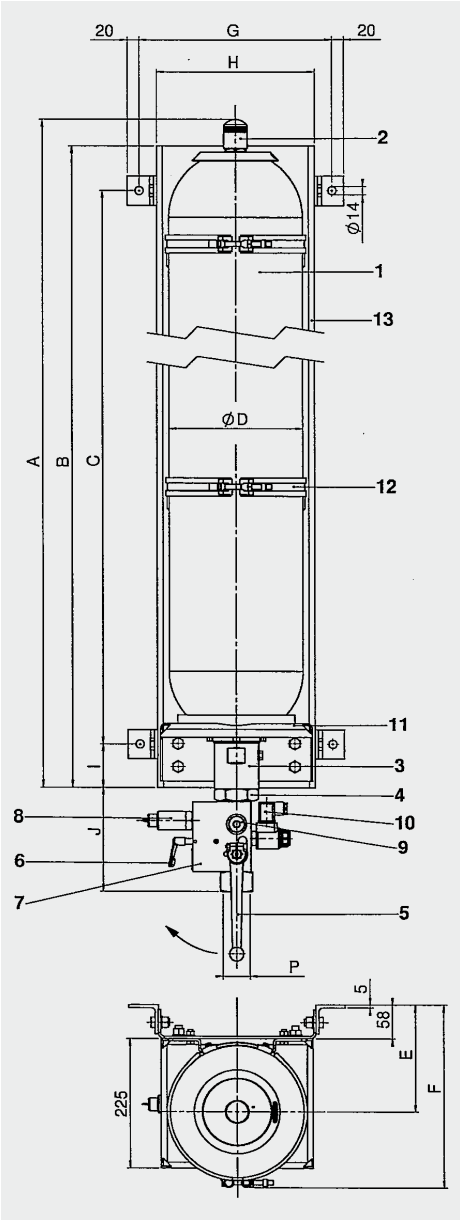
4. PREFERRED MODELS

Description	Part no.	SB330-1A1/112U-330A	SB330-2.5A1/112U-330A	SB330-4A1/112U-330A	SB330-6A1/112U-330A	SB330-10A1/112U-330A	SB330-13A1/112U-330A	SB330-20A1/112U-330A	SB330-24A1/112U-330A	SB330-32A1/112U-330A	SB330-50A1/112U-330A	SAF10M12T330A	SAF10E12Y1T330A	SAF20M12T330A	SAF20E12Y1T330A	SAF32M12T330A	SAF32E12Y1T330A
ACCUSET SB330-1A1/112U-10M-330	3033471	●										●					
ACCUSET SB330-1A1/112U-10Y1-330	3033472	●											●				
ACCUSET SB330-2.5A1/112U-10M-330	3033473		●									●					
ACCUSET SB330-2.5A1/112U-10Y1-330	3033474		●										●				
ACCUSET SB330-4A1/112U-10M-330	3033475			●								●					
ACCUSET SB330-4A1/112U-10Y1-330	3033476			●									●				
ACCUSET SB330-6A1/112U-10M-330	3033477				●							●					
ACCUSET SB330-6A1/112U-10Y1-330	3033478				●								●				
ACCUSET SB330-10A1/112U-10M-330	3033479					●						●					
ACCUSET SB330-10A1/112U-10Y1-330	3033480					●							●				
ACCUSET SB330-13A1/112U-10M-330	3033481						●					●					
ACCUSET SB330-13A1/112U-10Y1-330	3033482						●						●				
ACCUSET SB330-13A1/112U-20M-330	3033483						●							●			
ACCUSET SB330-13A1/112U-20Y1-330	3033484						●								●		
ACCUSET SB330-20A1/112U-20M-330	3033485							●						●			
ACCUSET SB330-20A1/112U-20Y1-330	3033486							●							●		
ACCUSET SB330-24A1/112U-20M-330	3033487								●					●			
ACCUSET SB330-24A1/112U-20Y1-330	3033488								●						●		
ACCUSET SB330-32A1/112U-20M-330	3033489									●				●			
ACCUSET SB330-32A1/112U-20Y1-330	3033490									●					●		
ACCUSET SB330-32A1/112U-32M-330	3033491									●						●	
ACCUSET SB330-32A1/112U-32Y1-330	3033492									●							●
ACCUSET SB330-50A1/112U-20M-330	3033493										●			●			
ACCUSET SB330-50A1/112U-20Y1-330	3033494										●				●		
ACCUSET SB330-50A1/112U-32M-330	3033495										●					●	
ACCUSET SB330-50A1/112U-32Y1-330	3033496										●						●

Other combinations and models available on request.

5. DIMENSIONS

Description	Item
Accumulator shell	1
Gas valve	2
Oil valve	3
Adapter S	4
Switching handle	5
Release spindle	6
SAF safety block	7
Pressure relief valve	8
Connection for pressure gauge	9
Release valve	10
Console	11
HyRac clamp	12
Back plate	13



Bladder accumulator	A_{max} [mm]	B [mm]	C [mm]	$ØD_{max}$ [mm]	E [mm]	F [mm]	I [mm]	G [mm]	H [mm]
SB330-1 [1]	302	–	–	118	–	–	–	–	–
SB330-2.5 [2]	532	460	310		133	214	75	198	138
SB330-4	410	410	320	173	152	265	45	330	270
SB330-6	540	570	420				75		
SB330-10	568			229	180	317			
SB330-13	660								
SB330-20	896								
SB330-24	1062								
SB330-32	1411	1340	1190						
SB330-50	1931								

[1] without back plate and console, with a HyRac clamp 110-118/124 H10 ST
[2] without console, with back plate and two HyRac clamps 110-110/124 H10 ST

SAF series	Nominal size SB330 [l]	P ISO 228	Connection for pressure gauge	J [mm]
SAF10	1	G 1/2	2 x G 1/4	142
	2.5 ... 6			143
	≥ 10			147
SAF20	1	G 1	G 1/4, G 1/2	173
	2.5 ... 6			174
	≥ 10			178
SAF32	≥ 1	G 1 1/2		203

6. NOTE

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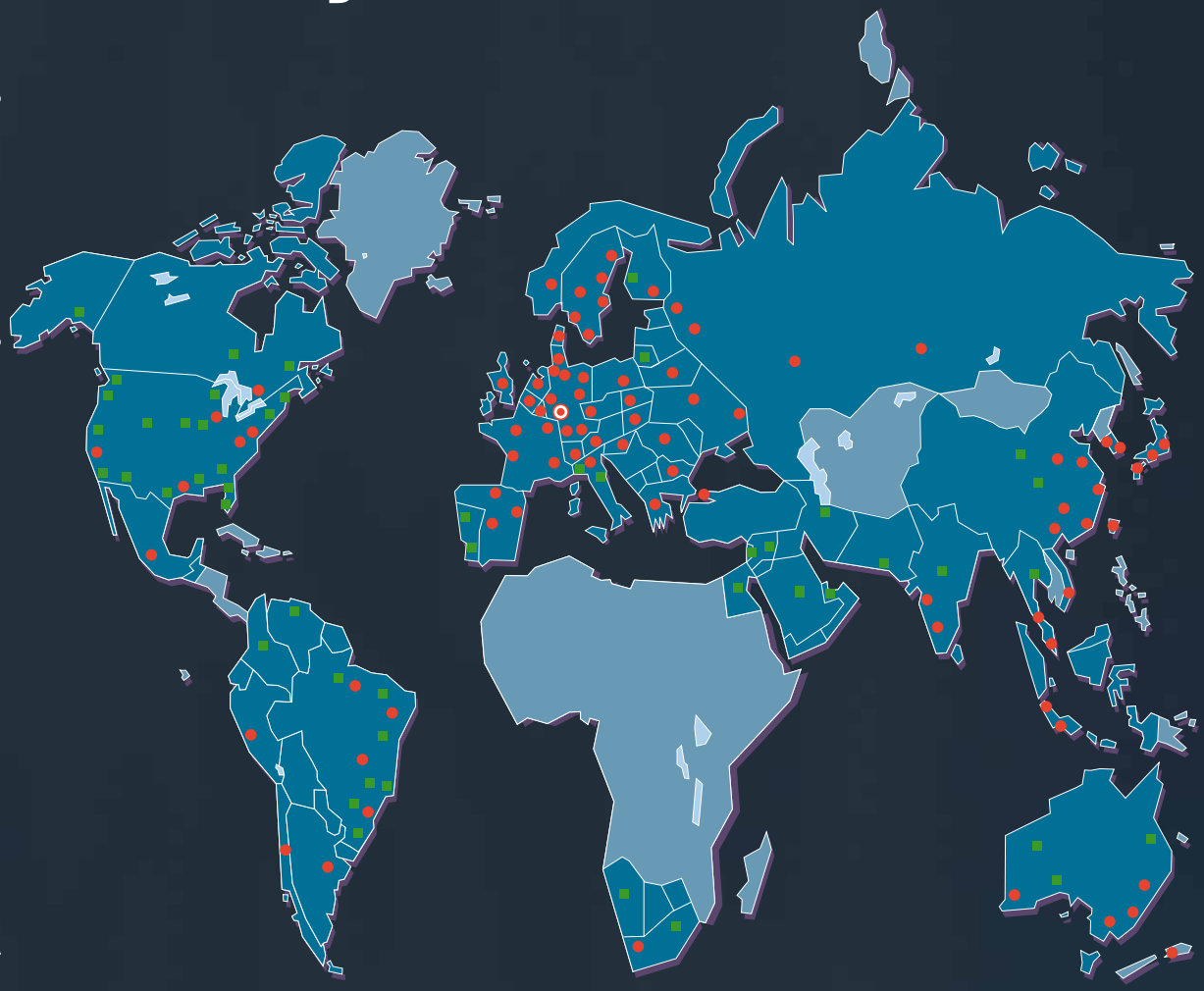

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