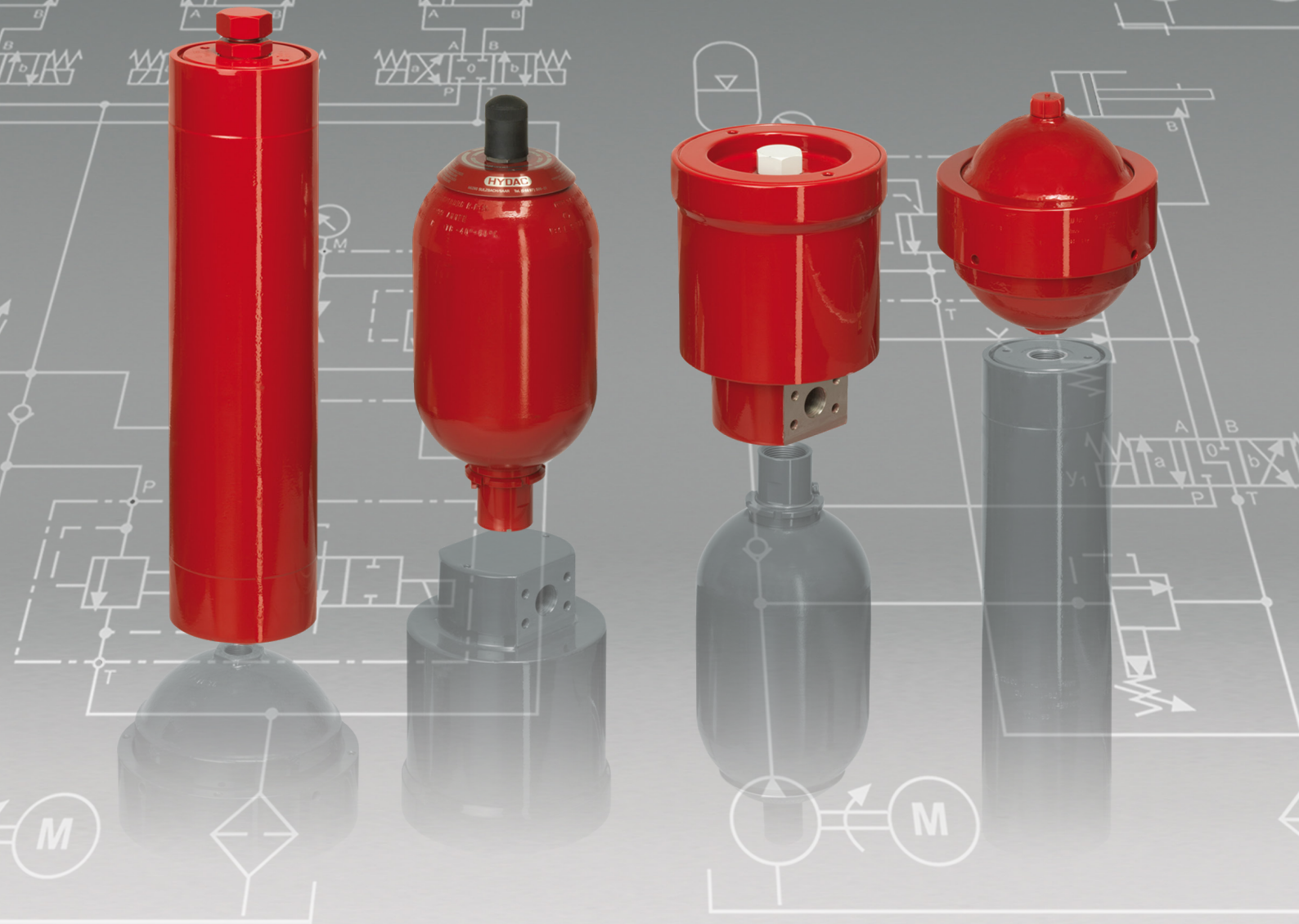
HYDAC INTERNATIONAL

Accumulator Technology. Product Catalogue.



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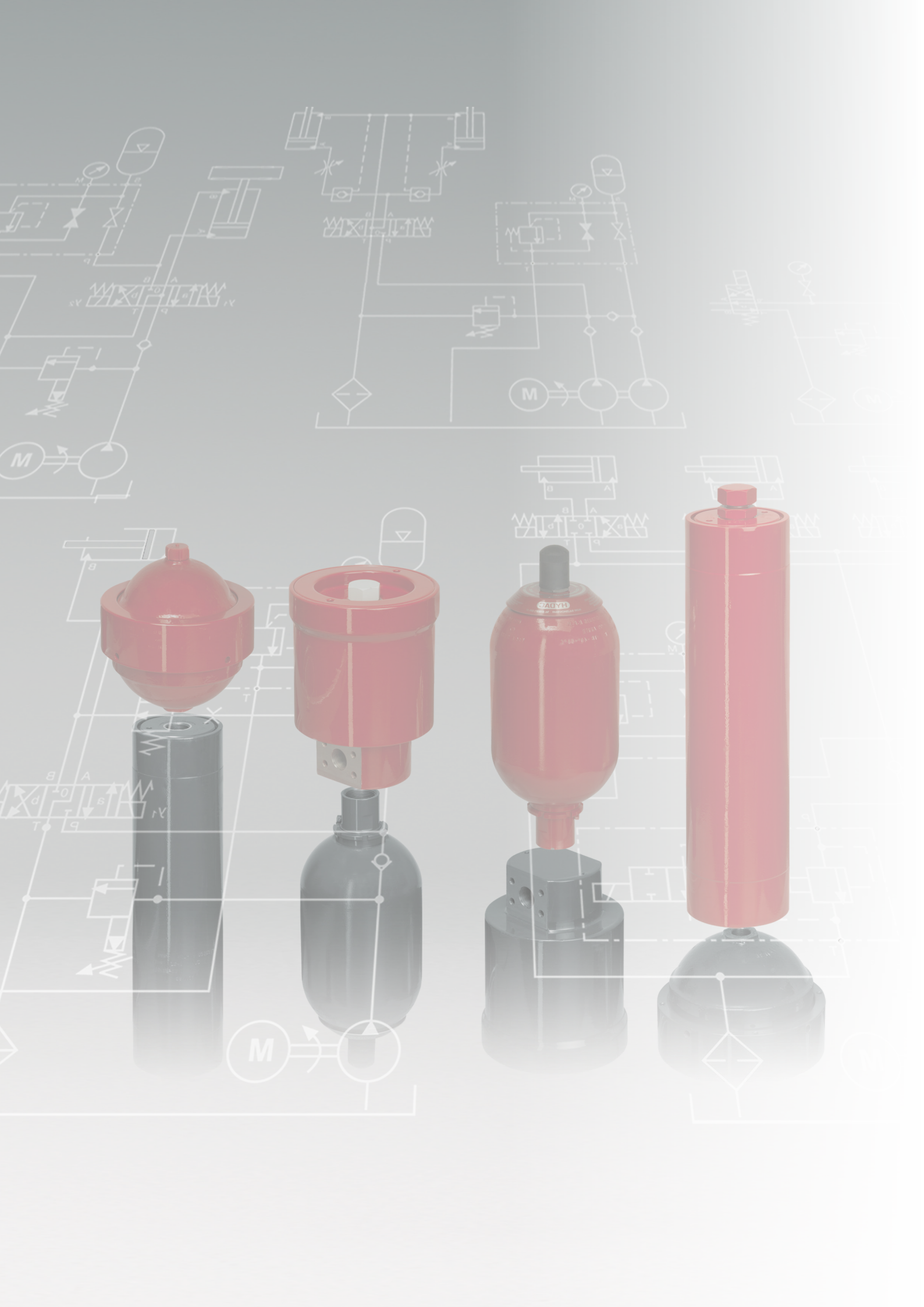


1. HYDAC ACCUMULATOR TECHNOLOGY FLUID ENGINEERING EFFICIENCY VIA ENERGY MANAGEMENT

1.1. GENERAL INFORMATION

HYDAC Accumulator Technology has many years' experience in the research & development, design and production of hydraulic accumulators.

All of HYDAC's bladder, piston, diaphragm and metal bellows accumulators are part of an unbeatable product range which supports hydraulic systems in almost all sectors at a component or unit level.

1.2. APPLICATION

The main applications of our accumulators are:

- Energy storage
- Emergency and safety functions
- Damping of vibrations, fluctuations, pulsations (pulsation dampers), shocks (shock absorbers) and noise (silencers)
- Suction flow stabilisation
- Media separation
- Volume and leakage oil adjustment
- Weight equalisation
- Energy recovery

1.3. ADVANTAGES

Accumulators improve the performance of the entire system. Here are some of their advantages in more detail:

- Improved functions
- Increased service lives
- Reductions in operating and maintenance costs
- Reductions in pulsations and noise

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

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

1.4. PARAMETERS

The following parameters are all important parameters which enable the correct accumulator size to be chosen:

- Design pressure
- Design temperature
- Fluid displacement volume
- Discharge / charging velocity
- Fluid
- Acceptance specifications
- Mounting options

Our accumulator specialists will also use their technical expertise to help you 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.

HYDAC customers can therefore be assured to receive 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.

Service, repeat testing and repairs can be carried out at the HYDAC head office or at all national and international HYDAC sales and service centres.

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 closed vessels that are designed and built to hold pressurised fluids. They are charged with nitrogen which is separated from the fluid section by a piston, bladder, diaphragm or metal bellows. Hydraulic accumulators are specifically designed to store and then discharge pressurised fluids.

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

Relevant instructions are provided in the operating instructions for our products.

Manufacturers of hydraulic accumulators and products with hydraulic accumulators must observe the following principles:

- Removal or reduction of risks, insofar as this is reasonably possible
- Implementation of appropriate protective measures against risks which cannot be eliminated
- If required, user training regarding any residual risks and the appropriate special measures for reducing these risks during installation and/or operation.

For safe handling and operation, the operator must draw up a risk assessment for the installation site which focuses on the interaction with other components and risks.

The measures which result from this risk assessment must be implemented accordingly.

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

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

3.1. RISK OF EXCESSIVE PRESSURE

Products:

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

See catalogue section:

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

Gas safety valve and gas safety block for the gas side

Burst 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 deenergised) in conjunction with temperature monitoring.

See catalogue section:

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

Temperature fuses

See catalogue section:

- Safety equipment for hydraulic accumulators
  No. 3.552

4. REGULATIONS

4.1. EUROPEAN PRESSURE EQUIPMENT DIRECTIVE (PED)

The European directive 2014/68/EU came into effect in July 2016. It replaces Directive 97/23/EC and governs the design, fabrication, conformity assessment and placing on the market of pressure equipment and assemblies with a maximum permitted pressure of more than 0.5 bar. It guarantees free movement of goods within the European Community. The EU member states are not permitted to prohibit, restrict or hinder pressure equipment being placed on the market and put into service on the basis of pressure-related risks, provided that the equipment in question meets the requirements of the European Pressure Equipment Directive, has undergone a conformity assessment and is labelled with a CE marking.

Hydraulic accumulators with a capacity of **V ≤ 1 l** and a maximum permitted pressure **PS ≤ 1000 bar** or a pressure capacity **PS • V ≤ 50 bar • l** for gases of fluid group 2 (non-hazardous fluids) are subject to article 4, section 3 of the European Pressure Equipment Directive and do not receive the CE marking.

Inspection, installation, operational safety and repeat testing of equipment 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 industrial health and safety regulations.

4.2. OTHER REGULATIONS

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

HYDAC pressure vessels can be supplied with virtually any test certificate.

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

Details of some selected approvals are as follows:

4.2.1 CERTIFICATE CODE = S (ASME)

Since 1985, HYDAC Technology GmbH has been authorised to label pressure equipment that has been manufactured in compliance with the ASME regulations with the "ASME" certification mark.

U

Such pressure equipment may be placed on the market in the jurisdiction (application area) of the National Board of Boiler and Pressure Vessel Inspectors.

4.2.2 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 authorised to manufacture and test pressure vessels for the Japanese market and to import them into Japan.

4.2.3 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.

4.2.4 CERTIFICATE CODE = A11 (KGS code)

Since concluding the registration procedure in 2012, HYDAC Technology GmbH is authorised to supply pressure vessels and safety equipment according to the Korean Gas Safety (KGS) code for Korea.

4.2.5 CERTIFICATE CODE = A6 (TR-CU)

Since 2014, the TR-CU 032/2013 regulation (technical regulation of the customs union "on the safety of pressure equipment") has applied for the countries of the Eurasian Economic Community.

HYDAC Technology GmbH has been certified in accordance with the regulation to supply its product range.

4.3. CERTIFICATES

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

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

Countries not included in the list may be possible on request. Alternative test certificates and differing values may also be possible on request.

European member states and EFTA states	Certificate code (CC)
Austria	
Belgium	
Bulgaria	
Cyprus	
Czech Republic	
Denmark	
Estonia	
Finland	
France	
Germany	
Greece	
Hungary	
Iceland	
Ireland	
Italy	U
Latvia	
Lithuania	
Luxembourg	
Malta	
Netherlands	
Norway	
Poland	
Portugal	
Romania	
Slovakia	
Slovenia	
Spain	
Sweden	
Switzerland	

A selection of other countries	Certificate code (CC)
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Japan	P
Korea (Republic of)	A11
New Zealand	T
Russia	A6
South Africa	S2
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces

Others on request

4.4. TRANSPORT REGULATIONS FOR PRESSURE VESSELS

The transport of gas-filled hydraulic accumulators must be carried out with the utmost care and in compliance with all relevant transport safety regulations (e.g. on public roads, dangerous goods regulations etc.).

The operating instructions must be observed!

5. PRODUCT OVERVIEW

The following overview shows the standard product range of HYDAC hydraulic accumulators.
For other models and sizes, please contact us.

5.1. BLADDER ACCUMULATORS

5.1.1 Low pressure

Permitted operating pressure:
up to 40 bar

Nominal volume:
2.5 ... 450 l

5.1.2 Standard design

Permitted operating pressure:
up to 550 bar

Nominal volume:
0.5 ... 200 l

5.1.3 High pressure

Permitted operating pressure:
up to 1000 bar

Nominal volume:
1 ... 50 l
Other volumes on request

Advantages of HYDAC bladder accumulators:

- High discharge speeds
- No pressure difference between the fluid side and gas side
- Compact, low-maintenance
- High charge and discharge frequencies

5.2. PISTON ACCUMULATORS

5.2.1 Standard design

Permitted operating pressure:
210 ... 350 bar

Nominal volume:
up to 3300 l

5.2.2 Series SK280

Permitted operating pressure:
280 bar

Nominal volume:
0.16 ... 15 l
Other volumes on request

5.2.3 High pressure

Permitted operating pressure:
up to 1000 bar

Nominal volume:
up to 50 l

Advantages of HYDAC piston accumulators:

- Minimal pressure difference between the fluid side and gas side
- Large effective volumes
- Variable installation positions
- Monitoring of the piston position is possible using a variety of systems
- Particularly suitable for back-up configurations
- Extreme flow rates
- No sudden discharge of gas when seals are worn

5.3. DIAPHRAGM ACCUMULATORS

Permitted operating pressure:
up to 750 bar

Nominal volume:
up to 4 l

Advantages of HYDAC diaphragm accumulators:

- Function-optimised and weight-optimised design
- Unlimited choice of installation positions
- No pressure difference between fluid and gas side
- Low-maintenance and long service life

5.4. METAL BELLOWS ACCUMULATORS

Permitted operating pressure:
40 ... 210 bar

Nominal volume:
0.16 ... 6.2 l

Other volumes on request

Advantages of the HYDAC metal bellows accumulator:

- Durable
- Wear-free
- Media resistance over a wide range of temperatures

See also flyer:

- Heavy diesel engines – Metal bellows accumulators
  No. 10.129.1

5.5. HYDRAULIC DAMPERS

Permitted operating pressure:
10 ... 1000 bar

Nominal volume:
0.075 ... 450 l

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 levels in hydraulic systems
- Lowering of servicing and maintenance costs
- Increase in service life of the system

5.6. SILENCERS

Permitted operating pressure:
up to 330 bar

Nominal volume:
0.4 ... 4.7 l

Other volumes on request

5.7. SPECIAL ACCUMULATORS

5.7.1 Weight-reduced accumulators

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

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

See also flyer:

- Weight-reduced accumulators
  No. 3.305

5.7.2 Spring accumulators

Fitted with a spring.
The energy is produced by the spring force instead of gas.

Further information on request.

Advantages of the HYDAC spring accumulator:

- No gas losses
- Linear p-V characteristic curve
- Functionality is independent of temperature influences

5.8. ACCUMULATOR STATIONS

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

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

5.9. ACCUMULATOR ACCESSORIES

5.9.1 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.

Advantages of HYDAC nitrogen bottles:

- Inexpensive increase in the accumulator volume
- This leads to smaller accumulators with the same gas volume

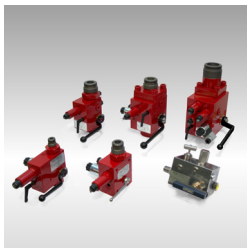
5.9.2 FPU Charging and testing unit

Charging hose, pressure gauge and pressure reducer for HYDAC and other brands of accumulator, up to 800 bar pre-charge pressure – higher pressures on request.

Further products related to "charging and testing" are available in the nitrogen charging units (N2 servers) section – see catalogue section:

- Nitrogen charging units N2-Server No. 2.201

Portable, mobile and stationary versions are available. We are always happy to give advice.



5.9.3 SAF/DSV Safety and shut-off block

Nominal size:
8 ... 50

Permitted operating pressure:
800 bar

Fluid-side protection, pressure relief valve, unloading to tank and separation of the accumulator from the fluid-side system.

Advantages of the HYDAC safety and shut-off block:

- Minimal space requirements and maintenance costs
- Minimal pipework required (as a rule, 1 SAF replaces up to 10 individual pipe connections)
- Considerable reduction in installation time
- Can be adapted to suit various different types and different brands of accumulator
- Can be adapted to additional valves (pilot-operated check valves, flow control valves, etc.)

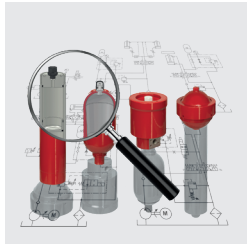
5.9.4 Safety devices

- GSV6 gas safety valve
- Temperature fuse
- Burst disc
- Gas safety block

All the above are safety equipment for HYDAC accumulator products.

Advantages of the HYDAC gas safety block:

- A gas safety block simplifies the operation of the hydraulic accumulator on the gas side and also offers the possibility of installing the above safety equipment using the various ports.



5.9.5 Monitoring systems for hydraulic accumulators

- Bladder integrity system
- Piston position monitoring systems
- Pre-charge pressure monitoring

See also flyer:

- Monitoring systems for hydraulic accumulators No. 3.506

5.9.6 Mounting elements for accumulators

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

Please make use of our online tool **Accu-MOUNT** to help you select the suitable mounting equipment for your hydraulic accumulator.

www.hydac.com » Service » Online tools » Tools for Hydraulic Accumulators

5.9.7 ACCUSET-SB

Permitted operating pressure:
330 bar

Nominal volume:
1 ... 50 l

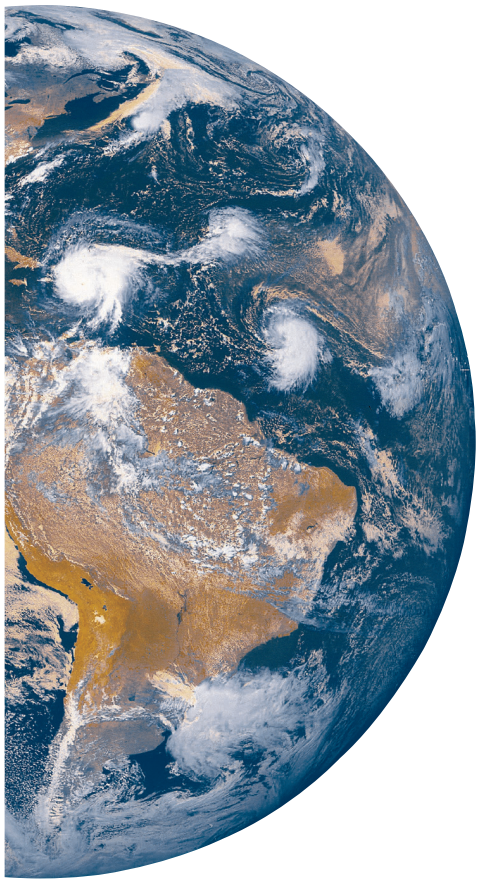
6. INDUSTRIES AND APPLICATIONS

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 the oil & gas/offshore industry and energy efficient applications involving hydraulic accumulators are gaining in importance.

The following list summarises the ways that accumulators/dampers are typically used in these industries:



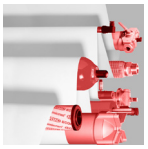
6.1. INDUSTRIAL HYDRAULICS

Automotive industry
- General industrial hydraulics, e.g. energy storage

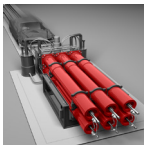
Mining machinery
- Hydraulic accumulators, e.g. in suspended monorails
- Pulsation damping
- Comfort and safety for mobile machines

Iron and steel industry
- Accumulators to maintain the pressure in rolling mills
- Blast furnace hydraulics

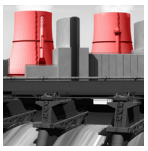
Plastics machinery
- Accumulator stations for storing energy during the injection moulding process
- Pulsation damping on the hydraulic drive



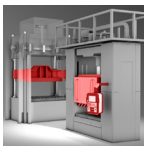
Paper industry
- Energy storage for emergency functions in friction bearing hydraulics
- Energy storage in high/low pressure power units



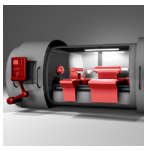
Test rigs and test systems
- Energy storage on crash test systems
- Pulsation damping on servo hydraulic axes



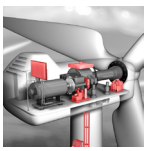
Thermal power plants
- Emergency supply for turbine control system
- Pulsation damping on pumps
- Lubrication, control and seal oil supply



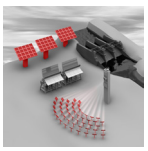
Forming machines
- Hydraulic accumulators used to store energy to support the pump



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



Wind turbines
- Hydraulic accumulators in the pitch control system
- Support of the pitch drive
- Accumulators on braking units



Solar power
- Support of hydraulic solar tracker (panel adjustment)

6.2. MOBILE TECHNOLOGY

Automotive technology

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

Construction machines

- 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 & material handling technology

- Noise damping
- Energy recovery
- Braking systems

Shipping

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

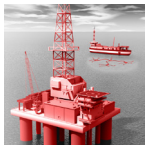
6.3. PROCESS TECHNOLOGY

Chemical industry

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

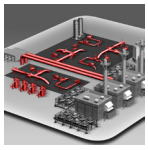
Loading stations / refineries

- Shock absorption for valve closing
- Pulsation damping on piping



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



Pipeline construction

- Energy storage for emergency actuation of valve stations
- Compressor stations

7. WEBSITE

Please visit us at: www.hydac.com

Browse the **Product catalogue** under **Hydraulic accumulators**.

Download our extensive documentation from our Download Center in the product category **Hydraulic accumulators**. You can find brochures, operating instructions, assembly and repair instructions and further product information in different languages.

CAD models are directly linked to the product and can be downloaded in the appropriate formats.

https://www.hydac.com/en/online-tools/download-center

Our online tool **ASP***light* facilitates quick and simple input, calculation and evaluation of the required accumulator parameters – see section 9.3.

Further tools, such as the **p_0-calculator** or **Accu-MOUNT** can also be found at the same location.

8. SPECIFICATION FORMS

The specification forms on the following pages are designed to help you pre-select the right hydraulic accumulator or damper for your application.

You can also do this online: download from the HYDAC product catalogue directly under **Hydraulic accumulators** as an online PDF.

The areas highlighted in green constitute the minimum information required for a response or calculation.

GENERAL ACCUMULATOR SPECIFICATION FORM (PAGE 1/2)

(Subject to technical modifications, mandatory field)

Company: _____ Location: _____

Surname, first name: _____ Project name: _____

E-mail: _____ Requirement: _____ pieces / year

Telephone no.: _____ as ☐ spare part ☐ original equipment

Accumulator type

☐ Bladder accumulator

☐ Piston accumulator

☐ Diaphragm accumulator

☐ Metal bellows accumulator

☐ _____

System data

Operating pressure

Min. _____ bar Max. _____ bar

Pre-charge pressure at 20 °C (nitrogen) [1]

_____ bar

Ambient temperature

Min. _____ °C Max. _____ °C

Operating temperature

Min. _____ °C Max. _____ °C

Complete cycle time

_____ s

Material of the accumulator [2]

Accumulator shell

_____

Fluid port

_____

Elastomer

_____

Fluids/medium

Fluid

_____

Density

Min. _____ °C _____ kg/m²

Max. _____ °C _____ kg/m²

Viscosity at 20 °C

_____ cSt

Viscosity at operating temperature

_____ cSt

Additional Information

Installation dimensions (height x Øa)

_____ mm

Fluid port

☐ Flange _____

☐ Thread _____

Gas port

☐ M28x1.5 ☐ 7/8-14UNF

☐ _____

Coating/finish

☐ Internal _____

☐ External _____

Further information

Industry

_____

Country of installation

_____

Approval

_____

Specification

_____

Fluid demand diagram

☐ 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

☐ SEVERAL pumps and/or consumers (see sheet 2, incl. example)

Remarks:

_____

_____

_____

_____

Spare parts/accessories are available at www.hydac.com » All products » Hydraulic accumulators

[1] See catalogue section No. 3.000, section on sizing

[2] Dependent on operating temperature and/or fluid resistance

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GENERAL ACCUMULATOR SPECIFICATION FORM (PAGE 2/2)

(Subject to technical modifications, mandatory field)

Fluid demand diagram for several pumps and/or consumers

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]

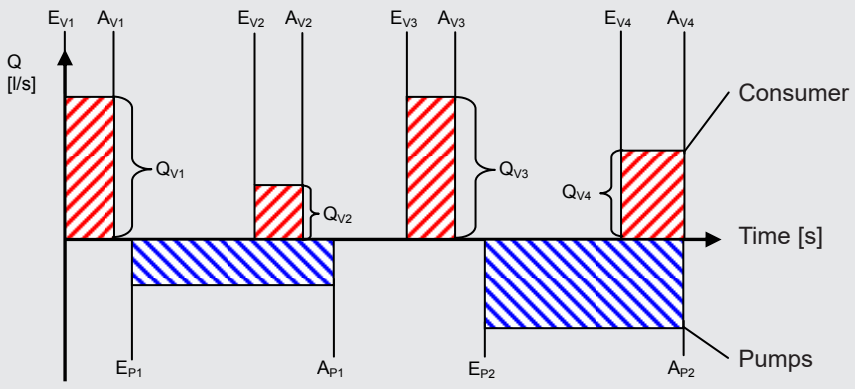
Number of consumers _____

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}= _____

Example



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EN 3.000.19/05.24

SHOCK ABSORBER SPECIFICATION FORM (SHEET 1/2)

(Subject to technical modifications, mandatory field)

Company: _____ Location: _____

Surname, first name: _____ Project name: _____

E-mail: _____ Requirement: _____ pieces / year

Telephone no.: _____ as ☐ spare part ☐ original equipment

Accumulator type

☐ Bladder accumulator

☐ Piston accumulator

☐ Diaphragm accumulator

☐ Metal bellows accumulator

☐ _____

System data

Operating pressure

Min. _____ bar Max. _____ bar

Pre-charge pressure at 20 °C (nitrogen) [1]

_____ bar

Ambient temperature

Min. _____ °C Max. _____ °C

Operating temperature

Min. _____ °C Max. _____ °C

Complete cycle time

_____ s

Material of the hydraulic accumulator [2]

Accumulator shell

_____

Fluid port

_____

Elastomer

_____

Fluids/medium

Fluid

_____

Density

Min. _____ °C _____ kg/m²

Max. _____ °C _____ kg/m²

Viscosity at 20 °C

_____ cSt

Viscosity at operating temperature

_____ cSt

Additional Information

Installation dimensions (height x Øa)

_____ mm

Fluid port

☐ Flange _____

☐ Thread _____

Gas port

☐ M28x1.5 ☐ 7/8-14UNF

☐ _____

Coating/finish

☐ Internal _____

☐ External _____

[1] See catalogue section No. 3.000, section on sizing

[2] Dependent on operating temperature and/or fluid resistance

Further information

Industry

_____

Country of installation

_____

Approval

_____

Specification

_____

Pump data

Zero-delivery head

_____ m

Pressure of the pump at the operating point

_____ bar

Flow rate of the pump at the operating point

_____ l/min

Cause of the pressure shock

☐ When pump starts

☐ When pump switches off

☐ When check valves close

☐ _____

Pipe data

Please provide pipe data on the next page.

Remarks:

_____

_____

_____

_____

Spare parts/accessories are available at www.hydac.com » All products » Hydraulic accumulators

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SHOCK ABSORBER SPECIFICATION FORM (SHEET 2/2)

(Subject to technical modifications, mandatory field)

General pipe data

Material of pipe		Total closing time of the valve	s
Max. permitted pressure of the pipe	bar	Speed of sound in the system	m/s

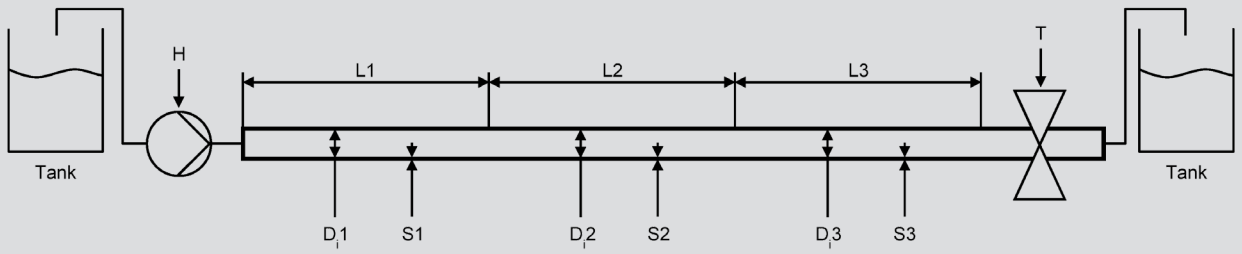
Information on pipe sections

L = Length of pipe [m]
D_i = Internal diameter of the pipe [mm]
S = Wall thickness of pipe [mm]
H = zero head of the pump [m]
T = closing time of the valve [s] (effective roughly. 30 % of the total closing time)

Number of different pipes

L1 =	m	D_i1 =	mm	S1 =	mm	L4 =	m	D_i4 =	mm	S4 =	mm
L2 =	m	D_i2 =	mm	S2 =	mm	L5 =	m	D_i5 =	mm	S5 =	mm
L3 =	m	D_i3 =	mm	S3 =	mm	L6 =	m	D_i6 =	mm	S6 =	mm

Example



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PULSATION DAMPER SPECIFICATION FORM

(Subject to technical modifications, mandatory field)

Company: _____ Location: _____

Surname, first name: _____ Project name: _____

E-mail: _____ Requirement: _____ pieces/year

Phone no.: _____ as ☐ spare part ☐ original equipment

Accumulator type

☐ Bladder accumulator

☐ Piston accumulator

☐ Diaphragm accumulator

☐ Metal bellows accumulator

☐ _____

System data

Operating pressure

Min. _____ bar Max. _____ bar

Pre-charge pressure at 20 °C (nitrogen) [1]

_____ bar

Ambient temperature

Min. _____ °C Max. _____ °C

Operating temperature

Min. _____ °C Max. _____ °C

Complete cycle time

_____ s

Material of the hydraulic accumulator [2]

Accumulator shell

_____

Fluid port

_____

Elastomer

_____

Fluids/medium

Fluid

_____

Density

Min. _____ °C _____ kg/m²

Max. _____ °C _____ kg/m²

Viscosity at 20 °C

_____ cSt

Viscosity at operating temperature

_____ cSt

Additional Information

Installation dimensions (height x Øa)

_____ mm

Fluid port

☐ Flange _____

☐ Thread _____

Gas port

☐ M28x1.5 ☐ 7/8-14UNF

☐ _____

Coating/finish

☐ Internal _____

☐ External _____

Application

☐ pressure side ☐ suction side

Required residual pulsation _____ %

Result _____ l gas volume

Further information

Industry

_____

Country of installation

_____

Approval

_____

Specification

_____

Pump and system data

Operating/pumppressure

_____ bar

Flow rate

_____ l/min

Rotational speed

_____ 1/min

Number of displacement elements _____

☐ single ☐ double acting

Pump factor _____ optional

Stroke volume

- for piston pump
  - d = Ø piston _____ mm
  - H = stroke length _____ mm
- for diaphragm pumps, see manufacturer's specifications

[1] See catalogue section No. 3.000, section on sizing

[2] Dependent on operating temperature and/or fluid resistance

Remarks:

_____

_____

_____

_____

Spare parts/accessories are available at www.hydac.com » All products » Hydraulic accumulators

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VOLUME COMPENSATION SPECIFICATION FORM

(Subject to technical modifications, mandatory field)

Company: _____ Location: _____

Surname, first name: _____ Project name: _____

E-mail: _____ Requirement: _____ pieces/year

Telephone no.: _____ as ☐ spare part ☐ original equipment

Accumulator type

☐ Bladder accumulator

☐ Piston accumulator

☐ Diaphragm accumulator

☐ Metal bellows accumulator

☐ _____

System data

Operating pressure

Min. _____ bar Max. _____ bar

Pre-charge pressure at 20 °C (nitrogen) [1]

_____ bar

Ambient temperature

Min. _____ °C Max. _____ °C

Operating temperature

Min. _____ °C Max. _____ °C

Temperature rise time

_____ min

Material of the hydraulic accumulator [2]

Accumulator shell

_____

Fluid port

_____

Elastomer

_____

Fluids/medium

Fluid

_____

Density

Min. _____ °C _____ kg/m²

Max. _____ °C _____ kg/m²

Viscosity at 20 °C

_____ cSt

Viscosity at operating temperature

_____ cSt

Volume expansion coefficient

_____ 1/°C

Additional Information

Installation dimensions (height x Øa)

_____ mm

Fluid port

☐ Flange _____

☐ Thread _____

Gas port

☐ M28x1.5 ☐ 7/8-14UNF

☐ _____

Coating/finish

☐ Internal _____

☐ External _____

Further information

Industry

_____

Country of installation

_____

Approval

_____

Specification

_____

Data on the section of the shut off pipe system

Pipe volume

_____ l

Max. shut-off pressure

_____ bar

Pipe material

_____

Permitted pressure with accumulator

_____ bar

Pipe temperature

Min. _____ °C Max. _____ °C

[1] See catalogue section No. 3.000, section on sizing

[2] Dependent on operating temperature and/or fluid resistance

Remarks:

_____

_____

_____

_____

Spare parts/accessories are available at www.hydac.com » All products » Hydraulic accumulators

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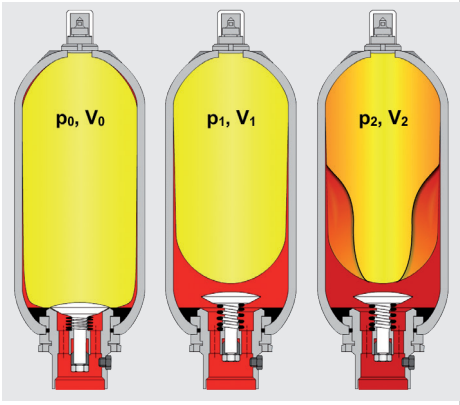
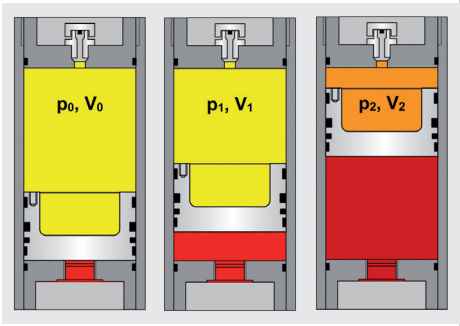
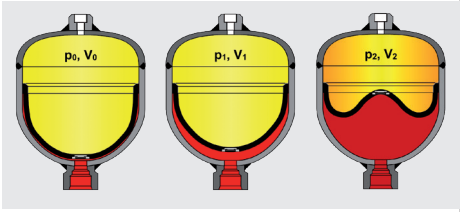
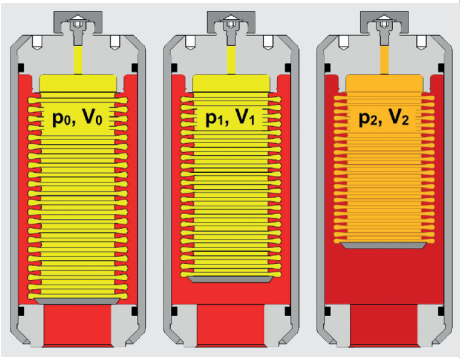
9. SIZING

9.1. DEFINITION OF VARIABLES FOR SIZING A HYDRAULIC ACCUMULATOR

Function	Limits for gas pre-charge pressure
Bladder accumulators  1. 2. 3.	p_0 ≤ 0.9 • p_1 with a permitted pressure ratio of $p_2 : p_0$ ≤ 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 accumulators  1. 2. 3.	$p_{0,tmin}$ ≥ 2 bar
Diaphragm accumulators  1. 2. 3.	a) Permitted pressure ratio: $p_2 : p_0$ <u>Weld type:</u> The pressure ratio of the weld-type diaphragm accumulators is between 4 : 1 and 8 : 1, depending on the design – see catalogue section Diaphragm accumulators, No. 3.100, section 4.2.1 <u>Screw type:</u> All sizes: 10 : 1 Other pressure ratios on request b) p_0 ≤ 0.9 • p_1
Metal bellows accumulators (e.g. corrugated bellow version)  1. 2. 3.	The max. permitted or optimal pre-charge pressure of a metal bellows accumulator (with corrugated or diaphragm bellows) must be determined for each application and each design version by providing information on the particular operating conditions and consulting with HYDAC.

The specified values are maximum values and must not be considered as referring to a prolonged load. The tolerable pressure ratio is influenced by the geometry, temperature, fluid, flow rate and gas losses caused by physical properties.

1. The accumulator is pre-charged with nitrogen. The separation element (piston, bladder, diaphragm, metal bellows) shuts off the fluid port.
2. Temperature effects must be taken into account when choosing the minimum operating pressure. The minimum operating pressure must also be higher than the gas pre-charge pressure ($p_1 > p_0$). This should prevent the separation element from striking the fluid port every time fluid is discharged.
3. Once the max. operating pressure is reached, the effective volume ΔV is available in the accumulator:

p_0 = 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 = pre-charge temperature
t_{min} = min. operating temperature
t_{max} = max. operating temperature

9.2. SELECTING THE PRE-CHARGE PRESSURE

The selection of the pre-charge pressure determines the accumulator capacity. In order to obtain optimum utilisation of the accumulator volume, the following pre-charge pressures are recommended:

9.2.1 Recommended values

For energy storage:

$p_{0,t\,max}$ = 0.9 • p_1

For shock absorption:

$p_{0,t\,max}$ = 0.6 to 0.9 • p_m

(p_m = average operating pressure for free flow)

For pulsation damping:

$p_{0,t\,max}$ = 0.6 • p_m

(p_m = average operating pressure)

or

$p_{0,t\,max}$ = 0.8 • p_1

(for several operating pressures)

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

Since the volume of the gas increases as the temperature increases, the pre-charge pressure must be determined at the maximum operating temperature using the recommended values. The accumulator must be charged with the pre-charge pressure which corresponds to the charging temperature.

9.2.2 Limits for gas pre-charge pressure

See section 9.1.

9.2.3 Temperature effect

So that the recommended 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:

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

$t_0 = t_{charge}$ (pre-charge temperature in °C)

To take the temperature influence into account when sizing accumulators, p_0 at 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. ONLINE TOOLS

The following HYDAC online tools are available at:
www.hydac.com » Service » Online tools » Tools for Hydraulic Accumulators

9.3.1 ASP*light*

ASP*light* is an intelligent application that takes the real gas behaviour into account. It enables you to calculate all the necessary parameters such as pressure, volume and temperature in different units for gases such as nitrogen or helium. Additional information fields help to evaluate the result and determine the type of accumulator.

The **ASP***light* is aimed at users who need to determine the main accumulator parameters in a short space of time.

9.3.2 p_0-calculator

The **p_0-calculator** is a simple conversion tool for determining the pre-charge pressure (p_0) in the hydraulic accumulator at a specific temperature.

All that is needed is the reference pre-charge pressure and the current temperature of the hydraulic accumulator measured on the gas side.

The **p_0-calculator** takes the real gas behaviour into account. The online tool display is optimised for both smartphones and desktops and is available online around the clock.

The **p_0-calculator** offers reliability for the inspection and any required correction of the accumulator's pre-charge pressure outside of the reference temperature.

9.3.3 Accu-MOUNT

With the **Accu-MOUNT**, the suitable clamps, consoles and accumulator mounting sets can be identified on the basis of the accumulator designation, the part number or its characteristics. These accessories can then be added to the request list.

You can also find links to the corresponding product pages on our website and download 3D models, brochures and other information.

The **Accu-Mount** can find the perfect mounting equipment for HYDAC hydraulic accumulators in an instant.

10. NOTE

The information in this brochure relates to the operating conditions and fields of application described.

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

Subject to technical modifications.

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Bladder accumulators
Low pressure

1. DESCRIPTION

1.1. FUNCTION

While fluids are practically incompressible, this does not apply to gases. Hydraulic accumulators use these basic laws of physics to store hydraulic energy. Nitrogen is normally used as the compressible medium.

The various types of hydraulic accumulator are categorised on the basis of the separation element that keeps the gas section separate from the fluid section in the pressure vessel. In the case of a bladder accumulator, the separation element is a closed elastomer bladder.

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

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

- Bladder accumulators Standard design
  No. 3.201

- Bladder Accumulators High pressure
  No. 3.203

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

- Hydraulic dampers
  No. 3.701

1.2. DESIGN

- **SB40-2.5...50 litres**
  HYDAC low pressure accumulators of the series SB40-2.5 ... 50 consist of a welded pressure vessel, the accumulator bladder with gas valve and the hydraulic connection with a perforated disc (check valve on request). In addition, we can offer suitable adapters for connection to the hydraulic system.
- **SB35HB**
  HYDAC high flow bladder accumulators in the series SB35HB are high performance accumulators with flow rates of up to 20 l/s at 2 bar Δp. They consist of a welded pressure vessel and an accumulator bladder with gas valve. The pressure vessel contains a fixed perforated disc which permits a high flow rate through its large free cross section. In addition, we can offer suitable adapters for connection to the hydraulic system.
- **SB40-70 ... 220 litres**
  HYDAC low pressure accumulators in the series SB40-70 ... 220 consist of a welded pressure vessel, an accumulator bladder with gas valve and a hydraulic connection with a check valve. In addition, we can offer suitable adapters for connection to the hydraulic system.
- **SB16/35A AND SB16/35AH**
  HYDAC low pressure bladder accumulators for large volumes have a welded design. The pressure vessel is fabricated in carbon steel or in stainless steel. The hydraulic outlet is covered by a perforated disc which prevents the flexible bladder from extruding from the shell. The bladder is top-removable.

2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

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 hydraulic accumulators must be used.

2.1.2 Bladder

The bladder material must be selected in accordance with the particular operating medium or operating temperature, see section 2.1.3. If discharge conditions are unfavourable (high p_2/p_0 pressure ratio, rapid discharge speed), the gas may cool to below the permitted temperature. This can cause cold cracking. The gas temperature can be calculated using the HYDAC Accumulator Simulation Program **ASP**.

2.1.3 Maximum temperature range of elastomer materials

The permitted working temperature of a bladder accumulator is dependent on the applications limits of the metal materials and the bladder. The operating medium must also be taken into account.
The following table shows the main **elastomer materials with their maximum possible temperature ranges** with examples of operating fluids.

Materials		Material code [1]	Max. possible temperature range [2]	Possible operating fluids, others on request	
				Resistant to	Not resistant to
NBR	Acrylonitrile butadiene rubber	2	-15 °C ... + 80 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the groups HFA, HFB, HFC – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Fuels
		5	-50 °C ... + 50 °C		
		9	-30 °C ... + 80 °C		
ECO	Ethylene oxide epichlorohydrin rubber	3	-30 °C ... +120 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the HFB group – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the groups HFA and HFC – Fuels
IIR	Butyl rubber	4	-50 °C ... +100 °C	– Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the group HFC – Water	– Mineral oils and greases – Synthetic esters (HEES) – Aliphatic, chlorinated and aromatic hydrocarbons – Fuels
FKM	Fluorine rubber	6	-10 °C ... +150 °C	– Mineral oil (HL, HLP) – Hydraulic fluids from the group HFD – Synthetic esters (HEES) – Fuels – Aromatic hydrocarbons – Inorganic acids	– Amines and ketones – Ammonia – Skydrol and HyJet IV – Steam

[1] The material code (MC) is described in more detail in the model code, see section 3.

[2] The specified temperature range relates to the particular elastomer material, not to the operating range of the hydraulic accumulator, see section 4.1.1

2.2. INSTALLATION POSITION

HYDAC bladder accumulators can be installed vertically, horizontally and at a slant. When installing vertically or at a slant, the oil valve must be at the bottom.
For certain applications listed below, particular positions are preferable:

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

If the installation position is horizontal or at a slant, the effective fluid volume and the maximum permitted flow rate of the operating fluid are reduced.
Bladder accumulators SB16A / SB35A and SB16AH / SB35AH must only be installed vertically with the gas side uppermost.

2.3. TYPE OF INSTALLATION

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

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

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. CERTIFICATES

Hydraulic accumulators that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering.
HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.
Others on request

2.6. FURTHER INFORMATION

Operating and maintenance instructions for low pressure bladder accumulators are available on request.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

SB16 A – 150 F 7 / 112 U – 40 A

Series

Type code
No details = standard
H = high flow
N = flow-optimised oil valve
A(H) = shock absorber (high flow)
B = bladder top-repairable
DA = bladder integrity system, industry version (others on request)
Combinations must be agreed with HYDAC.

Nominal volume [l]

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

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

Material code (MC)
Dependent on operating medium
Standard design = 112 or 342 for mineral oils
Others on request

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

Accumulator shell
0 = plastic (inner coating)
1 = carbon steel
2 = chem. nickel-plated (inner coating)
4 = stainless steel [2)]
6 = low temperature steel

Accumulator bladder [1) 3)]
2 = NBR [4)]
3 = ECO
4 = IIR
5 = NBR [4)]
6 = FKM
7 = other
9 = NBR [4)]

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

Permitted operating pressure [bar]

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

Flange, codes for fluid port: F
A = flange EN 1092-1
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)] When ordering a spare bladder, please state diameter of the smaller shell port
[2)] Dependent on type and pressure rating
[3)] Elastomer types not available for all bladder sizes
[4)] Observe temperature ranges, see section 2.1.

4. STANDARD ITEMS

The bladder accumulators and spare parts described below are manufactured in carbon steel and stainless steel with an NBR accumulator bladder (MC = 112/342).

The tables provide the most important data and dimensions for the series depicted.

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

4.1. TECHNICAL DATA

4.1.1 Permitted operating temperature

As standard, the products listed in the tables may be operated in the following temperature range:

-10 °C ... +80 °C

Other operating temperatures on request.

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The table in section 4.2. shows the permitted operating pressure in accordance with the European Pressure Equipment Directive.

4.1.3 Nominal volume

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

4.1.4 Effective gas volume

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

4.1.5 Effective volume

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

4.1.6 Maximum flow rate of the operating fluid

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

4.1.7 Limits for gas pre-charge pressure

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

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

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

Type SB40:	$p_{0\ max}$ = 20 bar (in model with perforated disc)
Type SB16/35A/AH:	$p_{0\ max}$ = 10 bar
Type SB35HB:	$p_{0\ max}$ = 10 bar

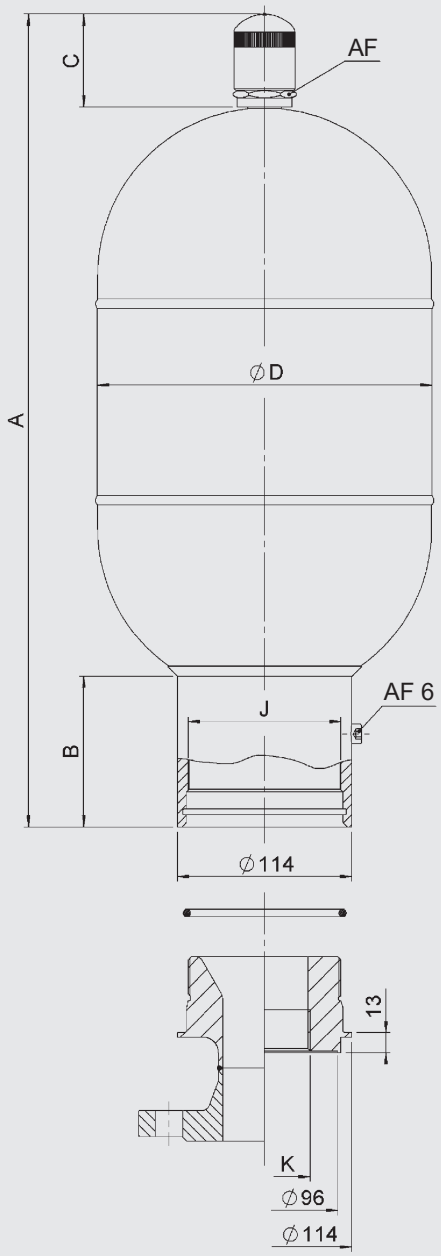
The specified values are maximum values and must not be considered as referring to a permanent load. The tolerable pressure ratio is influenced by the geometry, temperature, fluid and flow rate as well as any gas losses due to physical properties.

For more information, see catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

4.2. TABLES AND DRAWINGS

4.2.1 Series SB40-2.5 ... 50

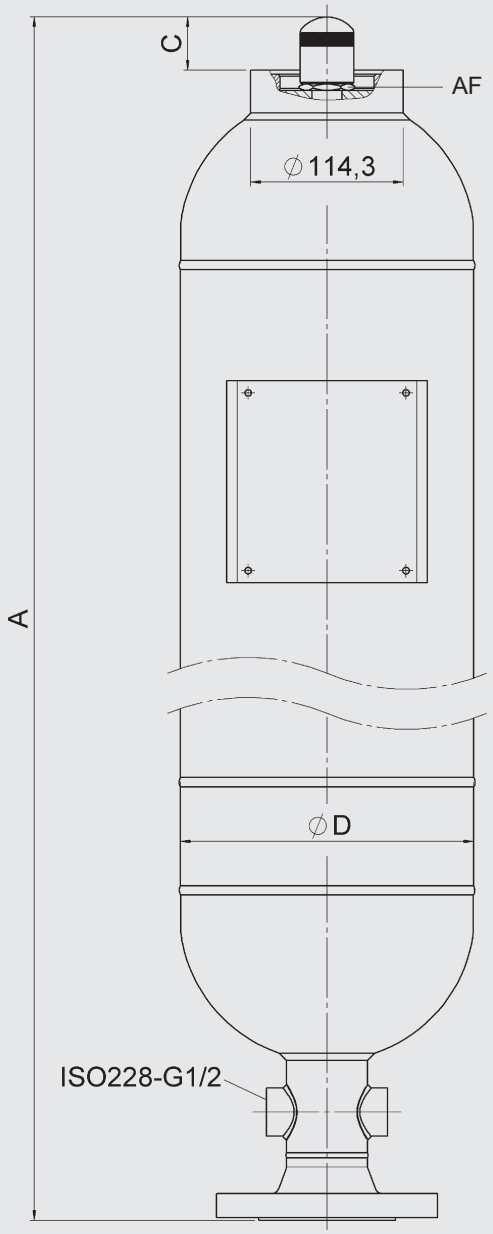


Nominal volume	Perm. operating pressure (PED)	Part no.		Eff. gas volume	A	B	C	Ø D	J thread	K thread	AF	Q_{max} [1]	Weight
		Carbon steel, NBR	Stainless steel, NBR										
[l]	[bar]			[l]	[mm]	[mm]	[mm]	[mm]	ISO DIN 13	ISO 228	[mm]	[l/s]	[kg]
2.5	40	3114684	3130528	2.5	541	122	68	108	M100x2	G 2	36	7	9
5		3113791	3118722	5	891								13
10		3111110	3125662	9.3	533	106		219					14
20		3125719	3130529	18	843								23
32		3130487	3130530	33.5	1363								38
50		3119445	3130531	48.6	1875		78				68 [2]		52

[1] Approx. 0.5 bar pressure drop via connection

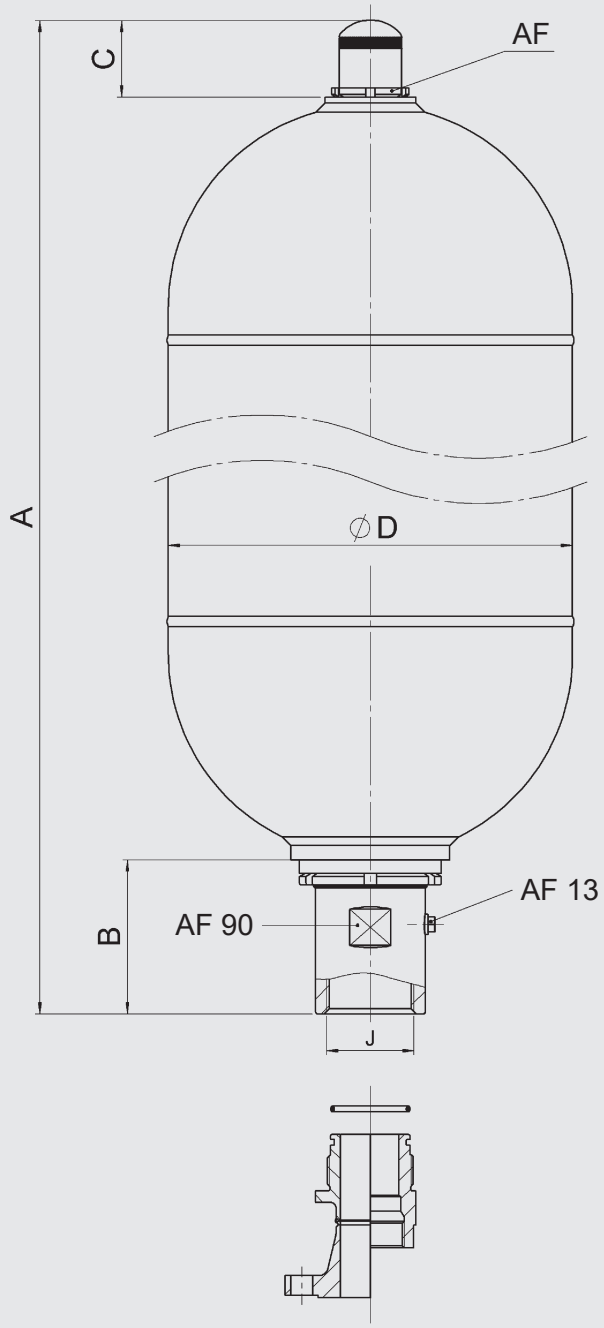
[2] Use C-spanner

4.2.2 SB35HB



Nominal volume	Perm. operating pressure (PED)	Part no.		Eff. gas volume	A max.	C	Ø D	AF	Q_{max}	DN [1]	Weight
		Carbon steel, NBR	Stainless steel, NBR								
[l]	[bar]			[l]	[mm]	[mm]	[mm]	[mm]	[l/s]		[kg]
20	35	3130682	3130683	19.8	1081	63	219	36	20	50	43
32		3130684	3130685	35	1591						56
50		3130686	3130687	50	2091	78		Ø 68 [2]			69

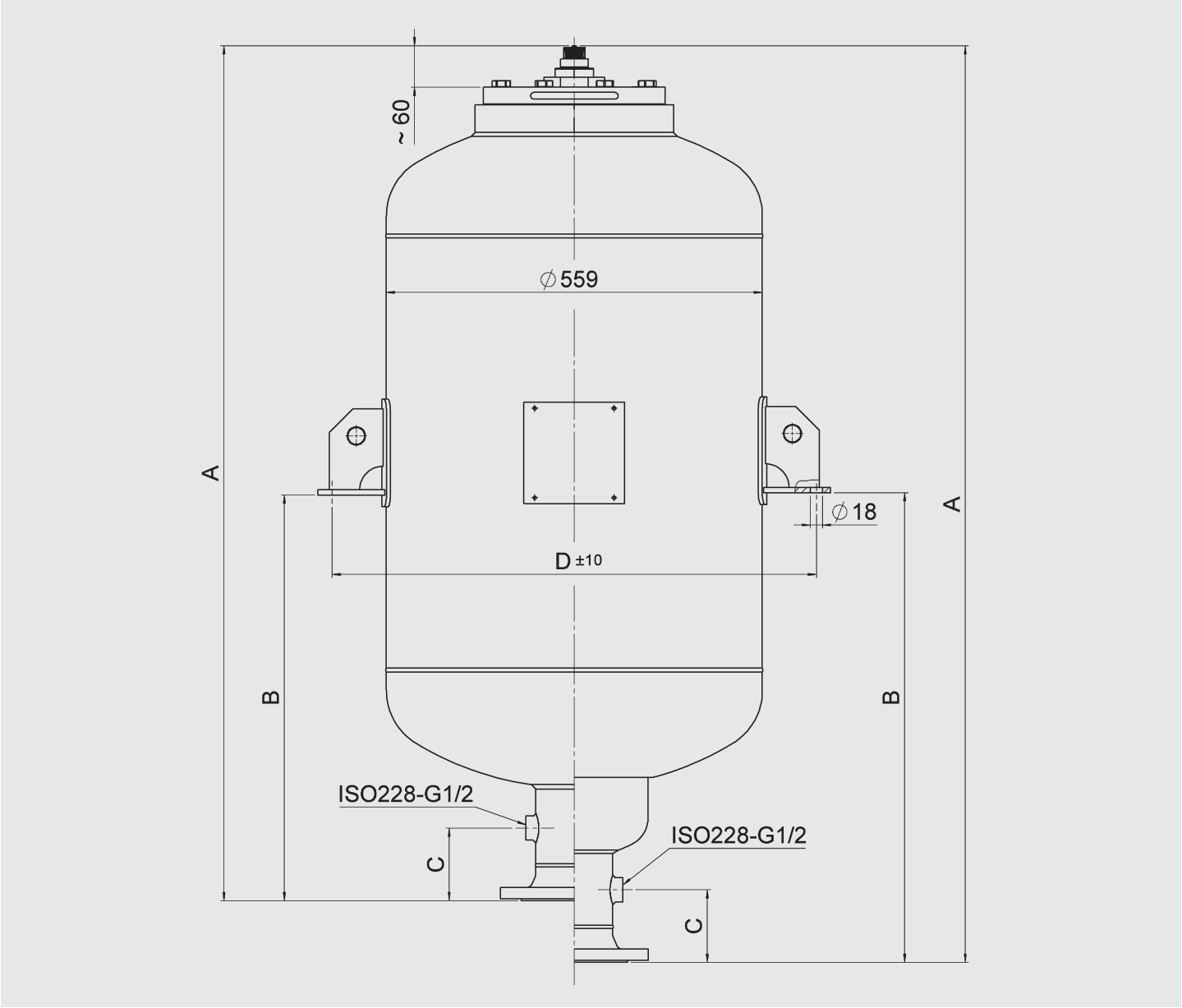
[1] To EN 1092-1/11 / PN40, others on request
[2] Groove nut



Nominal volume [l]	Perm. operating pressure (PED) [bar]	Part no. Carbon steel, NBR	Part no. Stainless steel, NBR	Eff. gas volume [l]	A max. [mm]	B [mm]	C [mm]	Ø D [mm]	J thread ISO 228	AF [mm]	Q_{max} [l/s]	Weight [kg]
70	40	2127513	2127533	65	1128	136	69	356	G 2 1/2	68 [1]	30	73
100		2127514	2127534	111	1655							99
130		2127515	2127535	133	1905							130
190		3182579	3182581	192	2101			406				175
220		3182582	3182583	221	2348							197

[1] Use C-spanner

4.2.4 SB16/35A, SB16/35AH

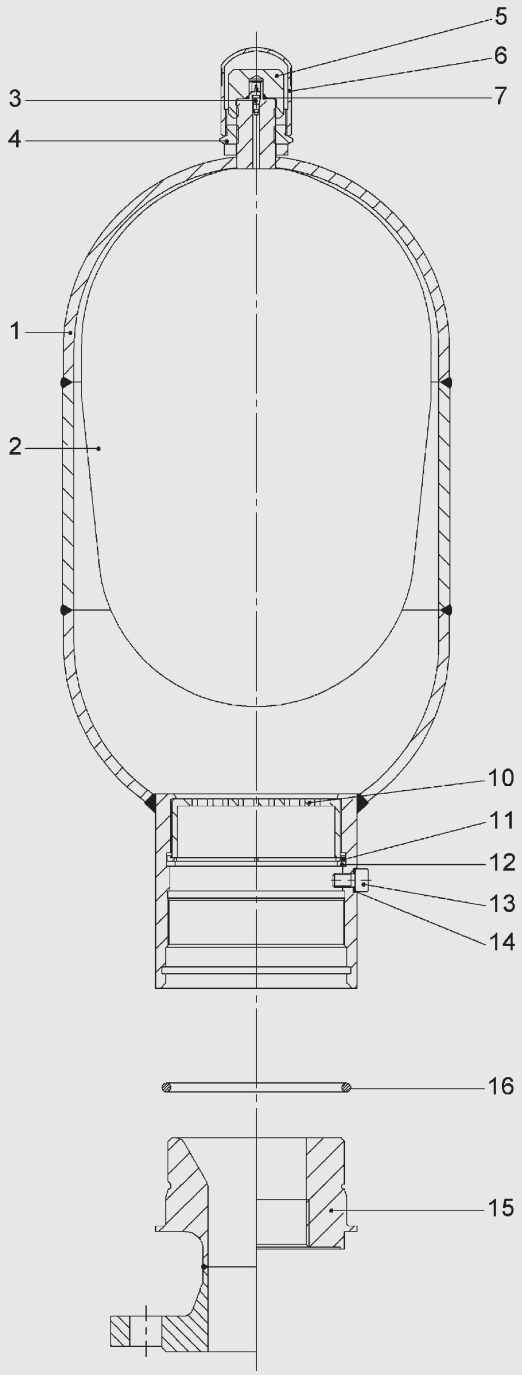


Series	Nominal volume [l]	Perm. operating pressure (PED) [bar]	Part no. Carbon steel, NBR	Part no. Stainless steel, NBR	Eff. gas volume [l]	A (approx.) [mm]	B (approx.) [mm]	C (approx.) [mm]	D ±10 [mm]	Weight [kg]
	150		4108288	4108241	149	1044	493			127
	200		4108290	4093557	203	1275	691			149
SB16A	300	16	4108291	4108242	288	1644	920	108	720	178
	375		4108292	4108243	374	2020	1063			214
	450		4108294	4108244	453	2361	1234			244
	150		4108339	4108306	149	1076	578			171
	200		4108341	4108307	203	1318	699			208
SB35A	300	35	4108342	4108308	288	1701	937	121	728	261
	375		4108355	4108312	374	2086	1083			315
	450		4108357	4108314	453	2436	1258			364
	150		4108720	4108702	149	1135	638			135
	200		4108721	4108703	203	1366	754			157
SB16AH	300	16	4108724	4108715	288	1735	988	108	720	186
	375		4108725	4108717	374	2111	1127			222
	450		4108726	4108718	453	2452	1298			252
	150		4108773	4108729	149	1166	641			180
	200		4108775	4108730	203	1408	762			217
SB35AH	300	35	4108774	4108734	288	1791	1000	121	728	270
	375		4108776	4108758	374	2176	1146			324
	450		4108778	4108762	453	2526	1321			373

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

4.3. SPARE PARTS

4.3.1 SB40-2.5 ... 50



Description	Item
Bladder assembly [1] consisting of:	
Bladder	2
Gas valve insert [2]	3
Lock nut	4
Seal cap	5
Protective cap	6
O-ring	7
Seal kit consisting of:	
O-ring	7
Vent screw	13
Seal ring	14
O-ring	16
Hydraulic connection assembly consisting of:	
Hydraulic connector	10
Anti-extrusion ring	11
Retaining ring	12
Vent screw	13
Seal ring	14

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

[2] Available separately

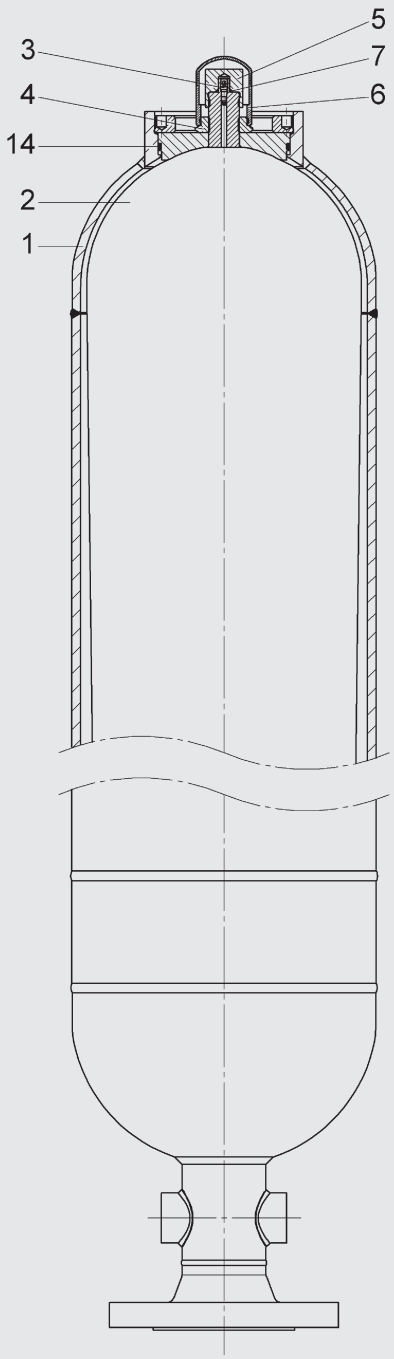
Accumulator shell (item 1) not available as spare part

Adapter (item 15) incl. O-ring (item 16) available as accessory, please ask

Carbon steel, NBR				
Nominal volume [l]	Bladder assembly	Seal kit	Hydraulic connector assembly	Gas valve insert
2.5	236171	3951615	2106751	632865
5	240917			
10	236088			
20	236089			
32	235335			
50	235290			

Stainless steel, NBR				
Nominal volume [l]	Bladder assembly	Seal kit	Hydraulic connector assembly	Gas valve insert
2.5	356019	4102701	2115039	632865
5	2123155			
10	356022			
20	4611049			
32	3259250			
50	356025			

4.3.2 SB35HB



Description	Item
Bladder assembly [1] consisting of:	
Bladder	2
Gas valve insert [2]	3
Lock nut	4
Seal cap	5
Protective cap	6
O-ring	7
Seal kit consisting of:	
Gas valve insert [2]	3
O-ring	7
O-ring	14

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

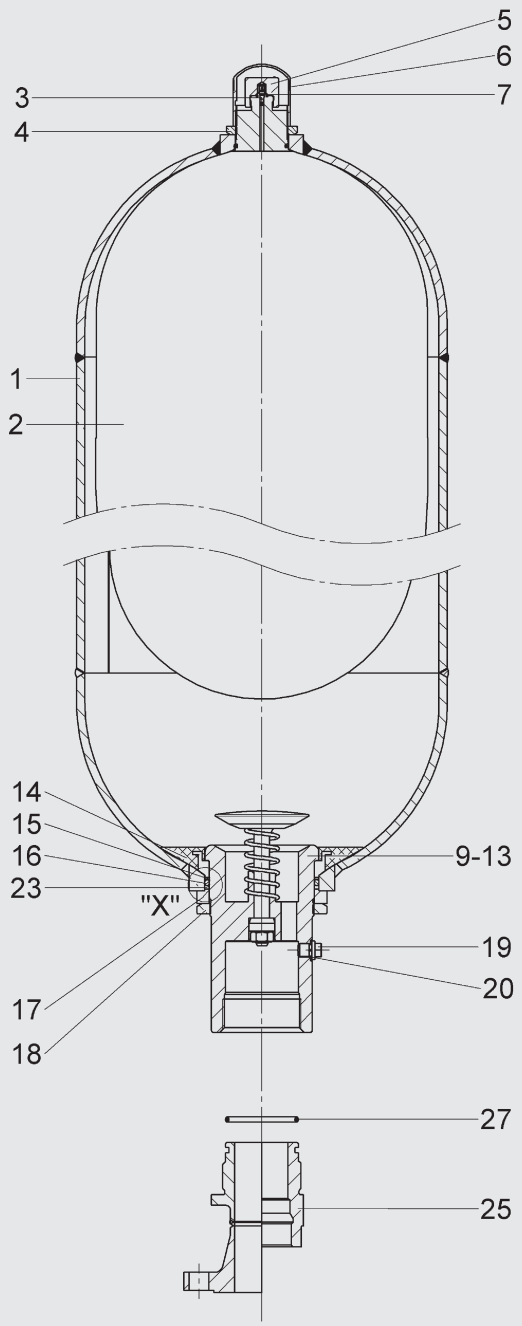
[2] Available separately

Accumulator shell (item 1) not available as spare part

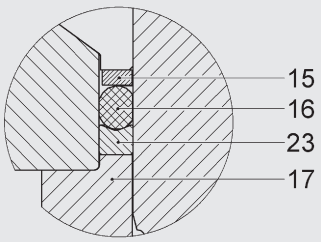
Carbon steel, NBR			
Nominal volume [l]	Bladder assembly	Seal kit	Gas valve insert
20	236089	2125204	2125204
32	235335		
50	376257		

Stainless steel, NBR			
Nominal volume [l]	Bladder assembly	Seal kit	Gas valve insert
20	4611049	2125204	632865
32	3259250		
50	4747510		

4.3.3 SB40-70 ... 220



Detail "X"



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

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

[2] Available separately

Accumulator shell (item 1) not available as spare part

Vent screw (item 19) for NBR/carbon steel: Seal ring (item 20) included

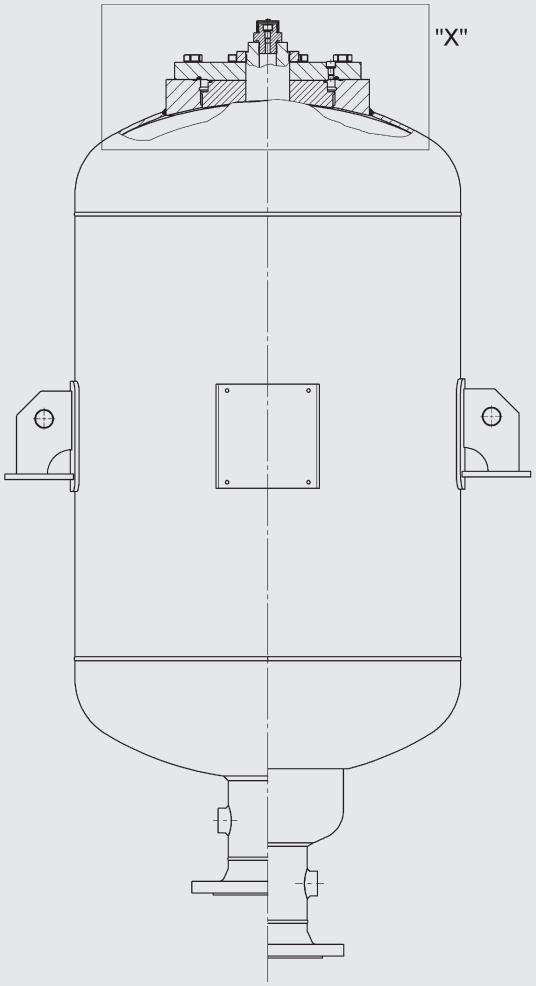
Adapter (item 25) incl. O-ring (item 27) available as accessory, please ask

Carbon steel, NBR					
Nominal volume [l]	Bladder assembly	Seal kit	Oil valve assembly	Anti-extrusion ring	Gas valve insert
70	3364274	4126907	3273734	3102326	632865
100	3127313				
130	4583554				
190	3640698				
220	3461300				

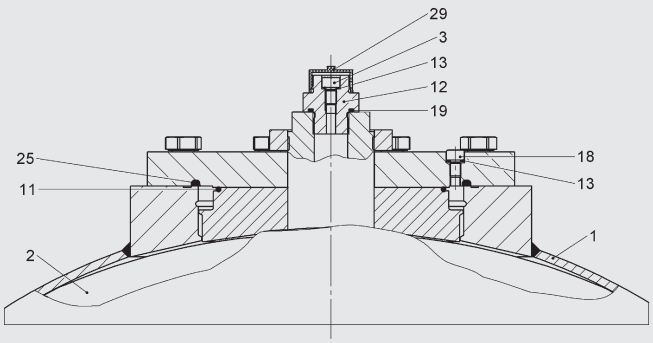
Stainless steel, NBR					
Nominal volume [l]	Bladder assembly	Seal kit	Oil valve assembly	Anti-extrusion ring	Gas valve insert
70	3143382	3102124	3891165	3099934	632865
100	3176772				
130	3143388				
190	3143389				
220	3143390				

4.3.4 SB16/35A, SB16/35AH

The following spare parts relate exclusively to hydraulic accumulators from the construction year 2016 and later. For low-pressure bladder accumulators SB16/35A and SB16/35AH with construction year < 2016, spare parts are available on request.



Detail "X"



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

Accumulator shell (item 1) not available as spare part

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

5. NOTE

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

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Bladder accumulators
Standard design

1. DESCRIPTION

1.1. FUNCTION

While fluids are practically incompressible, this does not apply to gases. Hydraulic accumulators use these basic laws of physics to store hydraulic energy. Nitrogen is normally used as the compressible medium.

The various types of hydraulic accumulator are categorised on the basis of the separation element that keeps the gas section separate from the fluid section in the pressure vessel. In the case of a bladder accumulator, the separation element is a closed elastomer bladder.

The fluid side of the bladder accumulator is connected to the hydraulic circuit so that the bladder accumulator draws in fluid when the system pressure increases and the trapped gas is compressed.

When the system pressure drops, the compressed gas expands and forces the stored fluid back out into the hydraulic circuit.

HYDAC bladder accumulators are available in various designs – see catalogue sections:

- Bladder accumulators Low pressure
  No. 3.202

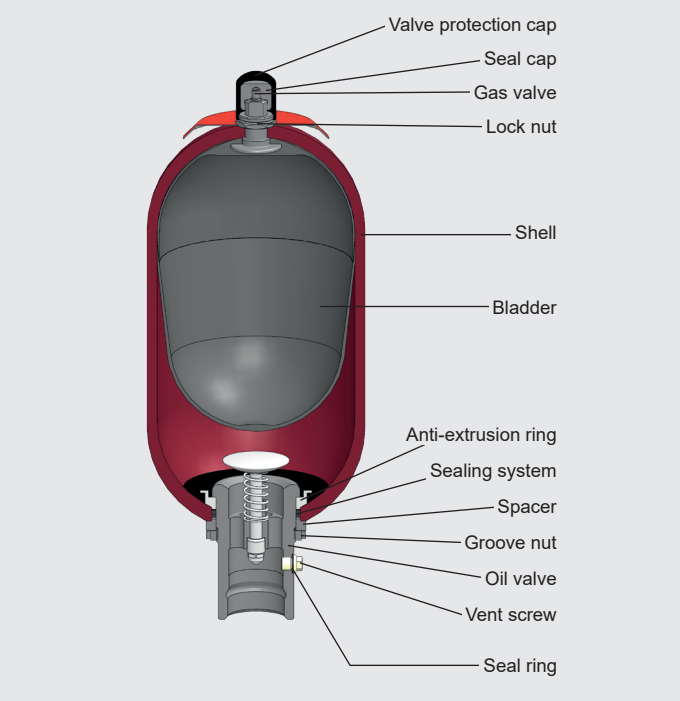
- Bladder accumulators High pressure
  No. 3.203

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

- Hydraulic dampers
  No. 3.701

1.2. DESIGN

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

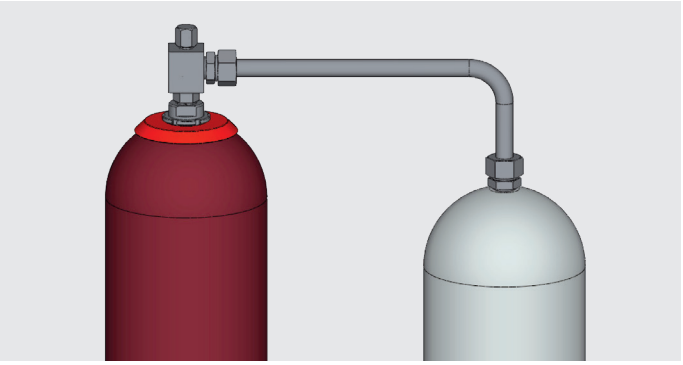


- **SB330N**
  The flow-optimised design of the standard oil valve enables the maximum possible operating fluid flow rate to increase to 25 l/s with this accumulator type.
- **SB330H (High Flow)**
  HYDAC high flow bladder accumulators type SB330 are high performance accumulators with a flow rate of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

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

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

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



2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

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

2.1.2 Bladder

The bladder material must be selected in accordance with the particular operating medium or operating temperature, see section 2.1.3.
If discharge conditions are unfavourable (high p_2/p_0 pressure ratio, rapid discharge speed), the gas may cool to below the permitted temperature. This can cause cold cracking. The gas temperature can be calculated using the HYDAC Accumulator Simulation Program **ASP**.

2.1.3 Maximum temperature range of elastomer materials

The permitted working temperature of a bladder accumulator is dependent on the applications limits of the metal materials and the bladder. The operating medium must also be taken into account.
The following table shows the main **elastomer materials with their maximum possible temperature ranges** with examples of operating fluids.

Materials		Material code [1]	Max. possible temperature range [2]	Possible operating fluids, others on request	
				Resistant to	Not resistant to
NBR	Acrylonitrile butadiene rubber	2	-15 °C ... + 80 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the groups HFA, HFB, HFC – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Fuels
		5	-50 °C ... + 50 °C		
		9	-30 °C ... + 80 °C		
ECO	Ethylene oxide epichlorohydrin rubber	3	-30 °C ... +120 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the HFB group – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the groups HFA and HFC – Fuels
IIR	Butyl rubber	4	-50 °C ... +100 °C	– Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the group HFC – Water	– Mineral oils and mineral greases – Synthetic esters (HEES) – Aliphatic, chlorinated and aromatic hydrocarbons – Fuels
FKM	Fluorine rubber	6	-10 °C ... +150 °C	– Mineral oil (HL, HLP) – Hydraulic fluids from the group HFD – Synthetic esters (HEES) – Fuels – Aromatic hydrocarbons – Inorganic acids	– Amines and ketones – Ammonia – Skydrol and HyJet IV – Steam

[1] The material code (MC) is described in more detail in the model code, see section 3.

[2] The specified temperature range relates to the particular elastomer material, not to the operating range of the hydraulic accumulator, see section 4.1.1

2.2. INSTALLATION POSITION

HYDAC bladder accumulators can be installed vertically, horizontally and at a slant. When installing vertically or at a slant, the oil valve must be at the bottom.
For certain applications listed below, particular positions are preferable:

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

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

2.3. TYPE OF INSTALLATION

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

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

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

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. CERTIFICATES

Hydraulic accumulators that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering.
HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.

Others on request

2.6. FURTHER INFORMATION

- Operating instructions for bladder accumulators
  No. 3.201.BA

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

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

For repairs to be performed on hydraulic accumulators, we provide corresponding assembly and repair instructions.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

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

Series

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

Nominal volume [l]

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

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

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

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

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

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

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

Permitted operating pressure [bar]

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

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

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

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

4. STANDARD ITEMS

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

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

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

4.1. TECHNICAL DATA

4.1.1 Permitted operating temperature

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

-10 °C ... +80 °C

Other operating temperatures on request.

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The table in section 4.2. shows the permitted operating pressures for the listed certification codes.

4.1.3 Nominal volume

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

4.1.4 Effective gas volume

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

4.1.5 Effective volume

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

4.1.6 Maximum flow rate of the operating fluid

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

4.1.7 Limits for gas pre-charge pressure

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

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

The specified values are maximum values and must not be considered as referring to a permanent load. The tolerable pressure ratio is influenced by the geometry, temperature, fluid and flow rate as well as any gas losses due to physical properties.

For more information, see catalogue section:

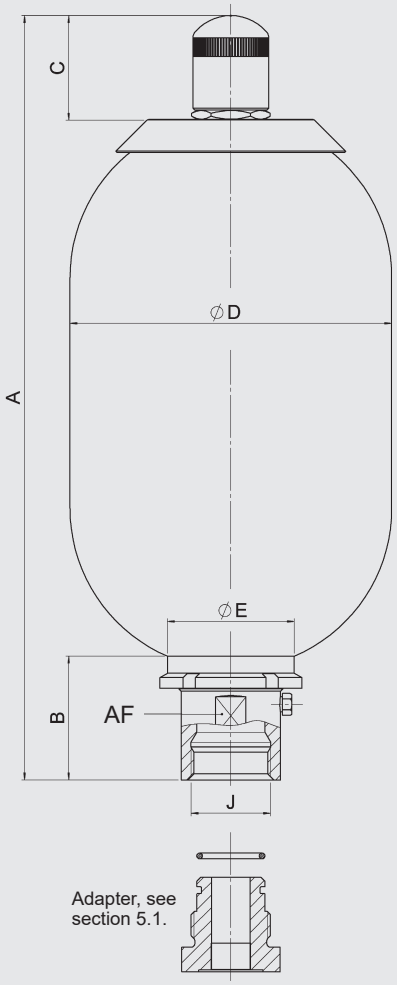
- HYDAC Accumulator Technology
  No. 3.000

4.1.8 Gas side connection

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

Other pressure ratings on request

4.2. TABLES AND DRAWINGS



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

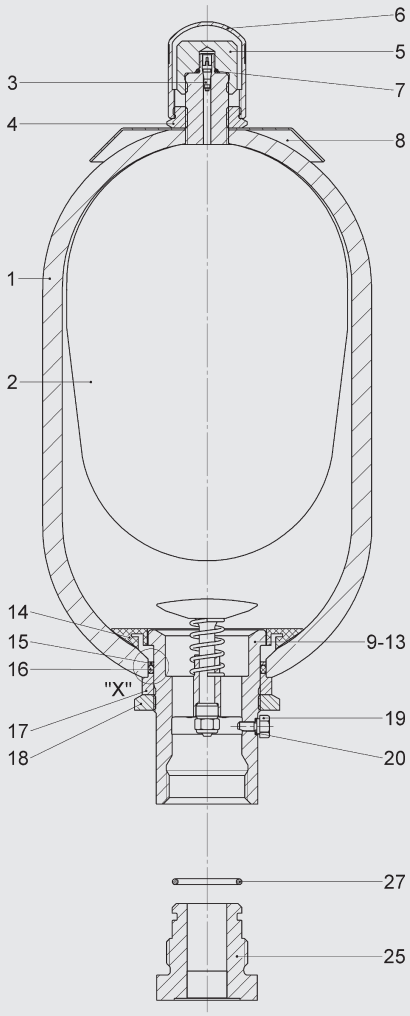
[1] If not specified, please request

[2] Under optimum conditions

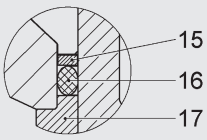
[3] Slimline version, for confined installation spaces

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

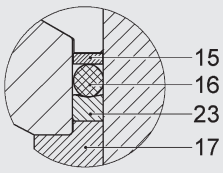
4.3. SPARE PARTS



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



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



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

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

SB330/400, standard gas valve

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

Others on request

[1] Only for SB400

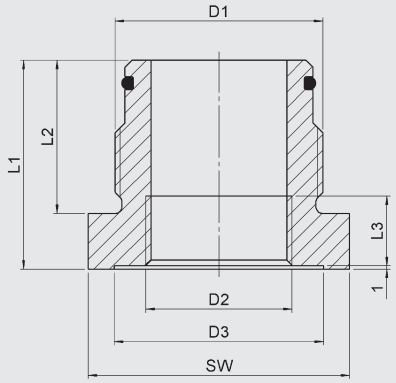
[2] Slimline version, for confined installation spaces

[3] Only for SB330

5. ACCESSORIES

5.1. ADAPTERS FOR STANDARD BLADDER ACCUMULATORS (FLUID SIDE)

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



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

* Others on request

5.2. ADAPTERS (GAS SIDE)

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

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

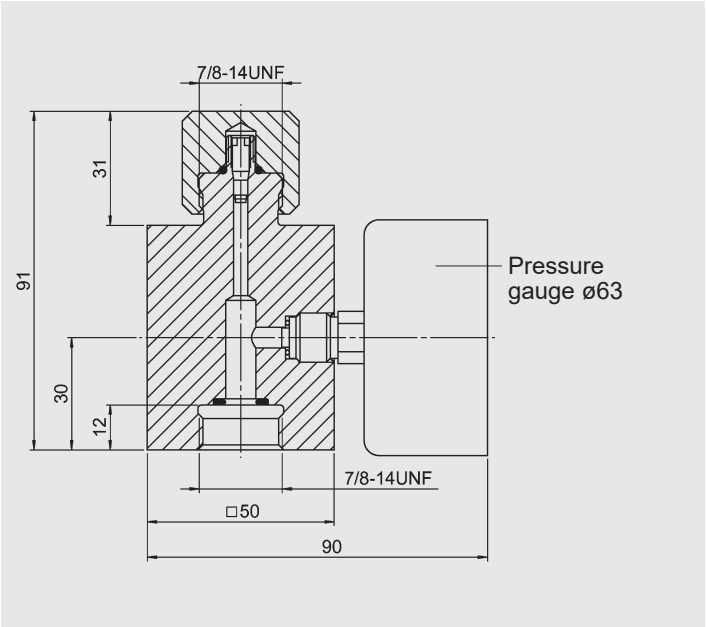
5.2.1 Adapter for safety devices

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

- Safety equipment for hydraulic accumulators No. 3.552

5.2.2 Pressure gauge model

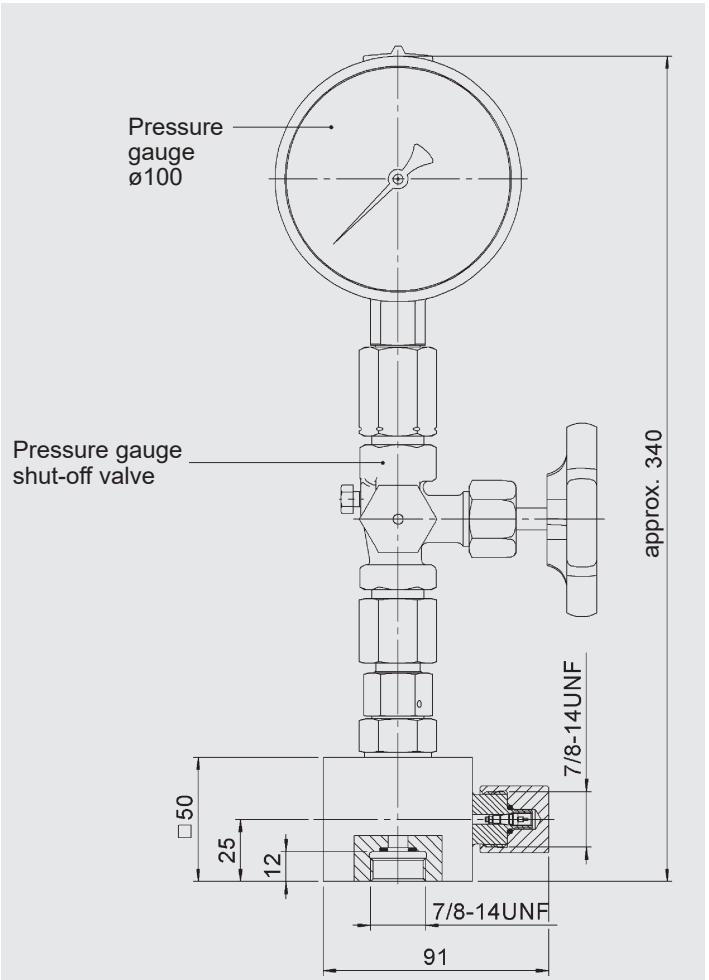
Gas-side connection on the bladder accumulator for permanent monitoring of the pre-charge pressure.



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

5.2.3 Pressure gauge model with shut-off valve

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

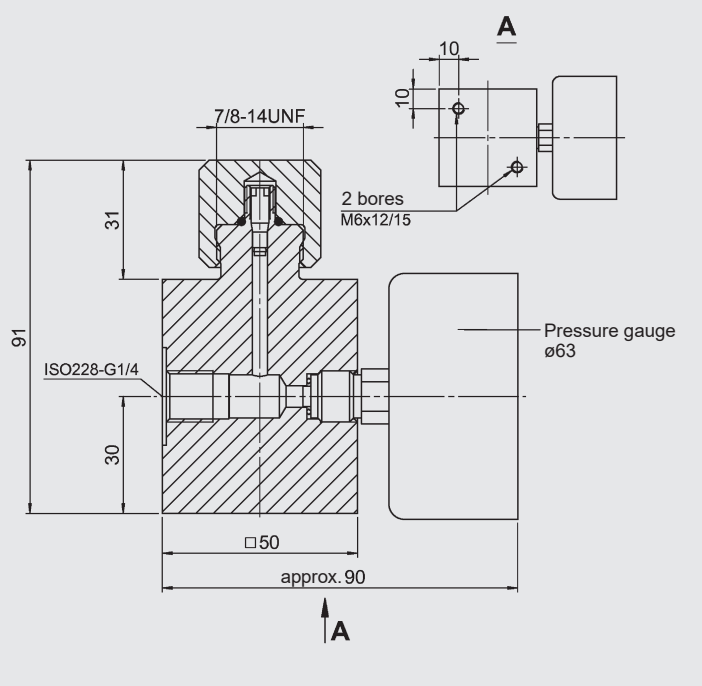


Gauge indication range	Pressure gauge Part no.	Adapter assembly Part no.
–	–	2103381
0 - 25 bar	617928	3784725
0 - 60 bar	606771	2110059
0 - 100 bar	606772	3139314
0 - 160 bar	606773	3202970
0 - 250 bar	606774	3194154
0 - 400 bar	606775	2103226

5.2.4 Remote monitoring of the pre-charge pressure

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

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



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

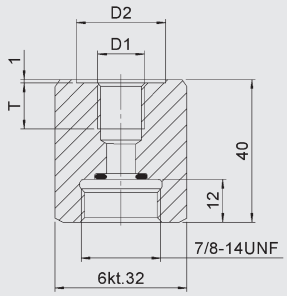


Fig 1

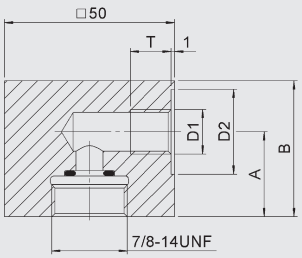


Fig 2

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

5.3. TRANSPORT EQUIPMENT FOR BLADDER ACCUMULATORS

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

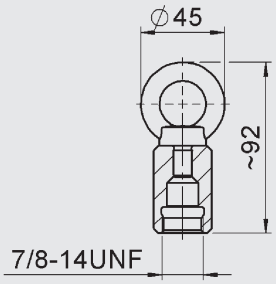


Fig. 1

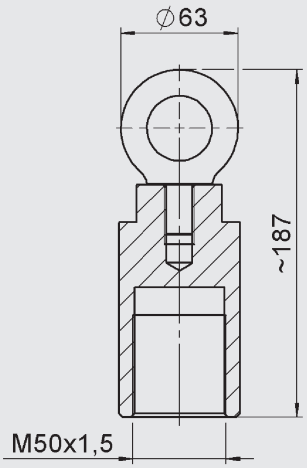


Fig. 2

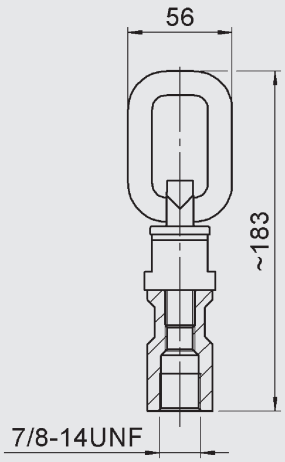


Fig. 3

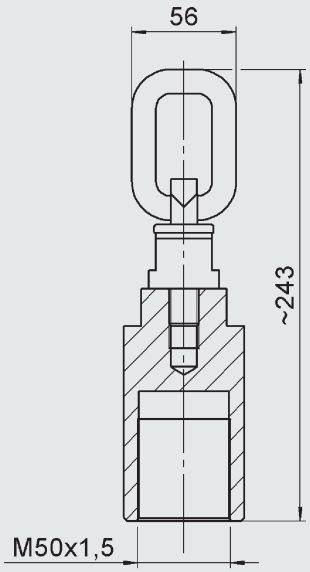


Fig. 4

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

Others on request

6. NOTE

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

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Bladder accumulators
High pressure

1. DESCRIPTION

1.1. FUNCTION

While fluids are practically incompressible, this does not apply to gases. Hydraulic accumulators use these basic laws of physics to store hydraulic energy. Nitrogen is normally used as the compressible medium.

The various types of hydraulic accumulator are categorised on the basis of the separation element that keeps the gas section separate from the fluid section in the pressure vessel. In the case of a bladder accumulator, the separation element is a closed elastomer bladder.

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

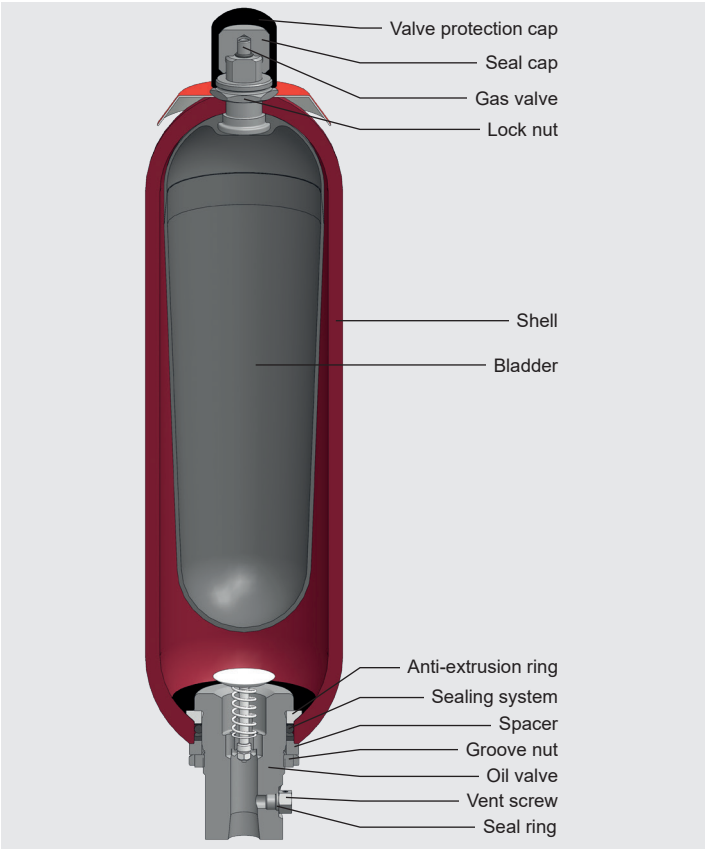
HYDAC bladder accumulators are available in various designs, see catalogue sections:

- Bladder accumulators Standard design
  No. 3.201

- Bladder accumulators Low pressure
  No. 3.202

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

- Hydraulic dampers
  No. 3.701



HYDAC high pressure bladder accumulators from the SB690 series consist of the pressure vessel, the flexible bladder with gas valve and the hydraulic connection with check valve.

2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

The pressure vessel is seamless and manufactured from high tensile chrome molybdenum steel.
For operation with chemically aggressive media, the accumulator shell can be chemically nickel-plated internally or supplied with a special plastic coating.
For external corrosion protection, the hydraulic accumulator can be supplied with an epoxy resin finish specially designed for offshore applications.

2.1.2 Bladder

The bladder material must be selected in accordance with the particular operating medium or operating temperature, see section 2.1.3.
If discharge conditions are unfavourable (high p_2/p_0 pressure ratio, rapid discharge speed), the gas may cool to below the permitted temperature. This can cause cold cracking. The gas temperature can be calculated using the HYDAC Accumulator Simulation Program **ASP**.

2.1.3 Maximum temperature range of elastomer materials

The permitted working temperature of a bladder accumulator is dependent on the applications limits of the metal materials and the bladder. The operating medium must also be taken into account.

The following table shows the main **elastomer materials with their maximum possible temperature ranges** with examples of operating fluids.

Materials		Material code [1]	Max. possible temperature range [2]	Possible operating fluids, others on request	
				Resistant to	Not resistant to
NBR	Acrylonitrile butadiene rubber	2	-15 °C ... + 80 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the groups HFA, HFB, HFC – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Fuels
		5	-50 °C ... + 50 °C		
		9	-30 °C ... + 80 °C		
ECO	Ethylene oxide epichlorohydrin rubber	3	-30 °C ... +120 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the HFB group – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the groups HFA and HFC – Fuels
IIR	Butyl rubber	4	-50 °C to ... 100 °C	– Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the group HFC – Water	– Mineral oils and mineral greases – Synthetic esters (HEES) – Aliphatic, chlorinated and aromatic hydrocarbons – Fuels
FKM	Fluorine rubber	6	-10 °C ... +150 °C	– Mineral oil (HL, HLP) – Hydraulic fluids from the group HFD – Synthetic esters (HEES) – Fuels – Aromatic hydrocarbons – Inorganic acids	– Amines and ketones – Ammonia – Skydrol and HyJet IV – Steam

[1] The material code (MC) is described in more detail in the model code, see section 3.

[2] The specified temperature range relates to the particular elastomer material, not to the operating range of the hydraulic accumulator, see section 4.1.1

2.2. INSTALLATION POSITION

HYDAC bladder accumulators can be installed vertically, horizontally and at a slant. When installing vertically or at a slant, the oil valve must be at the bottom.
For certain applications listed below, particular positions are preferable:

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

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

2.3. TYPE OF INSTALLATION

See catalogue sections:

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

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. CERTIFICATES

Hydraulic accumulators that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering.
HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.
Others on request

2.6. FURTHER INFORMATION

- Operating instructions for bladder accumulators
  No. 3.201.BA

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

- Installation and repair instructions bladder accumulators
  No. 3.201.M

For repairs to be performed on hydraulic accumulators, we provide corresponding assembly and repair instructions.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

SB690 – 32 A 1 / 312 U – 690 D 320

Series

Nominal volume [l]

Fluid port
A = standard connection

Gas side connection
1 = standard design (see section 4.1.7)
9 = special design (example: 1/4" BSP)

Material code (MC)
Dependent on operating medium
Standard design = 312 for mineral oils
Others on request

Fluid port*
3 = stainless steel [1)]

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

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

Permitted operating pressure [bar]

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

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

* Others on request
[1)] Dependent on type and pressure rating
[2)] Observe temperature ranges of the accumulator bladder, see section 2.1.3.

4. STANDARD ITEMS

The bladder accumulators and spare parts described below are manufactured in carbon steel (with a stainless steel fluid port) with an NBR accumulator bladder (MC = 312).

The table provides the most important data and dimensions for the following series: SB690

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

4.1. TECHNICAL DATA

4.1.1 Permitted operating temperature

As standard, an SB690 can be operated in the following temperature range:

-10 °C ... +80 °C

Other operating temperatures on request.

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The table in section 4.2. shows the permitted operating pressure in accordance with the European Pressure Equipment Directive.

4.1.3 Nominal volume

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

4.1.4 Effective gas volume

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

4.1.5 Effective volume

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

4.1.6 Limits for gas pre-charge pressure

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

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

The specified values are maximum values and must not be considered as referring to a permanent load. The tolerable pressure ratio is influenced by the geometry, temperature, fluid and flow rate as well as any gas losses due to physical properties.

For more information, see catalogue section:

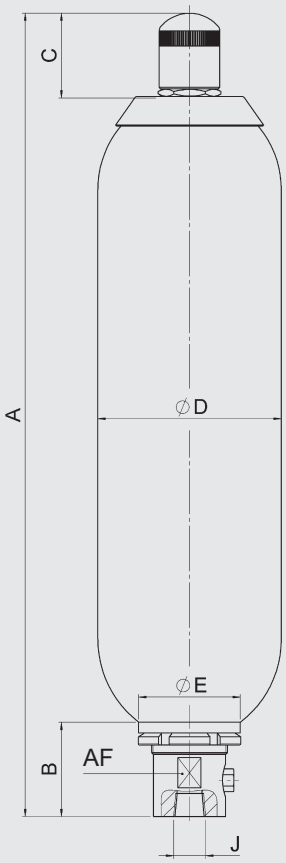
- HYDAC Accumulator Technology
  No. 3.000

4.1.7 Gas side connection

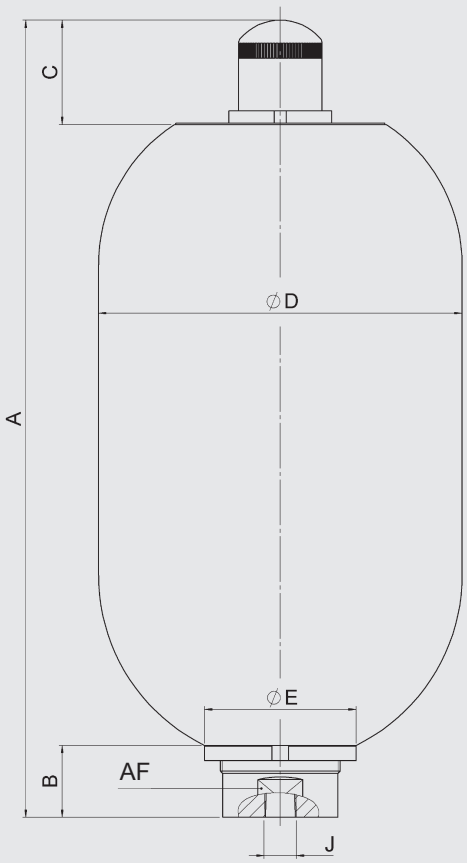
Volume [l]	Gas valve design
< 10	7/8-14UNF
≥ 10	M50x1.5 / 7/8-14UNF

4.2. TABLES AND DRAWINGS

SB690-1 ... 5



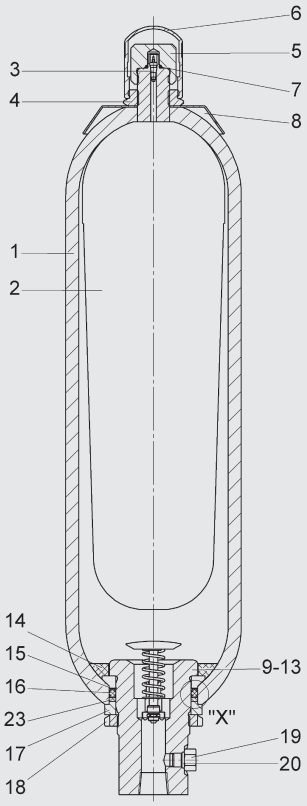
SB690-10 ... 50



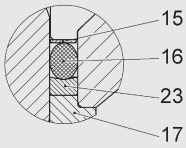
Nominal volume [l]	Series	Perm. operating pressure (PED) [bar]	Part no.	Effective gas volume [l]	A max. [mm]	B [mm]	C [mm]	Ø D max. [mm]	J thread ANSI	Ø E [mm]	AF [mm]	Weight [kg]
1	SB690	690	3444800	1	324	61	58	122	1/2 NPTF	67	45	8.5
2.5			3129516	2.5	531							13.5
5			3129515	4.9	860							23
10			3436744	9	522	43	68	250		100	75	54
20			3436795	17	865							114
32			3436499	33.5	1385							186
50			4291199	49.7	1900							260

4.3. SPARE PARTS

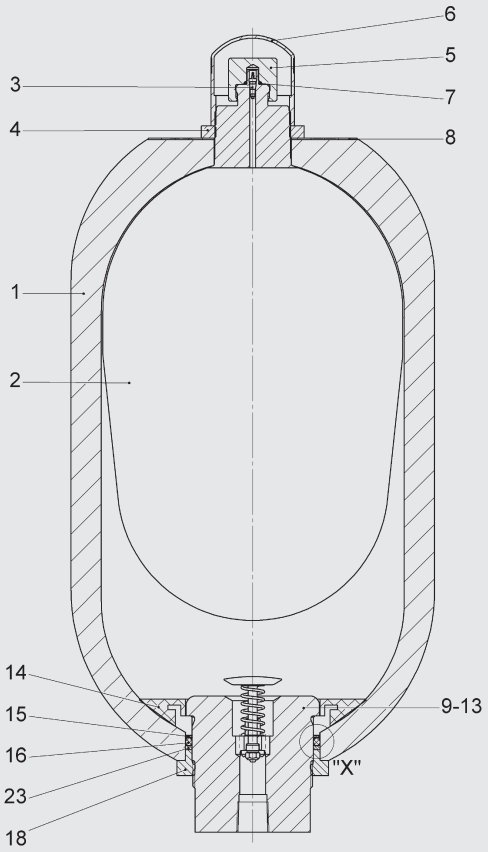
SB690-1 ... 5



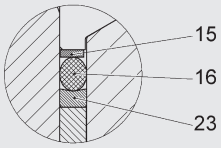
Detail "X" (2:1)



SB690-10 ... 50



Detail "X" (2:1)



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

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

[2] Available separately

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

Vent screw (item 19) for NBR/carbon steel: Seal ring (item 20) included

Nominal volume [l]	Bladder assembly Part no.	Seal kit Part no.	Repair kit Part no.	Oil valve assembly Part no.
1	3010110	3182615	3182617	4291202
2.5	3211568		3201771	
5	3211569		3201772	
10	3120931	4192830	4347598	4030279 [1]
20	3211592		4347600	
32	3211571		4347601	
50	3116598		4347602	

[1] Request versions with spacer (item 17) separately

5. NOTE

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

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Piston accumulators
Standard design

1. DESCRIPTION

1.1. FUNCTION

While fluids are practically incompressible, this does not apply to gases. Hydraulic accumulators use these basic laws of physics to store hydraulic energy. Nitrogen is normally used as the compressible medium.

The various types of hydraulic accumulator are categorised on the basis of the separation element that keeps the gas section separate from the fluid section in the pressure vessel. In the case of the piston accumulator, this is a piston made from aluminium or steel with a sealing system that is compatible with the application.

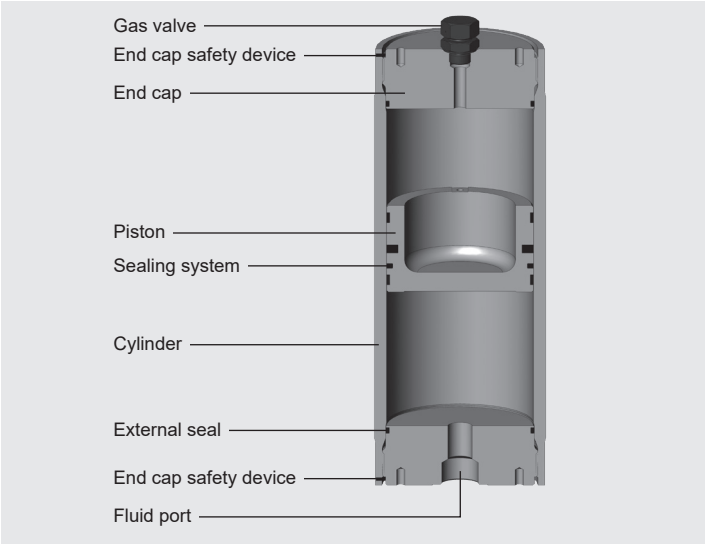
The fluid side of the piston accumulator is connected to the hydraulic circuit so that the piston accumulator draws in fluid when the system pressure increases and the trapped gas is compressed. When the system pressure drops, the compressed gas expands and forces the stored fluid back out into the hydraulic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

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

- Piston accumulators SK280
  No. 3.303

- Piston accumulators High pressure
  No. 3.302

1.2. DESIGN

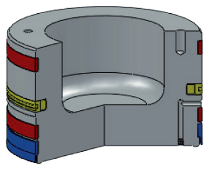
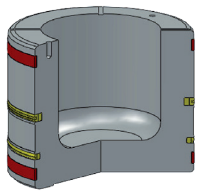
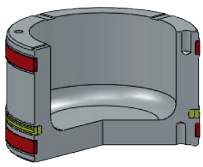
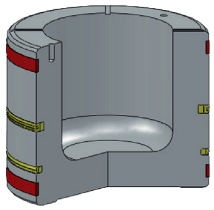


HYDAC piston accumulators consist of the following key individual components:

- Cylinder with a very finely machined internal surface
- Gas side end cap and oil side end cap, both sealed with O-rings
- Steel or aluminium piston
- Sealing system adapted to the particular field of application

The piston floats on guide rings which prevent metal-to-metal contact between the piston and the accumulator wall.
Suitable materials are available for low temperature applications.

1.2.1 Piston design

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

2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

The cylinder and the two end caps are manufactured in carbon steel as standard. For use with certain aggressive or corrosive fluids, the parts coming into contact with the fluid can be nickel plated for protection, or made entirely from corrosion-resistant material. When supplied piston accumulators are suitable for short-term storage. Piston accumulators suitable for long-term storage are available on request.

2.1.2 Pistons with a sealing system

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

- Design pressure
- Actual pressure differential
- Switching frequency or switching cycle
- Piston velocity
- Operating temperature
- Operating fluid
- Cleanliness of fluid (filtration rating)
- Maintenance requirements

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

2.1.3 Maximum temperature range of elastomer materials

The permitted working temperature of a piston accumulator is dependent on the application limits of the metal materials and the piston seal. The operating medium must also be taken into account.
The following table shows the main **elastomer materials with their maximum possible temperature ranges** with examples of operating fluids.

Materials		Material code [1]	Max. possible temperature range [2]	Possible operating fluids, others on request	
				Resistant to	Not resistant to
NBR	Acrylonitrile butadiene rubber	2	-20 °C ... + 80 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the groups HFA, HFB, HFC – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Fuels
		5	-40 °C ... + 80 °C		
PUR	Polyurethane	8	Standard application -30 °C ... + 80 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the HFA group	– Water and water-glycol mixture HFC – Alkalis – Acids
			Special application -40 °C ... +100 °C		
FKM	Fluorine rubber	6	-15 °C ... +160 °C	– Mineral oil (HL, HLP) – Hydraulic fluids from the group HFD – Synthetic esters (HEES) – Fuels – Aromatic hydrocarbons – Inorganic acids	– Amines and ketones – Ammonia – Skydrol and HyJet IV – Steam

[1] The material code (MC) is described in more detail in the model code, see section 3.

[2] The specified temperature range relates to the particular elastomer material, not to the operating range of the hydraulic accumulator, see section 4.1.1

2.2. INSTALLATION POSITION

HYDAC piston accumulators operate in any position. Vertical installation is preferable with the gas side at the top, to prevent contaminant particles from the fluid settling on the piston seals. For hydraulic accumulators with certain piston position indicators, vertical installation is essential.

2.3. TYPE OF INSTALLATION

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

- Mounting elements for hydraulic accumulators
  No. 3.502

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. HYDRAULIC FLUID

Hydraulic accumulators must only be operated with operating fluids with a minimum cleanliness class of:

- NAS 1638 Class 6 or
- ISO 4406 Class 17/15/12

2.6. CERTIFICATES

Hydraulic accumulators that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering. HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.

Others on request

2.7. EFFECT OF SEALING FRICTION

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

2.8. PERMITTED VELOCITIES

Gas velocity

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

Oil velocity

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

2.9. FUNCTION TESTS AND FATIGUE TESTS

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

2.10. FURTHER INFORMATION

- Operating instructions for piston accumulators
  No. 3.301.BA

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

- Assembly and repair instructions piston accumulators
  No. 3.301.M
  For repairs to be performed on hydraulic accumulators, we provide corresponding assembly and repair instructions.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

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

Series

Nominal volume [l]

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

Piston design (see section 1.2.1)

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

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

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

Certification code
U = European Pressure Equipment Directive (PED)
For others, see section 2.6.

Permitted operating pressure [bar]

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

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

Piston diameter

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

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

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

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

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

[1)] Dependent on type and pressure rating
[2)] Observe temperature ranges, see section 2.1.3
[3)] If required, please state at time of ordering

Table 1, Connection type

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

Table 2, Threaded connection: standard or specification

Code letter	Description
A	Thread to ISO 228 (BSP)
B	Thread to DIN 13 or ISO 965/1 (metric)
C	Thread to ANSI B1.1 (UN..-2B, seal SAE J 514)
D	Thread to ANSI B1.20.3 (NPTF)

Table 3, Flange connection: standard or specification

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

Table 4, Threaded version: connection sizes

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

Table 5, Flange version: connection sizes

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

Table 6, Gas valve models

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

4. STANDARD ITEMS

4.1. TECHNICAL DATA

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

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

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

4.1.1 Permissible operating temperature

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

-10 °C ... +80 °C

Other operating temperatures on request.

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The table in section 4.2. shows the permitted operating pressure in accordance with the European Pressure Equipment Directive.

4.1.3 Nominal volume

HYDAC piston accumulators are available with set nominal volumes, as described in the table in section 4.2.

4.1.4 Effective gas volume

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

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

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

4.1.5 Effective volume

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

4.1.6 Limits for gas pre-charge pressure

For more information, see catalogue section:

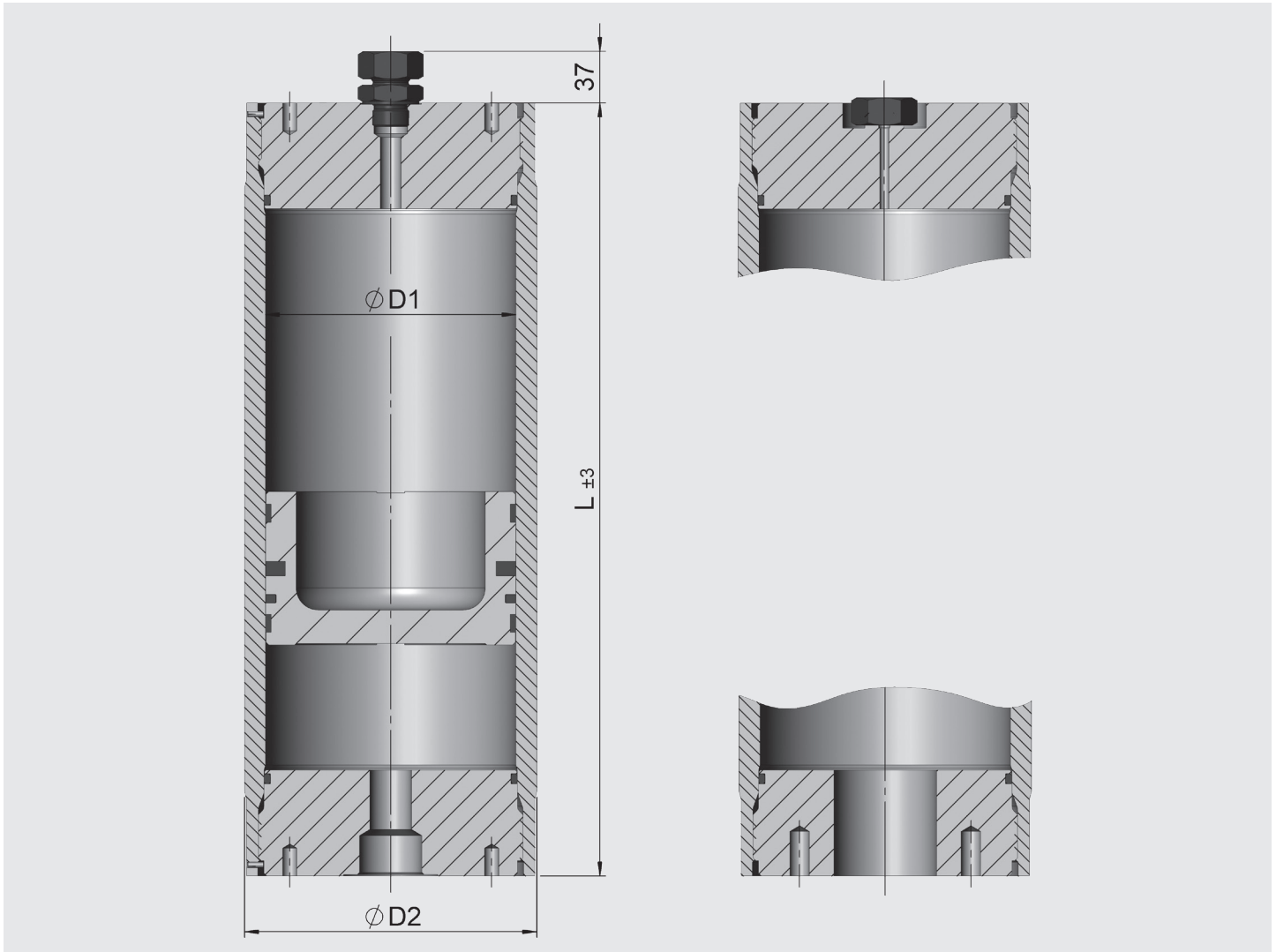
- HYDAC Accumulator Technology
  No. 3.000

4.2. TABLES AND DRAWINGS

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

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

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



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

[1] Preferred models, others on request

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

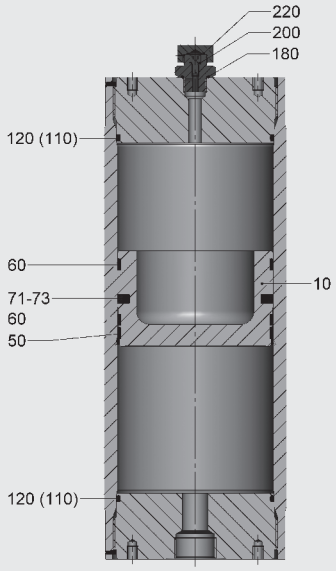
[3] Gas side connection, see section 3.

Notice:

Dimensions, particularly lengths, are approximate and dependent on various factors (e.g. piston design, approval).
The specified values are maximum values and must not be considered as referring to a permanent load. The tolerable pressure ratio is influenced by the geometry, temperature, fluid and flow rate as well as any gas losses due to physical properties.

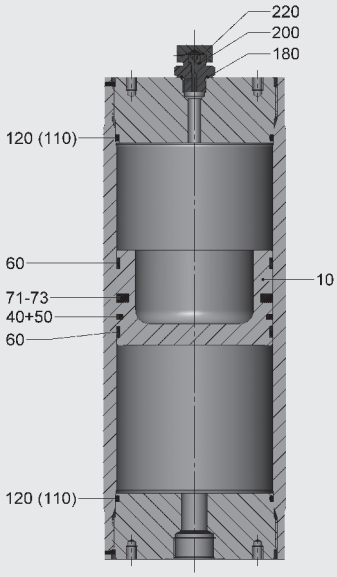
4.2.1 Spare parts

Piston design 1



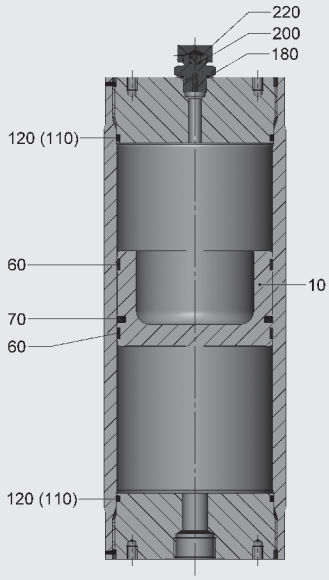
Description	Qty.	Item
Piston assembly [2] consisting of:		
Piston	1	10
Seal ring	1	50
Guide ring	2	60
Centre seal	1	71-73
Seal kit consisting of:		
Seal ring	1	50
Guide ring	2	60
Centre seal	1	71-73
(Support ring)	(2)	(110)
O-ring	2	120
O-ring	1	180
Seal ring	1	200
O-ring	1	220

Piston design 2



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

Piston design 3



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

Pressure-bearing parts cannot be supplied as spares.

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

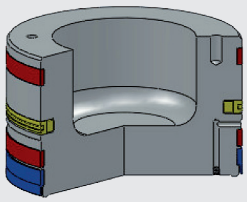
[1] The bottom guide ring for internal diameters 180 mm and above

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

Spare parts for piston design 4 are available on request.

4.2.2 Piston and seal kit

Piston design 1



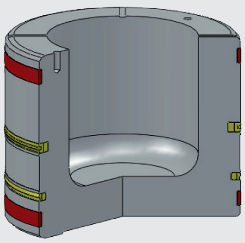
Piston assembly

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

Seal kit

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

Piston design 2



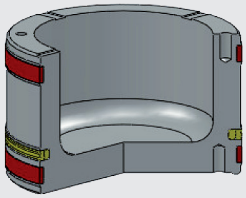
Piston assembly

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

Seal kit

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

Piston design 3



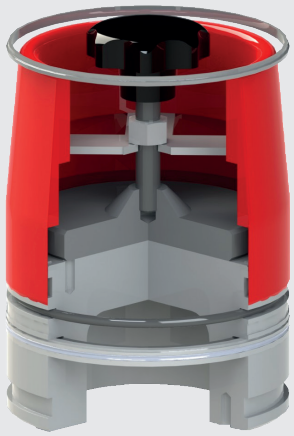
Piston assembly

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

Seal kit

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

4.2.3 Assembly sleeves



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

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

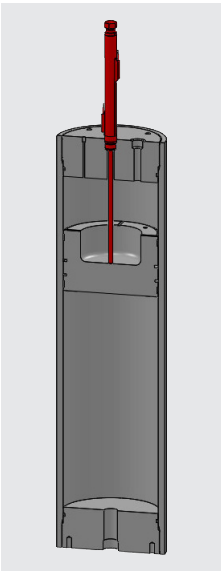
5. ACCESSORIES

5.1. PISTON POSITION INDICATORS

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

- Monitoring equipment for hydraulic accumulators No. 3.506

5.1.1 Electrical limit switch



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

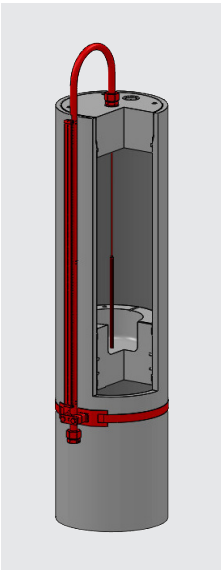
How are measurements taken?
As point measurements

Where to measure?
Gas side

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

Product information:
No. 10000769094

5.1.2 Magnetic flap indication



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

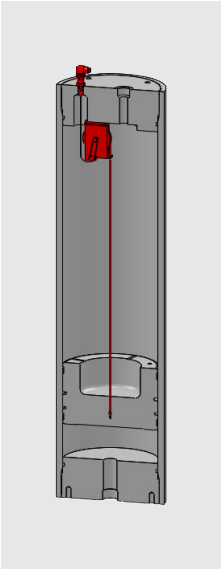
How are measurements taken?
Continuously

Where to measure?
Gas side

Identification in the model code:
M

Product information:
No. 10000769200

5.1.3 Cable tension measurement system



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

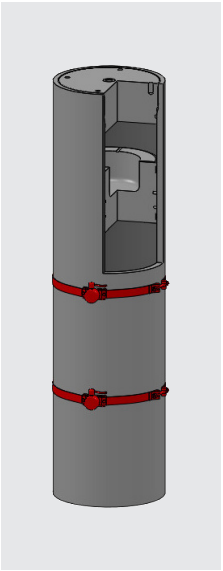
How are measurements taken?
Continuously

Where to measure?
Gas side

Identification in the model code:
S

Product information:
No. 10000641374

5.1.4 Piston position switch



What is measured?
Piston position via ultrasonic measurement

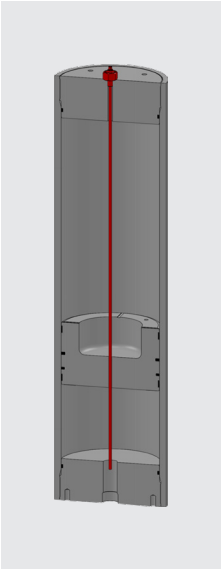
How are measurements taken?
As point measurements

Where to measure?
Fluid side

Identification in the model code:
UP...

Product information:
No. 10000769179

5.1.5 Linear position measurement system



What is measured?
Piston position via elapsed time measurement

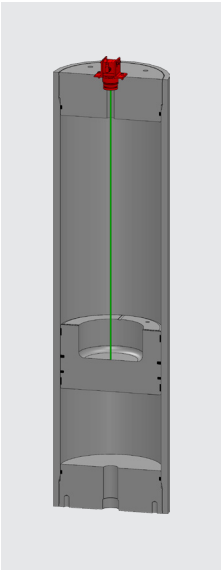
How are measurements taken?
Continuously

Where to measure?
Gas side

Identification in the model code:
L

Product information:
No. 10000810655

5.1.6 Laser linear position measurement system



What is measured?
Piston position via laser elapsed time measurement

How are measurements taken?
Continuously

Where to measure?
Gas side

Identification in the model code:
LA

Product information:
No. 10000810664

6. NOTE

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

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Piston accumulators
Series SK280

1. DESCRIPTION

1.1. FUNCTION

While fluids are practically incompressible, this does not apply to gases. Hydraulic accumulators use these basic laws of physics to store hydraulic energy. Nitrogen is normally used as the compressible medium.

The various types of hydraulic accumulator are categorised on the basis of the separation element that keeps the gas section separate from the fluid section in the pressure vessel. In the case of the piston accumulator, this is a piston made from aluminium or steel with a sealing system that is compatible with the application.

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

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

- Piston accumulators Standard design
  No. 3.301

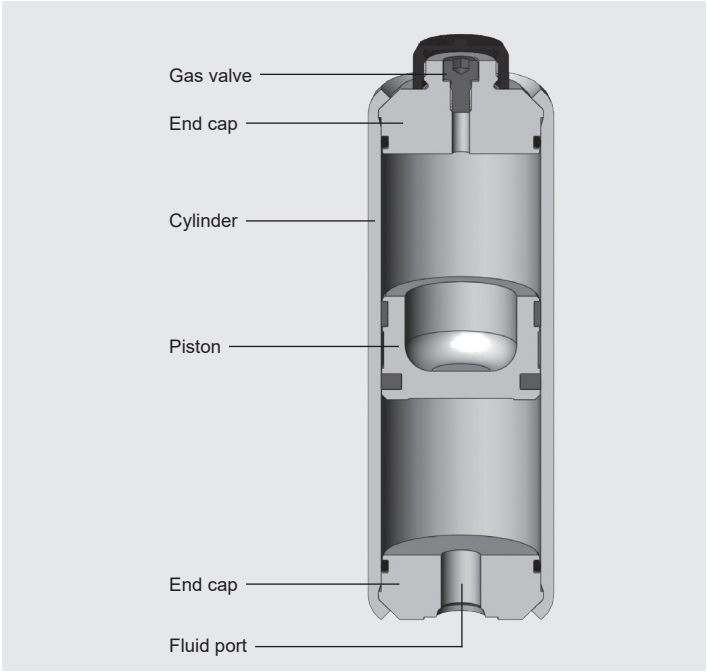
- Piston accumulators High pressure
  No. 3.302

1.2. DESIGN

HYDAC piston accumulators consist of the following key individual components:

- Cylinder with a very finely machined internal surface
- Gas side end cap and oil side end cap, both sealed with O-rings
- Steel or aluminium piston
- Sealing system adapted to the particular field of application

The piston floats on guide rings which prevent metal-to-metal contact between the piston and the accumulator wall.
Suitable materials are available for low temperature applications.



2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

The cylinder and the two end caps are manufactured in carbon steel as standard. For use with certain aggressive or corrosive fluids, the parts coming into contact with the fluid can be nickel plated for protection, or made entirely from corrosion-resistant material. When supplied piston accumulators are suitable for short-term storage. Piston accumulators suitable for long-term storage are available on request.

2.1.2 Pistons with a sealing system

- Piston design 3: NBR/PUR

For further information, see catalogue section:

- Piston accumulators Standard design
  No. 3.301

2.1.3 Maximum temperature range of elastomer materials

See catalogue section:

- Piston accumulators Standard design
  No. 3.301

2.2. INSTALLATION POSITION

HYDAC piston accumulators operate in any position. Vertical installation is preferable with the gas side at the top, to prevent contaminant particles from the fluid settling on the piston seals. For hydraulic accumulators with certain piston position indicators, vertical installation is essential.

2.3. TYPE OF INSTALLATION

HYDAC can provide suitable accumulator clamps for the piston accumulator series SK280. The table in section 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.

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. HYDRAULIC FLUID

Hydraulic accumulators must only be operated with operating fluids with a minimum cleanliness class of:

- NAS 1638 Class 6 or
- ISO 4406 Class 17/15/12

2.6. CERTIFICATES

Hydraulic accumulators that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering.
HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.

Others on request

2.7. FURTHER INFORMATION

- Operating instructions for piston accumulators
  No. 3.301.BA

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

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

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

Series

Nominal volume [l]

Material and piston code (MC)
Dependent on operating fluid
Standard design = 3218 for mineral oil
Others on request

Piston design (see section 2.1.2)

Piston material
2 = carbon steel

Material of cylinder and end cap
1 = carbon steel
6 = carbon steel (low temperature)

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

Certification code
U = European Pressure Equipment Directive (PED)
For others, see section 2.6.

Permitted operating pressure [bar]

Fluid port
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 9/16-18UNF, SAE #6
ACF = threaded connection to SAE J 514 size 3/4-16UNF, SAE #8
ACH = threaded connection to SAE J 514 size 1 1/16-12UN, SAE #12
ACK = threaded connection to SAE J 514 size 1 5/16-12UN, SAE #16

Gas-side connection or gas valve
VB = gas valve type M28x1.5/M8 integrated into end cap
000 = non-rechargeable version (see drawing, section 4.2.) on request

Piston diameter
05 = 50 mm

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

4. STANDARD ITEMS

4.1. TECHNICAL DATA

The piston accumulators described below are manufactured in carbon steel with a design 3 piston in carbon steel and a sealing system made from NBR/PUR (MC = 3218).

The table provides the most important data and dimensions for the following series: SK280

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

4.1.1 Permitted operating temperature

As standard, a piston accumulator can be operated in the following temperature range:
-20 °C ... +80 °C

Extended temperature range:
-40 °C ... +100 °C

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The table in section 4.2. shows the permitted operating pressure in accordance with the European Pressure Equipment Directive.

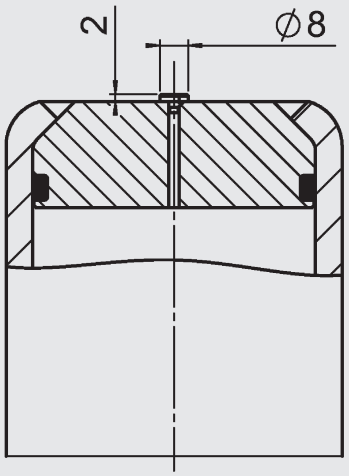
The specified values are maximum values and must not be considered as referring to a permanent load. The tolerable pressure ratio is influenced by the geometry, temperature, fluid and flow rate as well as any gas losses due to physical properties.

4.1.3 Nominal volume

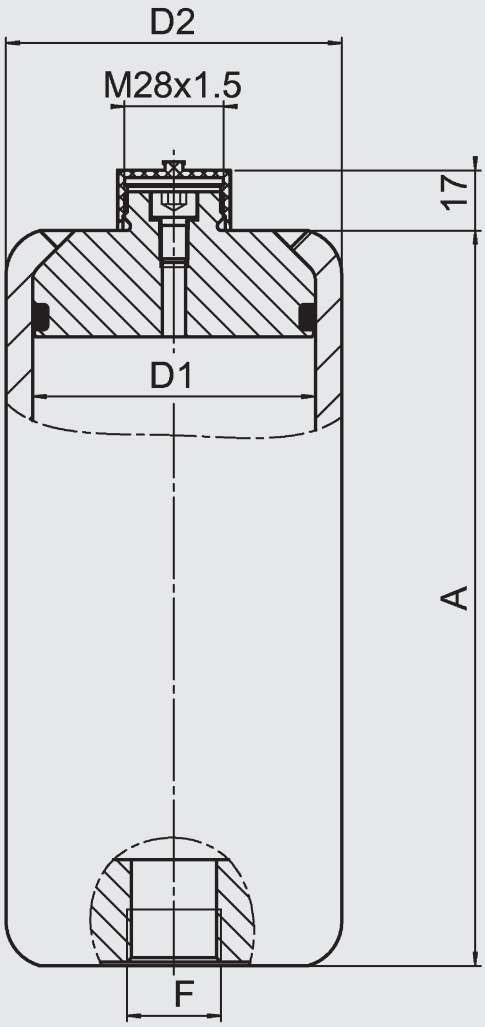
HYDAC piston accumulators are available with set nominal volumes, as described in the table in section 4.2.

4.2. TABLES AND DRAWINGS

Rechargeable



Non-rechargeable



Nominal volume	D1	D2	A ±3	Perm. operating pressure 280 bar (PED)				Weight	Mounting clamps [2]
				to ISO 228		to SAE J 514			
[l]	[mm]	[mm]	[mm]	F	Part no. [1]	F	Part no. [1]	[kg]	
0.16	50	60	160	G 1/2	3200525	9/16-18UNF	–	2	3018442 HRGKSM 0 R 58-61/62 ST
0.32			240		3200521		–	2.5	
0.5			335		3200528	3/4-16UNF	–	3.1	
0.75			460		3200522		–	4	
1			590		3200523		–	4.8	
0.32	60	75	205	G 1/2	3200524	3/4-16UNF	–	4	444912 HRGKSM 0 R 73-76/76 ST
0.5			265		3200546		–	4.7	
0.75			355		3200547		–	5.8	
1			445		3200548		–	6.9	
1.5			620		3200549		–	9.1	
2			800		3200550		–	11.4	
2.5			975		3200551		–	13.6	
0.5	80	95	210	G 3/4	3200552	1 1/16-12UN	–	6.5	444995 HRGKSM 0 R 92-95/96 ST
0.75			260		3200553		–	7.2	
1			310		3200554		–	8	
1.5			410		3200557		–	9.5	
2			510		3200558		–	11.5	
2.5			605		3200559		–	13	
3			705		3200560		–	14.5	
3.5			805		3200561		–	16	
4			905		3200562		–	17.5	
0.75	100	120	235	G 1	3200563	1 5/16-12UN	3984528	11.7	444505 HRGKSM 1 R 119-127/124 ST
1			265		3200564		3984529	12.5	
1.5			330		3200565		3984530	14.3	
2			395		3200566		3984531	16	
2.5			460		3984479		3984533	18	
3			520		3200568		3984534	19.5	
3.5			585		3984478		3984555	21.5	
4			650		3200569		3984556	23	
5			775		3200570		3984557	26.3	
6			900		3200571		3984558	30	
4	125	150	445	G 1	4092344	1 5/16-12UN	4092420	29	444321 HRGKSM 1 R 146-154/151 ST
5			528		4092395		4092421	32.5	
6			609		4092396		4092422	36	
7			691		4092397		4092423	39.5	
8			772		4092398		4092424	43	
9			854		4092399		4092445	46.5	
10			935		4092400		4092446	50	
6	150	175	467	G 1	4289054	1 5/16-12UN	–	39.4	444402 HRGKSM 2 R 172-180/178 ST
8			581		4289105		–	45.1	
10			695		4289106		–	50.8	
12			809		4289108		–	56.5	
15			980		4289109		–	65.1	

[1] Preferred models, others on request

[2] Clamps must be mounted near the end caps in order to prevent deformation of the cylinder; for further information see the following catalogue section:

- Mounting elements for hydraulic accumulators
  No. 3.502

5. NOTE

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

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Piston accumulators
High pressure

1. DESCRIPTION

1.1. FUNCTION

While fluids are practically incompressible, this does not apply to gases. Hydraulic accumulators use these basic laws of physics to store hydraulic energy. Nitrogen is normally used as the compressible medium.

The various types of hydraulic accumulator are categorised on the basis of the separation element that keeps the gas section separate from the fluid section in the pressure vessel. In the case of the piston accumulator, this is a piston made from aluminium or steel with a sealing system that is compatible with the application.

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

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

- Piston accumulators Standard design
  No. 3.301

- Piston accumulators SK280
  No. 3.303

1.2. DESIGN

HYDAC piston accumulators consist of the following key individual components:

- Cylinder with a very finely machined internal surface
- Gas side end cap and oil side end cap, both sealed with O-rings
- Steel or aluminium piston
- High-pressure sealing system adapted to the particular field of application

The piston floats on guide rings which prevent metal-to-metal contact between the piston and the accumulator wall.
Suitable materials are available for low temperature applications.

2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

The cylinder and the two end caps are manufactured in carbon steel as standard. For use with certain aggressive or corrosive fluids, the parts coming into contact with the fluid can be nickel plated for protection, or made entirely from corrosion-resistant material. When supplied piston accumulators are suitable for short-term storage. Piston accumulators suitable for long-term storage are available on request.

2.1.2 Pistons with sealing system

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

- Design pressure
- Actual pressure differential
- Switching frequency or switching cycle
- Piston velocity
- Operating temperature
- Operating fluid
- Cleanliness of fluid (filtration rating)
- Maintenance requirements

For high-pressure piston accumulators, an advanced piston design 2 is used which has been modified for applications up to 1000 bar.

2.1.3 Maximum temperature range of elastomer materials

The permitted working temperature of a piston accumulator is dependent on the application limits of the metal materials and the piston seal. The operating medium must also be taken into account.
The following table shows the main **elastomer materials with their maximum possible temperature ranges** with examples of operating fluids.

Materials		Material code [1]	Max. possible temperature range [2]	Possible operating fluids, others on request	
				Resistant to	Not resistant to
NBR	Acrylonitrile butadiene rubber	2	-20 °C ... + 80 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the groups HFA, HFB, HFC – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Fuels
		5	-40 °C ... + 80 °C		
FKM	Fluorine rubber	6	-15 °C … +160 °C	– Mineral oil (HL, HLP) – Hydraulic fluids from the group HFD – Synthetic esters (HEES) – Fuels – Aromatic hydrocarbons – Inorganic acids	– Amines and ketones – Ammonia – Skydrol and HyJet IV – Steam

[1] The material code (MC) is described in more detail in the model code, see section 3.

[2] The specified temperature range relates to the particular elastomer material, not to the operating range of the hydraulic accumulator, see section 4.1.1

2.2. INSTALLATION POSITION

HYDAC piston accumulators operate in any position. Vertical installation is preferable with the gas side at the top, to prevent contaminant particles from the fluid settling on the piston seals.

2.3. TYPE OF INSTALLATION

Information on secure installation and mounting elements can be found in the following catalogue section:

- Mounting elements for hydraulic accumulators
  No. 3.502

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. HYDRAULIC FLUID

Hydraulic accumulators must only be operated with operating fluids with a minimum cleanliness class of:

- NAS 1638 Class 6 or
- ISO 4406 Class 17/15/12

2.6. CERTIFICATES

Hydraulic accumulators that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering. HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.

Others on request

2.7. FURTHER INFORMATION

- Operating instructions for piston accumulators
  No. 3.301.BA

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

- Assembly and repair instructions piston accumulators
  No. 3.301.M
  For repairs to be performed on hydraulic accumulators, we provide corresponding assembly and repair instructions.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

SK690 – 1 / 2212 U – 690 ADE – VB – 08 UP2 – 1 – 300

Series

Nominal volume [l]

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

Piston design
High pressure piston 2

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

Material of cylinder and end cap
1 = carbon steel
3 = stainless steel [1)]

Material of seals including piston seals
2 = NBR [2)] / PTFE
6 = FKM / PTFE

Certification code
U = European Pressure Equipment Directive (PED)
For others, see section 2.6.

Permitted operating pressure [bar]

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

Gas side connection or gas valve
Type of connection (see Table 1)
Standard or specification of the type of connection (see Table 2)
Size of connection (see Table 3)

Piston diameter
08 = 80 mm
12 = 125 mm
15 = 150 mm
18 = 180 mm

Additional equipment [3)]
For detailed technical data, see flyer: "Monitoring equipment for hydraulic accumulators", No. 3.506
M = magnetic flap indication
UP.. = piston position switch (e.g. UP2 = 2 position switches)

Safety equipment [3)]
1 = burst disc (please give nominal pressure and temperature)

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

[1)] Dependent on type and pressure rating
[2)] Observe temperature ranges, see section 2.1.3
[3)] If required, please state at time of ordering

Table 1, Connection type

Code letter	Description
A	Threaded connection (internal)
K	Customer-specific connection
V	Gas valve port
S	Special connection on request

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 B 1.1 (UN..-2B, seal SAE J 514)
D	Thread to ANSI B1.20.3 (NPTF)

Table 3, Threaded connection: sizes

Type listed in Table 2	Code letter, size						
	A	B	C	D	E	F	G
A	G 1/8	G 1/4	G 3/8	G 1/2	G 3/4	G 1	G 1 1/4
B	M10x1	M12x1.5	M14x1.5	M16x1.5	M18x1.5	M22x1.5	M27x2
C	5/16-24UNF	3/8-24UNF	7/16-20UNF	1/2-20UNF	9/16-18UNF	3/4-16UNF	7/8-14UNF
D	1/16-27 NPTF	1/8-27 NPTF	1/4-18 NPTF	3/8-18 NPTF	1/2-14 NPTF	3/4-14 NPTF	1-11 1/2 NPTF

Table 4, Connection size for preferred high pressure connections (e.g. Maximator)

	Code letter, size						
	KCQ	KCR	KCT	KUR	KUY	KWB	KWP
1. Connection	13/16-16UNF (9MF)	13/16-16UNF (9MF)	9/16-18UNF (6MF)	9/16-18UNF (6MF)	1 3/8-12UNF (16MF)	9/16-18UNF (6MF)	3/4-16UNF (6HF)
2. Connection	13/16-16UNF (9MF)	-	-	9/16-18UNF (6MF)	-	G 3/4-ISO228	-

Other connections on request

Table 5, Gas valve port

Code letter	Description
B	Gas valve end connection M28x1.5/M8 (max. pre-charge pressure 800 bar with FPU-2)
M	Gas valve, male, for high pressure port 9/16-18UNF (6MF) (no limit for pre-charge pressure)

4. STANDARD ITEMS

4.1. TECHNICAL DATA

4.1.1 Permitted operating temperature

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

-20 °C ... +50 °C

Other operating temperatures on request.

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The table in section 4.2. shows the permitted operating pressure in accordance with the European Pressure Equipment Directive.

4.1.3 Nominal volume

HYDAC piston accumulators are available with set nominal volumes, as described in the table in section 4.2.

4.1.4 Effective volume

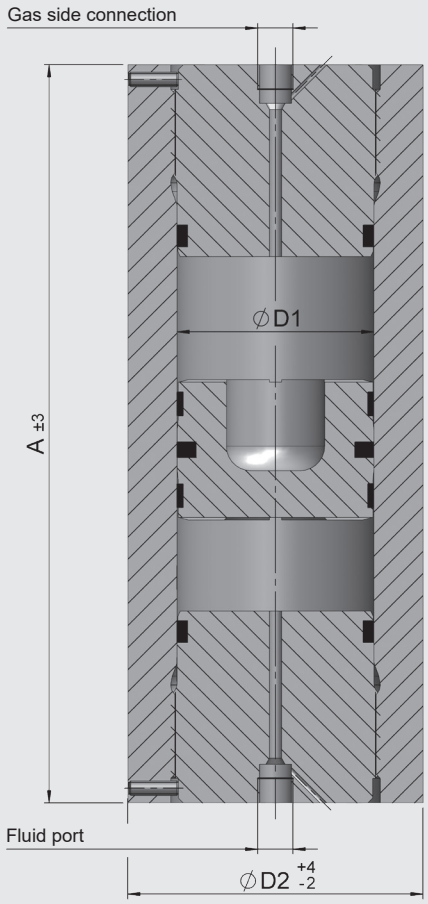
Volume (fluid side) between operating pressures p_2 and p_1.

4.1.5 Limits for gas pre-charge pressure

For more information, see catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

4.2. TABLES AND DRAWINGS



Nominal volume [l]	Series	Perm. operating pressure (PED) [bar]	Ø D1 [mm]	Ø D2 Carbon steel [mm]	Ø D2 Stainless steel [mm]	A [mm]	Approx. weight Carbon steel [kg]	Approx. weight Stainless steel [kg]
0.5 - 10	690	690	80	107	110	280 - 2170	15 - 74	16 - 83
	800	800						
	1000	1000		120	119	310 - 2200	23 - 117	22 - 113
1 - 20	690	690	125	160	160	295 - 1845	37 - 133	37 - 133
	800	800		162			38 - 140	
	1000	1000		172	164	295 - 1840	44 - 178	40 - 148
5 - 30	690	690	150	190	200	535 - 1950	75 - 194	88 - 241
	800	800		185		535 - 1990	80 - 182	87 - 240
	1000	1000		200	250	575 - 1990	100 - 253	179 - 529
5 - 50	690	690	180	246	220	480 - 2250	136 - 443	94 - 269
	800	800			224			100 - 293
	1000	1000			280	555 - 2325	168 - 475	229 - 732

Notice:

The specified values are maximum values and must not be considered as referring to a permanent load. The tolerable pressure ratio is influenced by the geometry, temperature, fluid and flow rate as well as any gas losses due to physical properties.

5. NOTE

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

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Diaphragm accumulators

1. DESCRIPTION

1.1. FUNCTION

While fluids are practically incompressible, this does not apply to gases. Hydraulic accumulators use these basic laws of physics to store hydraulic energy. Nitrogen is normally used as the compressible medium.

The various types of hydraulic accumulator are categorised on the basis of the separation element that keeps the gas section separate from the fluid section in the pressure vessel. In the case of diaphragm accumulators, this is an elastomer diaphragm or a full-PTFE diaphragm. Set into the base of the diaphragm is a valve plate. This shuts off the hydraulic outlet when the accumulator is completely empty and thus prevents damage to the diaphragm.

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

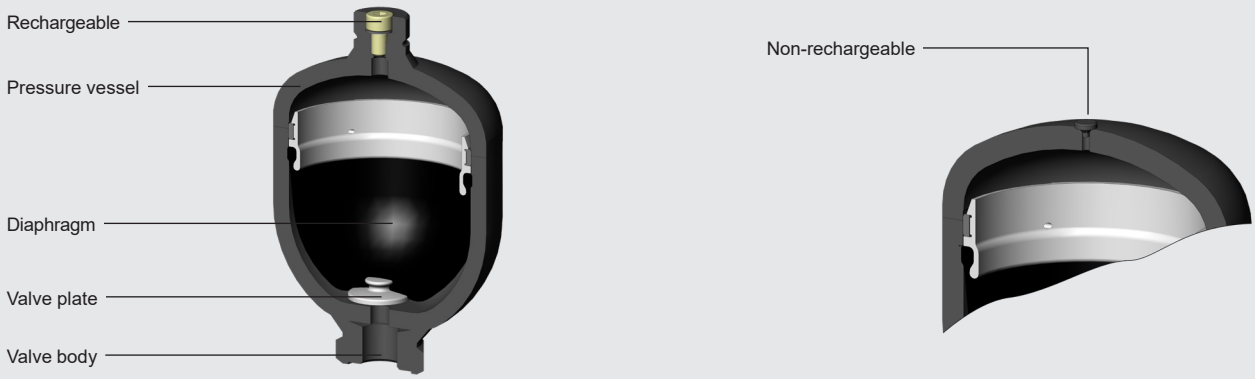
Diaphragm accumulators can also be used as dampers, for example – see catalogue section:

- Hydraulic dampers
  No. 3.701

1.2. DESIGN

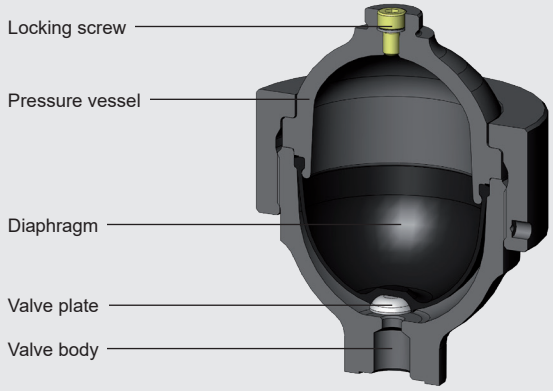
HYDAC weld type diaphragm accumulators consist of the following key individual components:

- Welded pressure vessel, rechargeable on the gas side or, alternatively, completely sealed, valve body
- Diaphragm to separate the fluid and gas sections
- Valve plate in diaphragm base



HYDAC screw type diaphragm accumulators consist of the following key individual components:

- Forged upper section with gas charging connection
- Forged lower section with valve body
- Exchangeable diaphragm to separate the gas section and fluid
- Valve plate in diaphragm base
- Lock nut to hold the upper and lower sections of the accumulator together



2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

As standard, the upper and lower sections are made from carbon steel.
For use with chemically aggressive fluids the hydraulic 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.

2.1.2 Diaphragm

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

If discharge conditions are unfavourable (high p_2/p_0 pressure ratio, rapid discharge speed), the gas may cool to below the permitted temperature. This can cause cold cracking. The gas temperature can be calculated using the HYDAC Accumulator Simulation Program **ASP**.

2.1.3 Maximum temperature range of elastomer materials

The permitted working temperature of a diaphragm accumulator is dependent on the application of the metal materials and the diaphragm. The operating medium must also be taken into account.
The following table shows the main **elastomer materials with their maximum possible temperature ranges** with examples of operating fluids.

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

[1] The material code (MC) is described in more detail in the model code, see section 3.

[2] The specified temperature range relates to the particular elastomer material, not to the operating range of the hydraulic accumulator, see section 4.1.1

2.2. INSTALLATION POSITION

Any position can be chosen. However, if there is a risk of contamination collecting, a vertical position is preferable (fluid port at the bottom).

2.3. TYPE OF INSTALLATION

Diaphragm accumulators up to a nominal volume of 2 l can be screwed directly inline. Where strong vibrations are expected, the hydraulic accumulator must be secured to prevent it working loose.

For strong vibrations and volumes above 2 litre, we recommend HYDAC mounting elements – see catalogue section:

- Mounting elements for hydraulic accumulators No. 3.502

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. HYDRAULIC FLUID

Hydraulic accumulators must only be operated with operating fluids with a minimum cleanliness class of:

- NAS 1638 Class 6 or
- ISO 4406 Class 17/15/12

2.6. CERTIFICATES

Hydraulic accumulators that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering. HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.

Others on request

2.7. FURTHER INFORMATION

- Operating instructions for diaphragm accumulators No. 3.100.BA

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

- Assembly and repair instructions for diaphragm accumulators No. 3.100.M

For repairs to be performed on hydraulic accumulators, we provide corresponding assembly and repair instructions.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

SBO210 – 2 E1 / 112 U – 210 AK 050

Series

Nominal volume [l]

Type
Weld type (diaphragm not exchangeable)
E1 = rechargeable M28x1.5
E2 = sealed gas connection, with gas pre-charge as requested [1)]
E3 = rechargeable,, gas valve M16x1.5 / M14x1.5

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

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

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

Accumulator shell
1 = carbon steel
2 = carbon steel with protective coating [3) 4)]
4 = stainless steel [2)]
6 = low-temperature steel
7 = other materials or material combinations

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

Certification code
U = European Pressure Equipment Directive (PED)
For others, see section 2.6.

Permitted operating pressure [bar]

Fluid port form
Standard connection = AK or AB
e.g. form AK = G 3/4
for SBO210-2, see section 4.2.

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

[1)] Only for E1 or E2 design, when ordered as standard
[2)] Dependent on type and pressure rating
[3)] Only for screw type design
[4)] Only for parts that come into contact with the fluid
[5)] Observe temperature ranges, see section 2.1.3.

4. STANDARD ITEMS

4.1. TECHNICAL DATA

The diaphragm accumulators and spare parts described below are manufactured in carbon steel or stainless steel with an NBR diaphragm (MC = 112 / 342).

The table provides the most important data and dimensions for the following series:
SBO50/100/140/160/180/210/250/300/330/400/450/500/750

The data provided refers to diaphragm accumulators in accordance with PED (CC = U).
Designs that differ from the standard types described below can be requested from HYDAC.

4.1.1 Permitted operating temperature

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

-10 °C ... +80 °C

Other operating temperatures on request.

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The tables in section 4.2. show the permitted operating pressure in accordance with the European Pressure Equipment Directive.

4.1.3 Nominal volume

HYDAC diaphragm accumulators are available with set nominal volumes, as described in the tables in section 4.2.

4.1.4 Effective gas volume

The effective gas volume corresponds to the nominal volume of the diaphragm accumulator.

4.1.5 Effective volume

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

4.1.6 Maximum flow rate of the operating fluid

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

4.1.7 Limits for gas pre-charge pressure

$p_0 \leq 0.9 \bullet p_1$
with the permitted pressure ratio specified in the tables in section 4.2. (= ratio of max. operating pressure p_2 to gas charging pressure p_0).

The specified values are maximum values and must not be considered as referring to a permanent load. The sustainable pressure ratio is affected by geometry, temperature, medium, flow rate and gas losses resulting from physical characteristics.

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

For more information, see catalogue section:

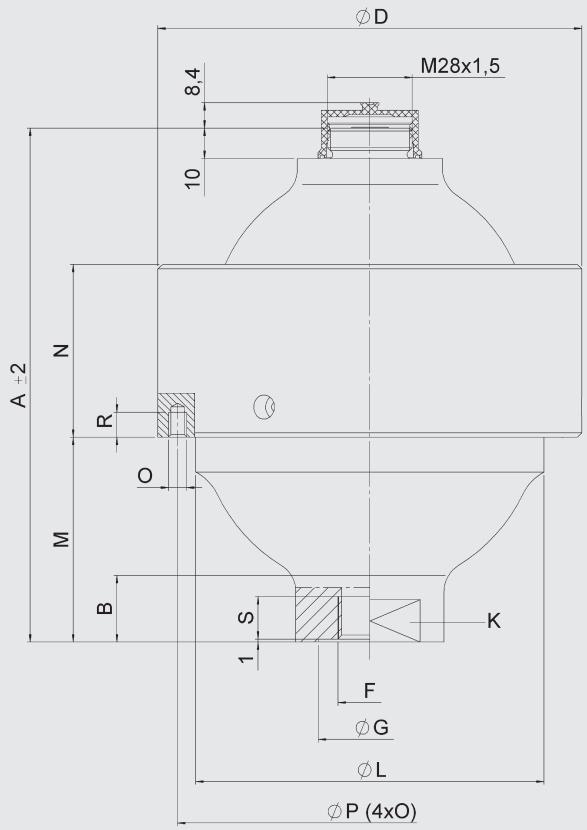
- HYDAC Accumulator Technology
  No. 3.000

4.2. TABLES AND DRAWINGS

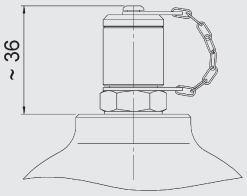
4.2.1 Screw type

– exchangeable diaphragm –

Type A6



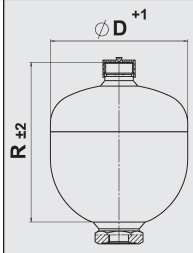
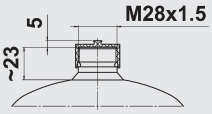
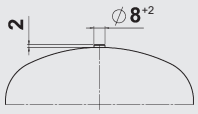
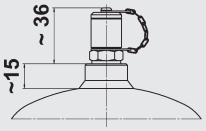
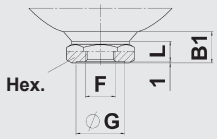
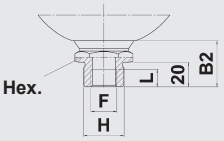
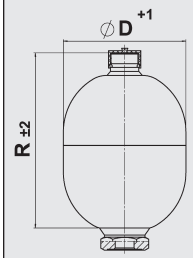
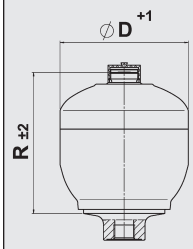
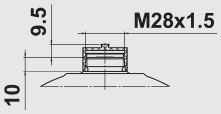
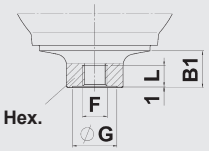
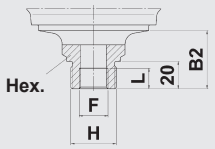
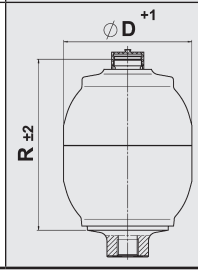
Type A3



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

[1] Max. flow rate of operating fluid

4.2.2 Weld type
– non-exchangeable diaphragm –

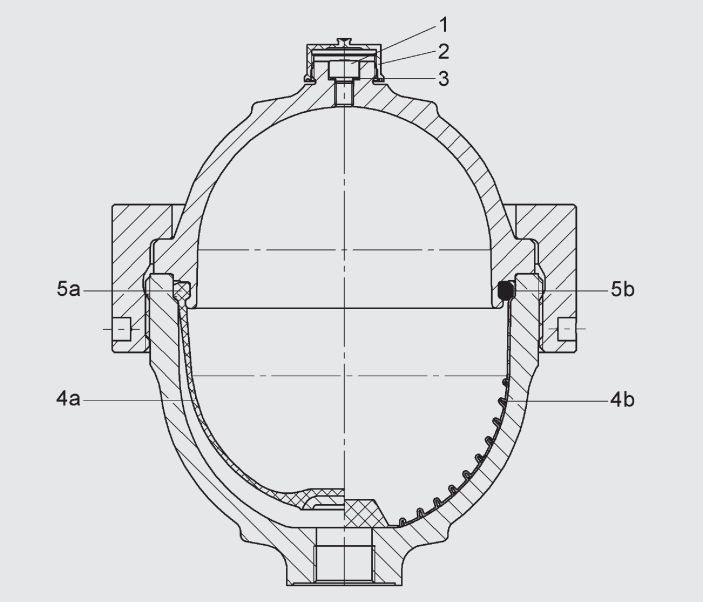
Fig.	Design	Gas side connection			Fluid side connection	
		E1	E2	E3	AK	AB
1						
2			–			
3			On request			
4			–			

Nom. vol.	Perm. press. ratio	Series	Perm. oper. pressure [bar]		R	ØD	Weight	Q [1]	Fluid port										Fig.
									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]	B1 [mm]	Hex. AF	F ISO 228	H DIN 13	L [mm]	B2 [mm]	Hex. AF	
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						1
		300	300	–	108	78	1.1												
0.32	8:1	100	100	–	116	90	0.9	95	G 1/2	–	14	21	30						1
		210	210	160		93	1.3												
		300	300	–	120	96	1.8												
0.5	8:1	160	160	–	130	102	1.3	95	G 1/2	–	14	21	30	G 1/2	M33x1.5	14	37	41	1
		210	210	–	133	105	1.7												
0.6	8:1	330	330	–	151	115	3.3	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
		350	350	–	130	121	3.5						50					50	3
0.7	8:1	100	100	–	151	106	1.8	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
0.75	8:1	140	140	–	142	116	1.8	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
		210	210	140	147	121	2.8												
		250	250	–	152	126	3.6									15	42		
		330	330	–	140	126	4					26							3
1	8:1	200	200	–	159	136	3.6	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
	4:1	250	250	–	192	126	4.4												2
		330	330	–	169		4.8					26				15	42		4
1.4	8:1	140	140	–	173	145	3.9	95	G 1/2	34	14	21	41	G 1/2	M33x1.5	14	37	41	1
		210	210	–	178	150	5.4												
		250	250	–	185	153	5.9									15			
		330	330	–	172	155	7.6					33					42		3
2	8:1	100	100	100	190	160	4	150	G 3/4	44	16	28	46	G 3/4	M45x1.5	16	33	46	1
		210	210	–	198	167	6.6												
	4:1	250	250	–	232	153	7.4												2
	8:1	330	330	–	181	172	9.2					43					42		3
2.8	4:1	210	210	–	250	167	8.2	150	G 3/4	44	16	28	46	G 3/4	M45x1.5	16	33	46	2
		250	250	–	250	170	9.5												
		330	330	–	237	172	11					43					42		4
	6:1				231							44							3
3.5	4:1	250	210	–	306	170	11.2	150	G 3/4	44	16	28	46	G 3/4	M45x1.5	16	33	46	2
		330	330	–	274	172	13.8					44					42		4
4	4:1	50	–	50	294	158	5	150	G 3/4	44	16	44	46	G 3/4	M45x1.5	16	33	46	2
		250	–	180	306	170	11.2												

[1] Max. flow rate of operating fluid

4.3. SPARE PARTS

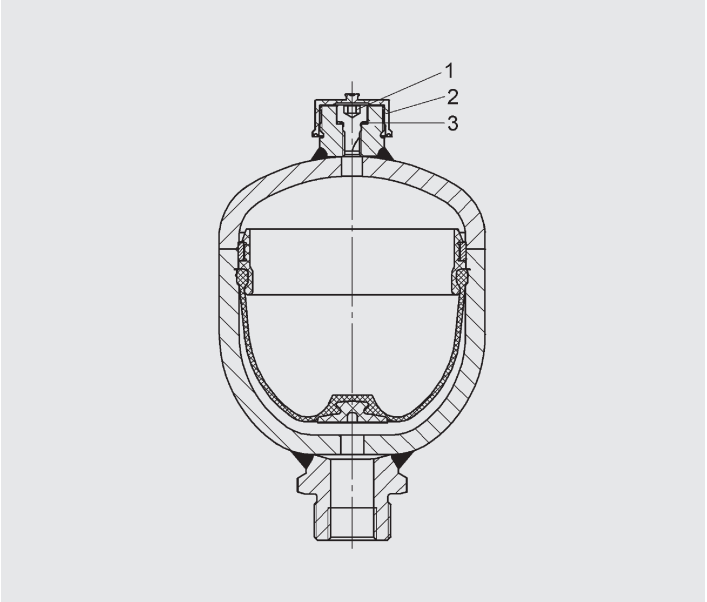
4.3.1 Weld type
– exchangeable diaphragm –



Description	Qty.	Item
Spare parts set for gas side consisting of:		
Locking screw	20	1
Protective cap	20	2
Seal ring	20	3
Spare parts kit for elastomer diaphragm consisting of:		
Locking screw	1	1
Seal ring	1	3
Elastomer diaphragm	1	4a
Support ring	1	5a
Spare part kit for full-PTFE diaphragm consisting of:		
Locking screw	1	1
Seal ring	1	3
Full-PTFE diaphragm	1	4b
O-ring	1	5b

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

4.3.2 Weld type
– non-exchangeable diaphragm –



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

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

5. NOTE

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

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Metal bellows accumulators

1. DESCRIPTION

1.1. FUNCTION

While fluids are practically incompressible, this does not apply to gases. Hydraulic accumulators use these basic laws of physics to store hydraulic energy. Nitrogen is normally used as the compressible medium.

The various types of hydraulic accumulator are categorised on the basis of the separation element that keeps the gas section separate from the fluid section in the pressure vessel. In the case of metal bellows accumulators, this is a metallic corrugated or diaphragm bellows.

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

HYDAC metal bellows accumulators are made with tailor-made designs and material selections. Because of their special properties, they are an outstanding addition to the HYDAC hydraulic accumulator product range.

Some examples are provided on the following pages and in our flyer

- Large engines – metal bellows accumulators
  No. 10.129.1

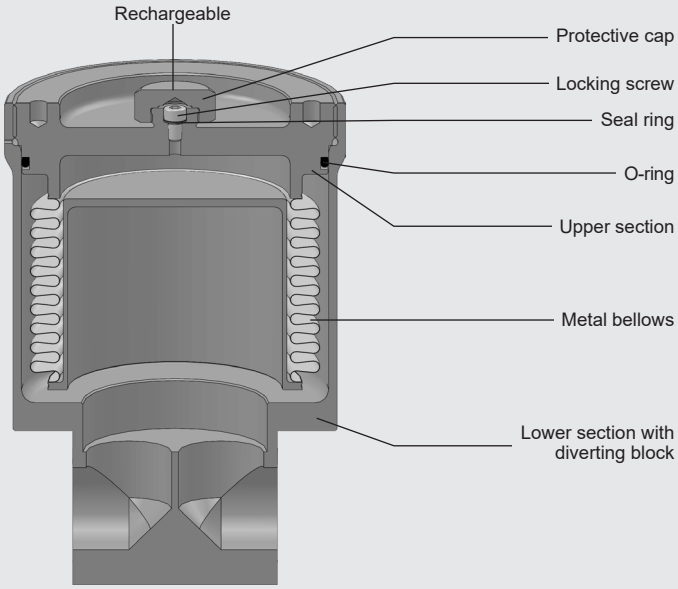
We are always happy to provide detailed advice.

1.2. DESIGN

HYDAC metal bellows accumulators are available as a standard series, see section 4.

Depending on customer requirements and the field of application, the metal bellows accumulator can be individually tailored in terms of the bellows design and the accumulator geometry.

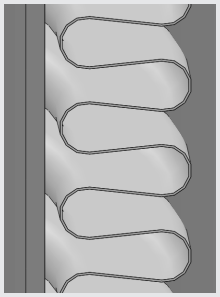
The following diagram illustrates an example of the structure of a metal bellows accumulator with convoluted bellows, configured for a damping application:



1.2.1 Bellows design

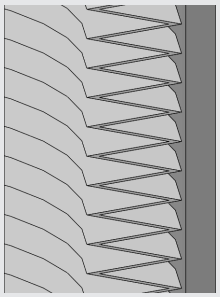
HYDAC supplies two types of metal bellows:

- **Corrugated bellows (formed)**



- Suitable for high differential pressures
- Unsusceptible to contamination
- Robust

- **Diaphragm bellows (welded)**



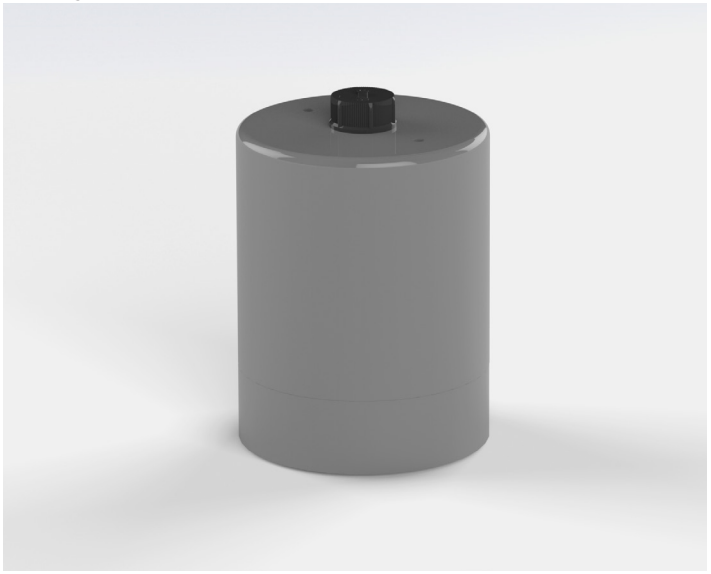
- High displacement volumes
- Very good energy storage properties
- Compact design

1.2.2 Pressure vessel

The pressure vessel of the metal bellows accumulator fundamentally comprises of an upper section and a lower section. These can be connected in a wide variety of ways.
The most common variants are listed below. Others are available on request.

Screw type

Weld type



Formed type

2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

The pressure vessel is fabricated in carbon steel or in stainless steel. Various coating systems are available to protect carbon steel versions.

2.1.2 Metal bellows

The metal bellows are made from stainless steel.

2.1.3 Sealing system

NBR, FKM, etc.

2.2. INSTALLATION POSITION

Metal bellows accumulators are preferably to be installed vertically, with the gas charging connection at the top. Other installation positions must be agreed with HYDAC.

2.3. TYPE OF INSTALLATION

HYDAC mounting elements must be used to securely fasten metal bellows accumulators.

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. HYDRAULIC FLUID

Diaphragm bellows accumulators must only be operated with hydraulic fluids that contain no hard particles and that have a minimum cleanliness class of:

- NAS 1638 Class 6 or
- ISO 4406 Class 17/15/12

Furthermore, the fluid must not solidify at any time.

2.6. CERTIFICATES

Hydraulic accumulators that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering. HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.
Others on request

2.7. FURTHER INFORMATION

- Operating instructions for metal bellows accumulators
  No. 3.304.BA

The operating instructions and the product-specific documents must be observed!
All work on HYDAC metal bellows accumulators must only be carried out by suitably trained staff. Incorrect installation or handling can lead to serious accidents.

- Assembly and repair instructions for metal bellows accumulators
  No. 3.304.M

For repairs to be performed on hydraulic accumulators, we provide corresponding assembly and repair instructions.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

SM50 P – 0,5 W E 1/ 116 U – 50 AAJ – 2,5

Series

Type code
No details = without divertingblock
P = with diverting block
L = light-weight

Nominal volume [l]

Version
W = corrugated bellows
M = diaphragm bellows

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

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 (MC)

Fluid port
1 = carbon steel
2 = carbon steel with corrosion protection
3 = stainless steel [1)]

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

Seal material
0 = no seal
2 = NBR
6 = FKM
7 = other materials
9 = FFKM

Certification code
U = European Pressure Equipment Directive (PED)
For others, see section 2.6.

Permitted operating pressure [bar]

Fluid port
See tables in catalogue section Piston accumulators, Standard design, No. 3.301

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

[1)] Dependent on type and pressure rating

4. STANDARD ITEMS

4.1. TECHNICAL DATA

The metal bellows accumulators described below are manufactured in stainless steel with a diaphragm bellows (MC = 340).

The table provides the most important data and dimensions for the following series: SM40/210

The data provided refers to metal bellows accumulators in accordance with PED (CC = U) and are guideline values for which specific part numbers can be provided on request.

4.1.1 Permitted operating temperature

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

-40 °C ... +120 °C

Other operating temperatures on request.

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The table in section 4.2. shows the permitted operating pressure in accordance with the European Pressure Equipment Directive.

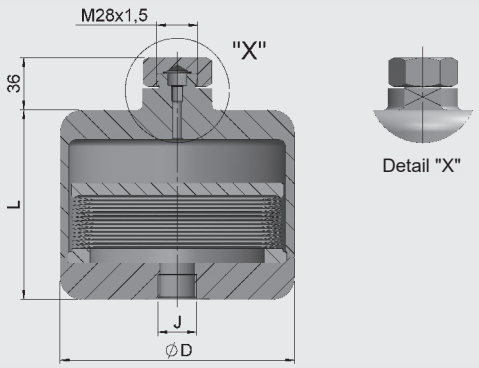
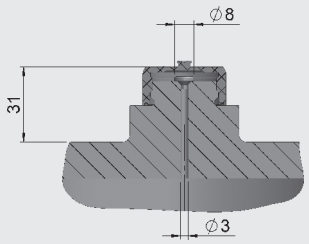
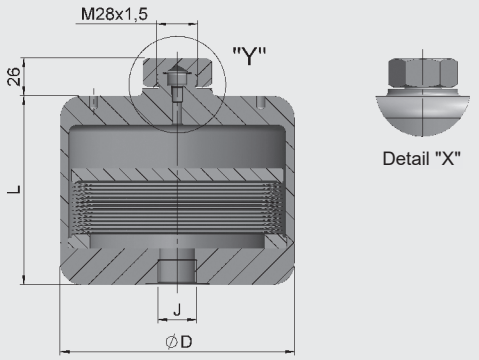
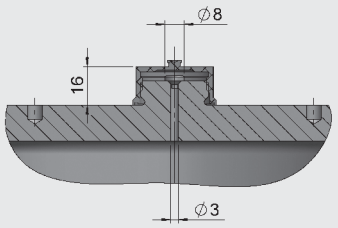
4.1.3 Nominal volume

HYDAC metal bellows accumulators are available with set nominal volumes, as described in the table in section 4.2.

4.1.4 Displacement volume

Max. volume (fluid side) between operating pressures p_2 and p_1.

4.2. TABLES AND DRAWINGS

Nominal volume	Rechargeable (E1)	Non-rechargeable (E2)
≤ 0.38 l		
> 0.38 l		

Nominal volume [1] [l]	Max. displacement volume [l]	Series	Perm. operating pressure [2] [bar]	L [3] [mm]	Ø D [3] [mm]	Approx weight. [3] [kg]	J ISO 228
0.17	0.1	40	40	94	69	1.4	G 1/2
		210	210	96	75	1.9	
0.38	0.25	40	40	119	86	2.3	G 1/2
		210	210	127	94	3.8	
0.73	0.5	40	40	140	106	3.7	G 1/2
		210	210	155	118	7.3	
1	0.75	40	40	131	131	5.2	G 3/4
		210	210	155	145	11.5	
1.3	1	40	40	128	156	8.1	G 3/4
		210	210	157	174	18.3	
2.6	2	40	40	213	156	10.2	G 3/4
		210	210	242	174	23.6	
3.8	3	40	40	181	228	19.7	G 1 1/2
6.5	5	40	40	177	330	50.3	G 1 1/2

[1] Higher nominal volume possible with same displacement volume

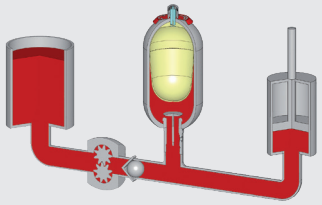
[2] At -40 °C to max. +120 °C

[3] Guidelines for dimensioning the pressure vessel at max. +120 °C

5. FUNCTION AND APPLICATION EXAMPLES

5.1. ENERGY STORAGE

The stored hydraulic energy is available from the accumulator for the following purposes: reserve pump capacity (emergency function, pump support) and leakage compensation.



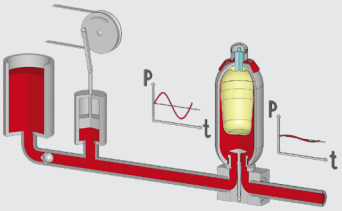
Application examples in the aviation industry

Application
Supporting the working hydraulics for flight control

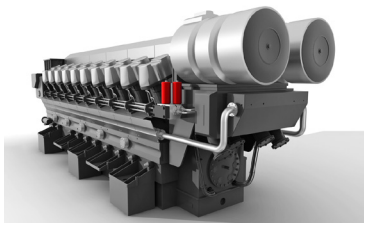
Accumulator type
SM209
Nominal volume
Up to 0.4 litres
Material
Stainless steel
Version
Diaphragm bellows

5.2. PULSATION DAMPING

Pressure pulsations are smoothed by the compressible gas inside the accumulator, e.g. suction flow stabilisation, reduction in noise level and vibrations.



Application examples in large diesel engines

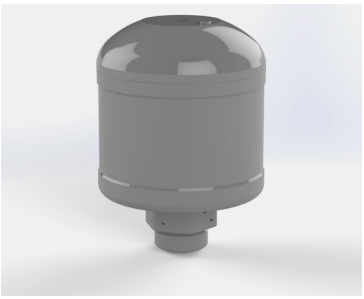


Application
Pulsation damping
Fuel system
Large diesel engines

Accumulator type
SM50P and SM50
Nominal volume
3.8 and 1.6 litres
Material
Carbon steel, coated
Version
Corrugated bellows

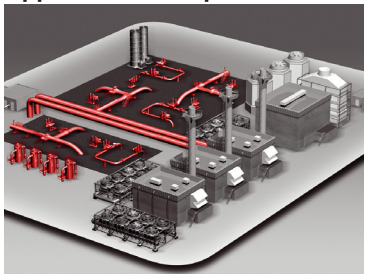
Application examples in the aviation industry

Application
Suction flow stabiliser
Hydraulic line
Engine supply



Accumulator type
SM16
Nominal volume
1 litre
Material
Stainless steel
Version
Diaphragm bellows
Special feature
Visual condition check

Application examples in the chemical industry/process technology

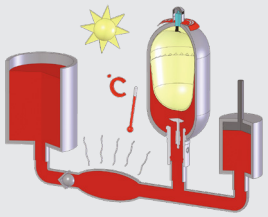


Application
Suction flow stabiliser
3-piston pump

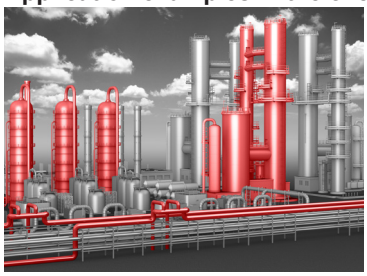
Accumulator type
SM210
Nominal volume
2 litres
Material
Stainless steel
Version
Diaphragm bellows
Special feature
Flange connection

5.3. VOLUME COMPENSATION

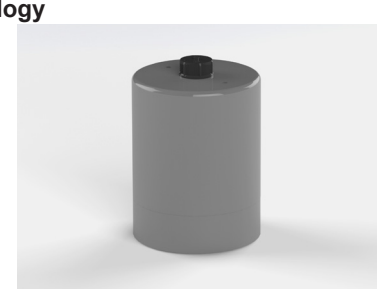
The hydraulic accumulator compensates for surplus volume, for instance when the volume of the fluid increases due to an increase in temperature.



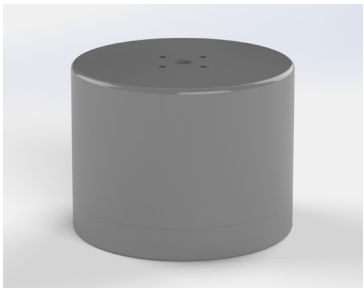
Application examples in the chemical industry/process technology



Application
Volume compensation when temperature fluctuates



Accumulator type
SM16
Nominal volume
1 litre
Material
Stainless steel
Version
Diaphragm bellows



Accumulator type
SM16
Nominal volume
9.4 litres
Material
Stainless steel
Version
Diaphragm bellows
Special feature
High displacement volume
Compact bellows design

6. NOTE

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

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Hydraulic dampers

1. DESCRIPTION

1.1. FUNCTION

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

- Flow rate fluctuations from displacement pumps
- Actuation of shut-off and control valves with short opening and closing times
- Switching on and off of pumps
- Sudden linking of spaces with different pressure levels

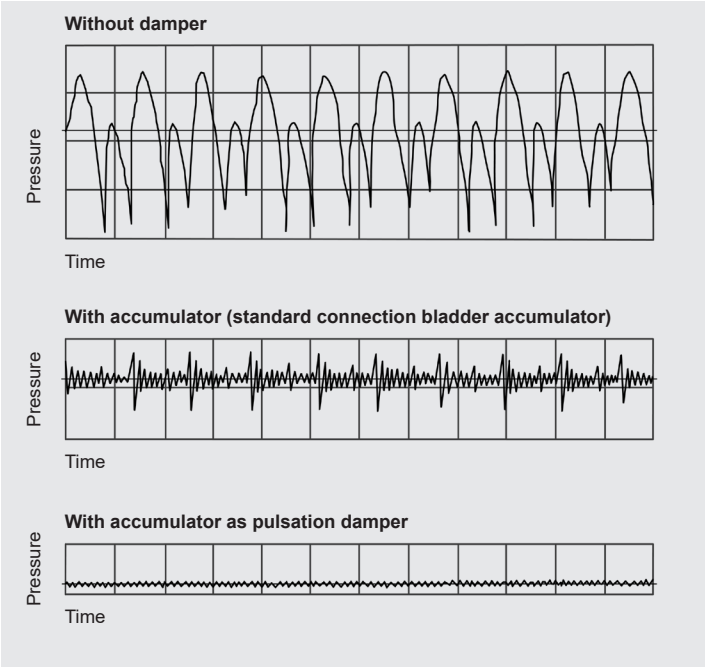
HYDAC hydraulic dampers are particularly suitable for damping such pressure fluctuations. Selecting the most suitable hydraulic damper for each system ensures that:

- Reduction in piping, valve and coupling vibrations, for example
  → less piping damage
- Protection of valves and measuring instruments
- Reduction in noise
- Improvement in machine tool performance
- Interconnection of several pumps in one line is possible
- A pump rpm and feed pressure increase is possible
- The maintenance and servicing costs can be reduced
- The service life of the system is increased

In addition to hydraulic dampers, HYDAC supplies fluid silencers, see catalogue section:

- Silencers
  No. 3.702

Pulsation dampers



Design

HYDAC pulsation dampers consist of the following key individual components:

- Welded or forged pressure vessel in carbon steel, available with internal coating or in stainless steel for chemically aggressive fluids
- Special fluid valve with inline connection, which guides the flow into the vessel (threaded or flange connection)
- Bladder or diaphragm in various elastomers as shown in section 2.1.3

Mode of operation

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

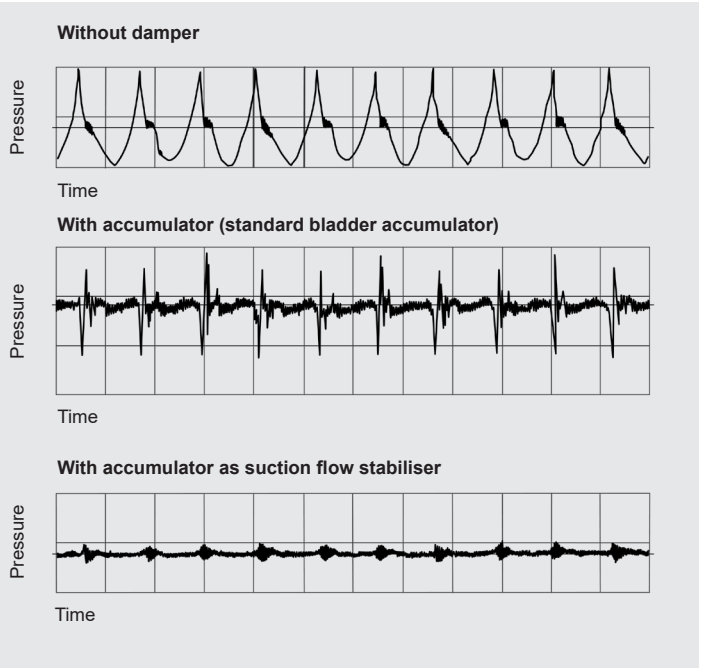
The flow is diverted in the fluid valve so that it is directed straight at the bladder or diaphragm. This causes direct contact of the flow with the bladder or diaphragm which, in an almost inertialess operation, balances the flow rate fluctuations via the gas volume. It particularly compensates for higher frequency pressure oscillations. The charge pressure is adjusted to individual operating conditions.

Applications

HYDAC pulsation dampers prevent pipe breaks caused by material fatigue, pipe oscillations and irregular flow rates. This protects valves, control devices and other instruments and reduces noise.

They are used in hydraulic systems, displacement pumps, sensitive measurement and control instruments and piping with extensive branching, e.g. in process circuits in the chemicals industry.

Suction flow stabilisation



Design

HYDAC suction flow stabilisers consist of the following key individual components:

- Welded vessel made from carbon steel or stainless steel
- The inlet and outlet are on opposite sides and are separated by a baffle, other versions on request
- Encapsulated bladder in the upper part
- Vent screw in end cap and a drainage facility on the bottom

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.

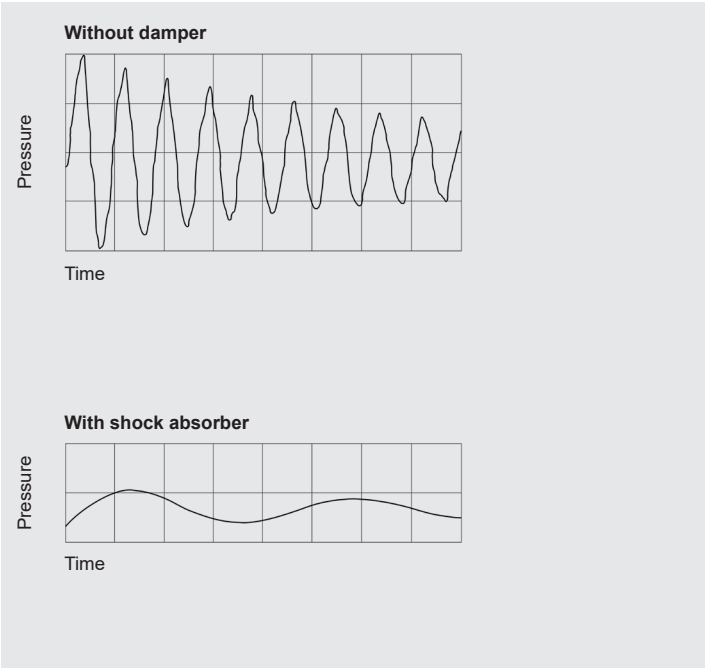
An air separation is also achieved due to the extremely low flow rate in the suction flow stabiliser and the deflection on a baffle. By adjusting the charging pressure of the bladder to the operating conditions, the best possible damping is achieved.

Applications

HYDAC suction flow stabilisers improve the NPSH value of the system, avoid pump cavitation and prevent pipe oscillations.

Their main application areas are piston and diaphragm pumps in public utility plants and the chemical industry.

Shock absorption



Design

Shock absorption can be provided by using bladder, piston and diaphragm accumulators. Further technical details on the individual accumulator types can be found in the following catalogue sections:

- Bladder accumulators Low pressure
  No. 3.202
- Bladder accumulators Standard design
  No. 3.201
- Diaphragm accumulators
  No. 3.100
- Piston accumulators Standard design
  No. 3.301

Mode of operation

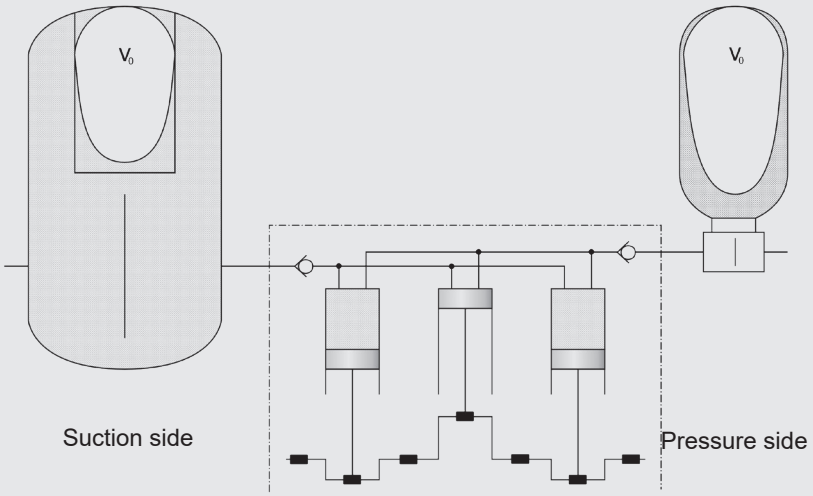
Sudden changes in pipeline flow, such as those caused by pump failure or the closing or opening of valves, can cause pressures which are many times higher than the normal values. The shock absorber prevents this by converting potential energy into kinetic energy and vice versa. This prevents pressure shocks and protects pipelines, valves, monitoring instruments and other pipe fittings from destruction.

Applications

HYDAC shock absorbers reduce pressure shocks and protect pipelines and other pipe fittings from destruction.

They are used 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.

1.3.1 PULSATION DAMPER AND SUCTION FLOW STABILISER



On the suction side and the pressure side of piston pumps there are almost identical conditions in terms of the irregularity of the flow rate. Therefore, the same formulae for determining the effective gas volume are used to calculate the damper size. The fact that two completely different damper types are ultimately used is due to the different acceleration and pressure ratios on the two sides.

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

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

By giving the residual pulsation or the gas volume, the damper size can be dimensioned with the aid of the HYDAC software **ASP** (**A**ccumulator **S**imulation **P**rogram).

Designations:

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

q = stroke volume [l]

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

d_κ = piston diameter [dm]

h_κ = piston stroke [dm]

m = amplitude factor

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

z = no. of compressions or effective cylinders per revolution

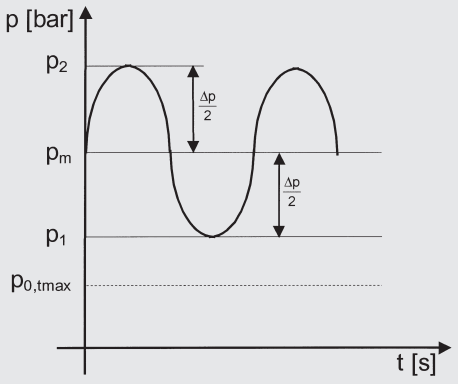
x = residual pulsation [± %]

κ = isentropic exponent

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

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

Δp = amplitude of pressure fluctuations
$\Delta p = p_2 - p_1$ [bar]



Formulae:

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

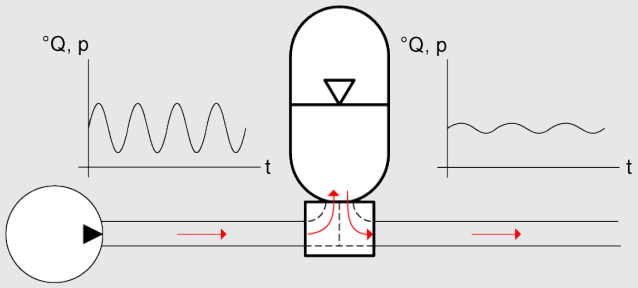
$$\Delta V = m \bullet q$$

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

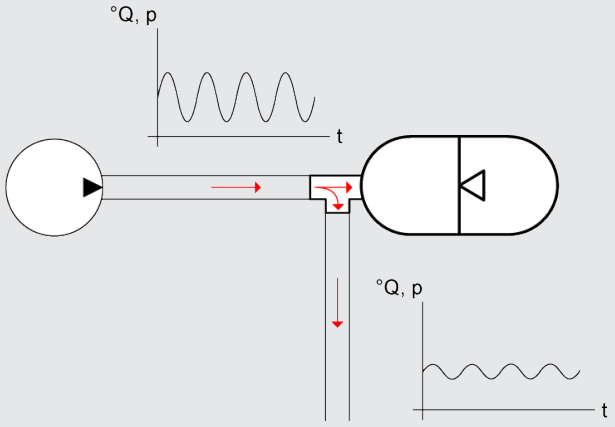
$$= \left|\frac{p_2 - p_m}{p_m} \bullet 100\right|$$

Diagram of mounting options:

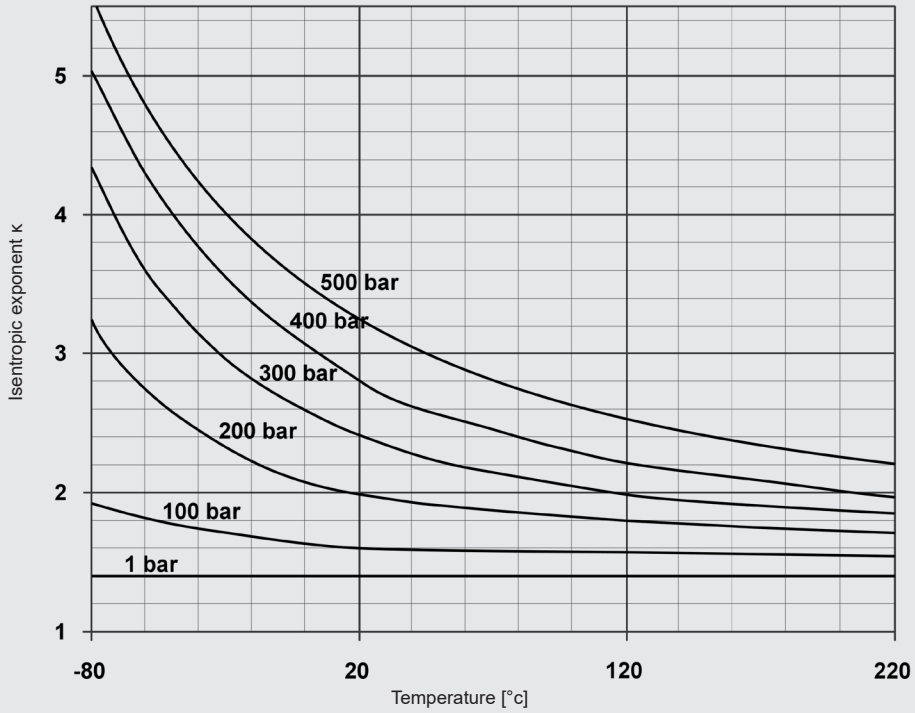
Preferred installation configuration with maximum damping effect



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



Isentropic exponent κ dependent on pressure and temperature:



Amplitude factor (m) for piston pump:

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

Others on request

1.3.2 Calculation example

Given parameters:

Single-acting 3-piston pump

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

Required:

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

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

Solution:

a) Determining the required suction flow stabiliser

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

$$V_0 = \frac{0{,}035 \bullet \frac{\pi \bullet 0{,}7^2}{4} \bullet 1{,}0}{\left[\frac{0{,}6}{1-\frac{2{,}5}{100}}\right]^{\frac{1}{1{,}4}} - \left[\frac{0{,}6}{1+\frac{2{,}5}{100}}\right]^{\frac{1}{1{,}4}}}$$

V_0 = 0.54 l

Selected: SB16S-12 with 1 litre gas volume

b) Determining the required pulsation damper

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

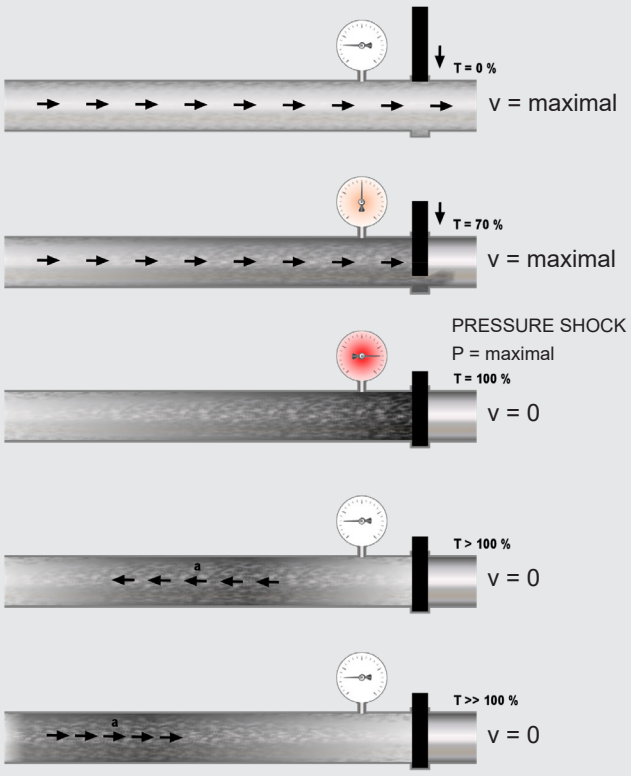
$$V_0 = \frac{0{,}035 \bullet \frac{\pi \bullet 0{,}7^2}{4} \bullet 1{,}0}{\left[\frac{0{,}7}{1-\frac{0{,}5}{100}}\right]^{\frac{1}{2{,}0}} - \left[\frac{0{,}7}{1+\frac{0{,}5}{100}}\right]^{\frac{1}{2{,}0}}}$$

V_0 = 3.2 l

Selected: SB330P-4

1.3.3 SHOCK ABSORBER

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



Simplified pressure shock calculation for the closing of a valve.

Estimate of Joukowsky's max. occurring pressure shock

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

ρ [kg/m³] = fluid density

Δv = $v - v_1$

Δv = change in 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] = elasticity modulus of the pipeline

D [mm] = internal diameter of the pipeline

e [mm] = wall thickness of the pipeline

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

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

L [m] = length of the pipeline

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

If T < t then: $p_{max} = p_1 + \Delta p$

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

Determining the required damper size

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

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

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

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

p_1 [bar] = zero head of the pump

p_2 [bar] = perm. operating pressure

p_0 [bar] = pre-charge pressure

A special calculation program for analysing the pressure curve is available for manifold sizing or sizing with regards to pump failure or start-up.

1.3.4 Calculation example

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

Given parameters:

Length of pipeline L:	2000 m
Size of pipeline D:	250 mm
Wall thickness of pipeline e:	6.3 mm
Material of the pipeline:	Steel
Flow rate Q:	432 m^3/h = 0.12 m^3/s
Density of medium ρ:	980 kg/m^3
Zero feed height of pump p_1:	6 bar
Min. operating pressure p_{min}:	4 bar
Eff. closing time of valve T:	1.5 s (approx. 20% of total closing time)
Operating temperature:	20 °C
Compression modulus of fluid K:	1.62 × 10^9 N/m^2
Elasticity modulus (steel) E:	2.04 × 10^{11} N/m^2

Required:

Size of 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 shock occurs and the formula as shown in section 1.3.3 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 shock absorbers
SB35AH-450

2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Accumulator shell

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

For special requirements, high-resistance plastic accumulator shells are available.

2.1.2 Bladder/diaphragm

The elastomer material must be selected in accordance with the particular operating medium or operating temperature, see section 2.1.3. If discharge conditions are unfavourable (high p_2/p_0 pressure ratio, rapid discharge speed), the gas may cool to below the permitted temperature. This can cause cold cracking. The gas temperature can be calculated using the HYDAC Accumulator Simulation Program **ASP**.

2.1.3 Maximum temperature range of elastomer materials

The permitted working temperature of a hydraulic damper is dependent on the application of the metal materials and the separation element. The operating medium must also be taken into account.
The following table shows the main **elastomer materials with their maximum possible temperature ranges** with examples of operating fluids.

Materials		Material code [1]	Accumulator type	Max. possible temperature range [2]	Possible operating fluids, others on request	
					Resistant to	Not resistant to
NBR	Acrylonitrile butadiene rubber	2	SB, SBO	-15 °C ... + 80 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the groups HFA, HFB, HFC – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Fuels
		5	SB, SBO	-50 °C ... + 50 °C		
		9	SB, SBO	-30 °C ... + 80 °C		
ECO	Ethylene oxide epichlorohydrin rubber	3	SB	-30 °C ... +120 °C	– Mineral oil (HL, HLP) – Flame-retardant fluids from the HFB group – Synthetic esters (HEES) – Water – Sea water	– Aromatic hydrocarbons – Chlorinated hydrocarbons (HFD-S) – Amines and ketones – Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the groups HFA and HFC – Fuels
			SBO	-40 °C ... +120 °C		
IIR	Butyl rubber	4	SB	-50 °C ... +100 °C	– Hydraulic fluids from the group HFD-R – Flame-retardant fluids from the group HFC – Water	– Mineral oils and greases – Synthetic esters (HEES) – Aliphatic, chlorinated and aromatic hydrocarbons – Fuels
			SBO	-50 °C ... +120 °C		
FKM	Fluorine rubber	6	SB, SBO	-10 °C ... +150 °C	– Mineral oil (HL, HLP) – Hydraulic fluids from the group HFD – Synthetic esters (HEES) – Fuels – Aromatic hydrocarbons – Inorganic acids	– Amines and ketones – Ammonia – Skydrol and HyJet IV – Steam

[1] The material code (MC) is described in more detail in the model code, see section 3.

[2] The specified temperature range relates to the particular elastomer material, not to the operating range of the hydraulic accumulator, see section 4.1.1

2.2. INSTALLATION POSITION

Pulsation damper

As close as possible to the pulsation source.
Mounting position preferably vertical (gas valve pointing upwards).
Preferred and alternative installation positions are shown in schematic form in section 1.3.

Suction flow stabiliser

As close as possible to the suction inlet of the pump.
Vertical mounting position (gas valve pointing upwards).

Shock absorber

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

2.3. TYPE OF INSTALLATION

Hydraulic dampers with large volumes are generally designed with corresponding mounting devices.

Bladder accumulator and diaphragm accumulator pulsation dampers are fitted directly inline.

In the case of strong vibrations and wherever these are possible, we recommend using HYDAC mounting elements, see catalogue section:

- Mounting elements for hydraulic accumulators
  No. 3.502

2.4. CHARGING GAS

- Charging gas: Nitrogen
- Specification: min. Class 2.8

If other gases are to be used or if these specifications are deviated from, please contact HYDAC.

2.5. CERTIFICATES

Hydraulic dampers that are installed outside of Germany are supplied with the relevant test certificate documentation. The country of installation must be stated at the time of ordering.
HYDAC pressure vessels can be supplied with almost any approval classification. The permitted operating pressure may differ from the nominal pressure.
The following table provides some examples of the code in the model code:

Country	Certificate code (CC)
EU member states	U
Australia	F [1)]
Belarus	A6
Canada	S1 [1)]
China	A9
Great Britain	Y
Hong Kong	A9
Iceland	U
Japan	P
Korea (Republic of)	A11
New Zealand	T
Norway	U
Russia	A6
South Africa	S2
Switzerland	U
Turkey	U
Ukraine	A10
USA	S

[1)] Registration required in the individual territories or provinces.
Others on request

2.6. FURTHER INFORMATION

- Operating instructions for bladder accumulators
  No. 3.201.BA
- Operating instructions for piston accumulators
  No. 3.301.BA
- Operating instructions for diaphragm accumulators
  No. 3.100.BA

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

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

SB330 P – 10 A 1 / 112 U – 330 AI

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

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

Nominal volume [l]

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

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

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

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

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

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

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

Permitted operating pressure [bar]

Connection, fluid side
AI = ISO 228 (BSP), standard connection
BI = DIN 13 in acc. with ISO 965/1 (metric) [1)]
CI = ANSI B1.1 (UNF thread, sealing to SAE standard) [1)]
DI = ANSI B1.20 (NPT thread) [1)]
SBO250P-0075E1 and for SBO210P-0.16E1:
AK = ISO 228 (BSP), standard connection

[1)] Specify full details of version
[2)] Not available for all versions
[3)] Dependent on type and pressure rating
[4)] When ordering a spare bladder, please state diameter of the smallest shell port
[5)] Observe temperature ranges, see section 2.1.3

4. STANDARD ITEMS

The hydraulic dampers and any spare parts described below are manufactured in carbon steel with an NBR diphragm and/or accumulator bladder (MC = 112).

The tables provide the most important data and dimensions for the following series: SB...P(H), SB16S, SBO...(P)

The part numbers provided refer to hydraulic dampers in accordance with PED (CC = U).

Designs that differ from the standard types described below can be requested from HYDAC.

4.1. TECHNICAL DATA

4.1.1 Permitted operating temperature

As standard, a hydraulic damper can be operated in the following temperature range:

-10 °C ... +80 °C

Other operating temperatures on request.

4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The tables in section 4.2. show the permitted operating pressure in accordance with the European Pressure Equipment Directive.

4.1.3 Nominal volume

HYDAC hydraulic dampers are available with set nominal volumes, as described in the tables in section 4.2.

4.1.4 Effective gas volume

The effective gas volume is based on nominal dimensions. It differs slightly from the nominal volume and must be used when calculating the effective fluid volume.
For diaphragm accumulators, the effective gas volume corresponds to the nominal volume.

4.1.5 Effective volume

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

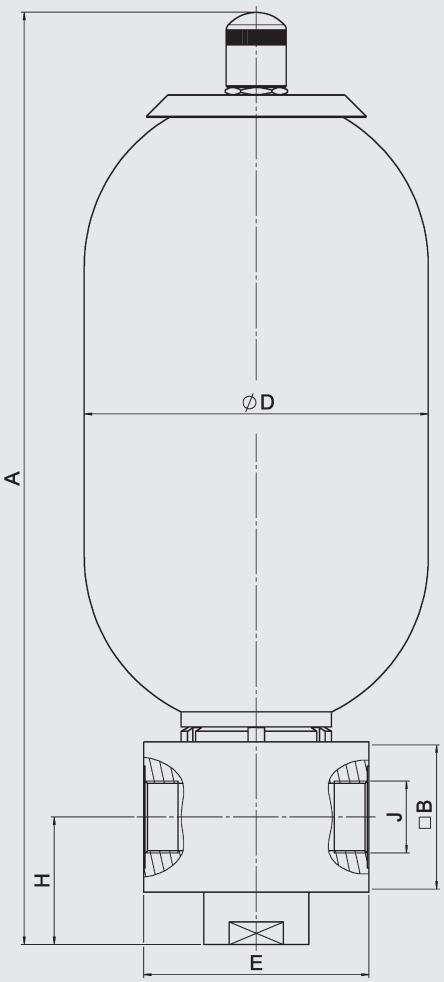
4.1.6 Limits for gas pre-charge pressure

Ratio of maximum operating pressure p_2 to gas pre-charge pressure p_0.
The specified values are maximum values and must not be considered as referring to a permanent load. The sustainable pressure ratio is affected by geometry, temperature, medium, flow rate and gas losses resulting from physical characteristics.
See catalogue section:

- HYDAC Accumulator Technology
  No. 3.000
- Bladder accumulators Low pressure
  No. 3.202
- Bladder accumulators Standard design
  No. 3.201
- Diaphragm accumulators
  No. 3.100

4.2.1 Pulsation damper bladder accumulator

SB330/550P(PH)-…, carbon steel, NBR



Nominal volume [l]	Series [3]	Max. operating pressure (PED) [bar]	Part no.	Eff. gas volume [l]	A [mm]	□ B [mm]	Ø D [mm]	E [mm]	H [mm]	J [1] Thread ISO 228	Weight [kg]
1	SB330P	330	296114	1	365	80	118	120	57	G 1 1/4	11
	SB550P	550	3435597 [3]		384	70	121		53		13
2.5	SB330P	330	3078967	2.4	570	80	118	120	57	G 1 1/4	16
	SB550P	550	3576155 [3]	2.5	589	70	121		53		20
4	SB330P	330	3121155	3.7	455	80	171		57		18
	SB330PH		–		491	100		150	85	G 1 1/2	26
5	SB550P	550	4313259 [3]	4.9	917	70	121	120	53	G 1 1/4	26
6	SB330P	330	3140558	5.7	559	80	171		57		20
	SB330PH		–		593	100		150	85	G 1 1/2	28
10	SB330P		3082257	9.3	620		229			G 1 1/2	40
	SB330PH		–		652	130x140			100	SAE 2" - 6000 psi	50
13	SB330P	330	2107871	12	712	100			85	G 1 1/2	48
20	SB330P		3084825	18.4	920						70
	SB330PH		–		952	130x140			100	SAE 2" - 6000 psi	80
24	SB330P	330	3152980	23.6	986	100			85	G 1 1/2	82
32	SB330P		3121154	33.9	1445						100
	SB330PH		–		1475	130x140			100	SAE 2" - 6000 psi	110

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

[2] Special/welded version, on request

[3] Material code (MC) = 212, see model code, section 3.

4.2.2 Pulsation damper diaphragm accumulator

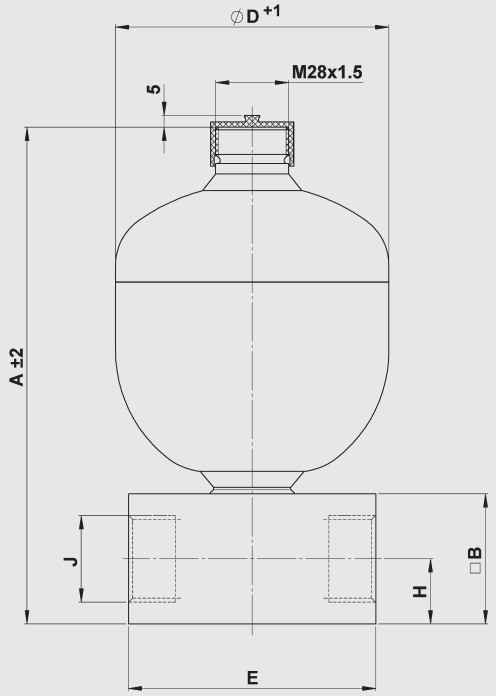


Fig. 1

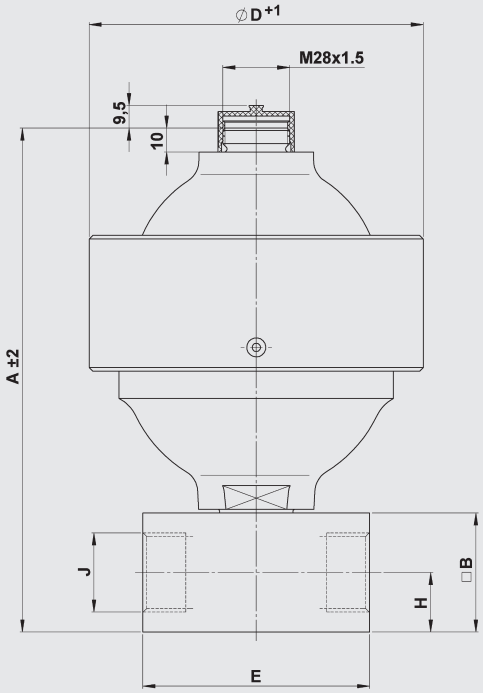


Fig. 2

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

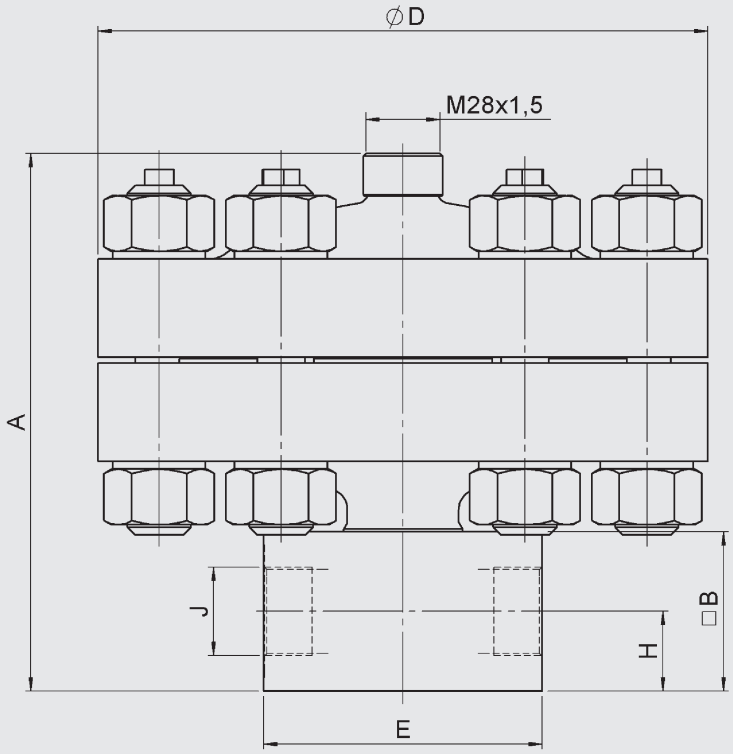
[1] Standard connection code = AK or AI, others on request

( ) Brackets indicate different dimensions for stainless steel version

4.2.3 Pulsation damper for aggressive media SBO...P-...A6/347...(PTFE)

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

Permitted operating temperature: -15 °C ... +80 °C
Permitted pressure ratio: $p_2 : p_0 = 2 : 1$



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

[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: $p_2 : p_0 = 2 : 1$

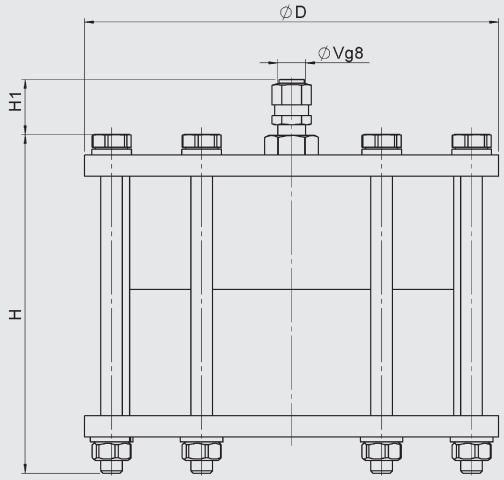


Fig. 1

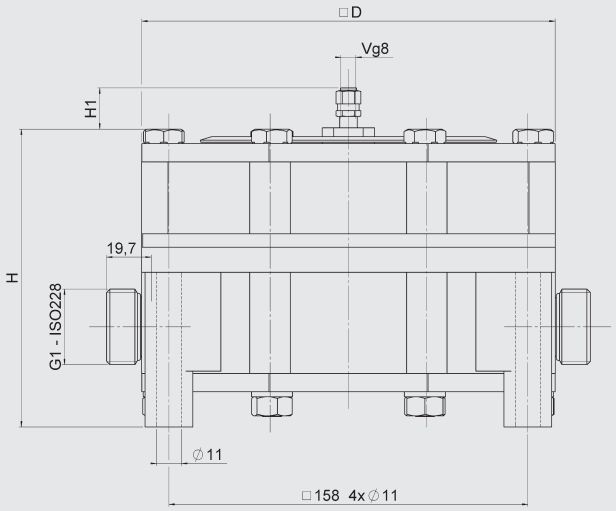
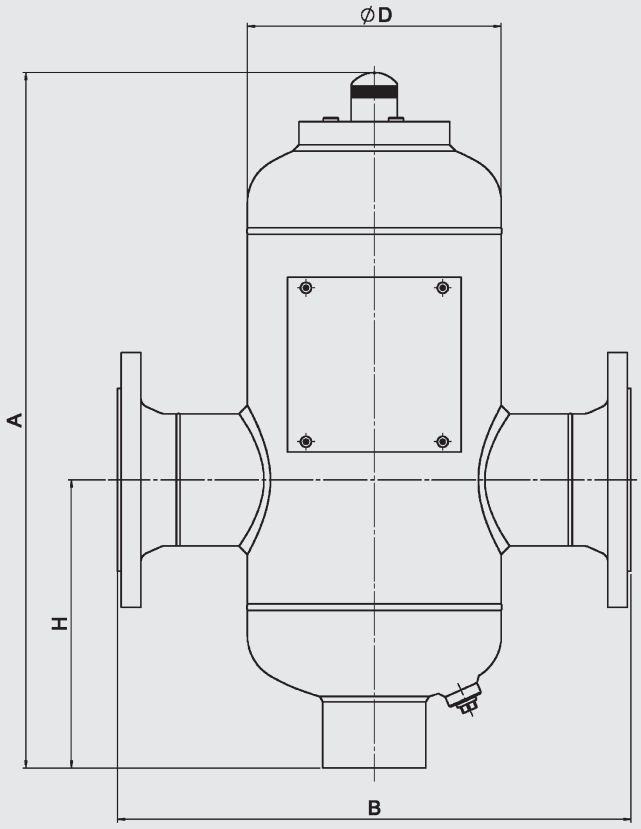


Fig. 2

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

Suction flow stabiliser SB16S



Nominal volume [l]	Fluid volume [l]	Perm. operating pressure (PED) [bar]	Eff. gas volume [l]	A [mm]	B [mm]	Ø D [mm]	H [mm]	DN [1]	Weight [kg]
12	12	16	1	580	425	219	220	65	40
25	25		2.5	1025					60
40	40		4	890	540	300	250	80	85
100	100		10	1150	650	406	350	100	140
400	400		35	2050	870	559	400	125	380

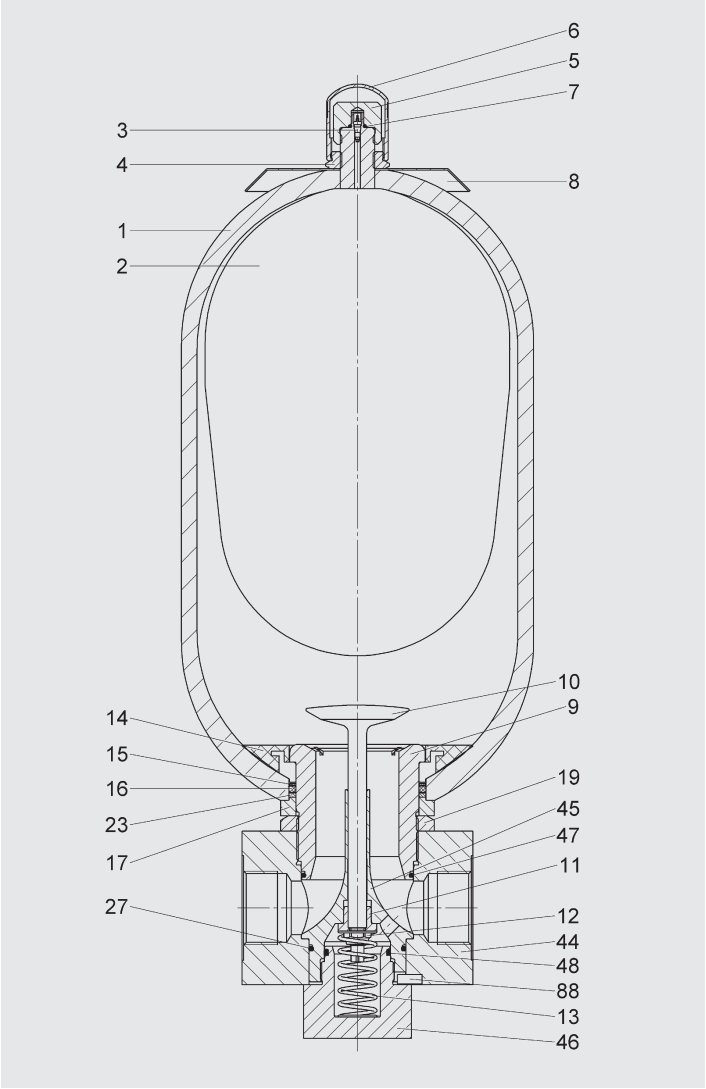
Further pressure ratings 25 bar, 40 bar; others on request

Other fluid volumes on request

[1] To EN1092-1/11 /B1/PN16

4.3. SPARE PARTS

4.3.1 Pulsation damper bladder accumulator SB330/550P(PH)



Description	Item
Bladder assembly consisting of:	
Bladder	2
Gas valve insert [1]	3
Lock nut	4
Seal cap	5
Protective cap	6
O-ring	7
Seal kit consisting of:	
O-ring	7
Washer	15
O-ring	16
Support ring	23
O-ring	27
O-ring	47
O-ring	48

[1] Available separately

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

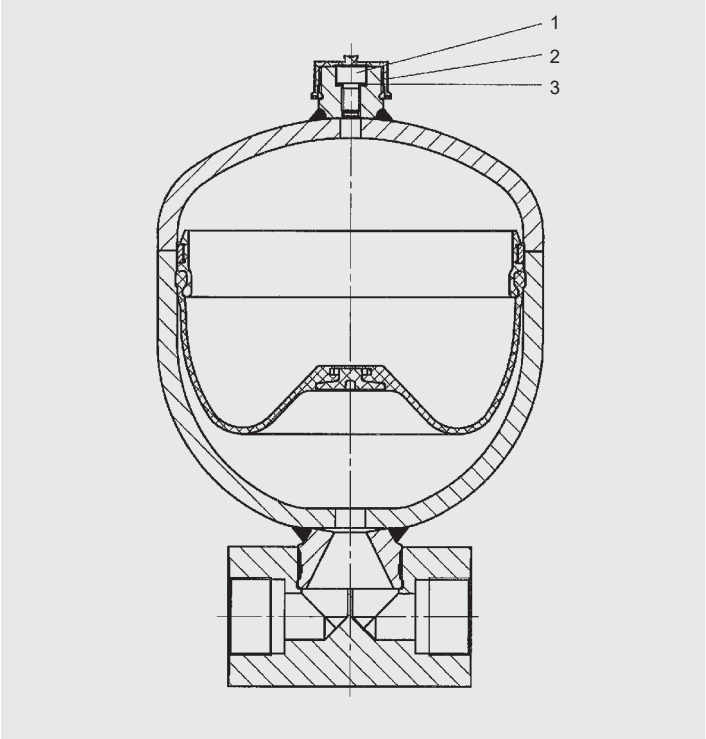
Description	Item
Connection assembly consisting of:	
Oil valve body	9
Valve plate	10
Damping bush	11
Lock nut	12
Valve spring	13
Anti-extrusion ring [1]	14
Washer	15
O-ring	16
Spacer	17
Groove nut	19
Support ring (only for 330 bar)	23
O-ring	27
Connector	44
Guide piece	45
Cap	46
O-ring	47
O-ring	48
Locking key	88

[1] Available separately

NBR, carbon steel, standard gas valve

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

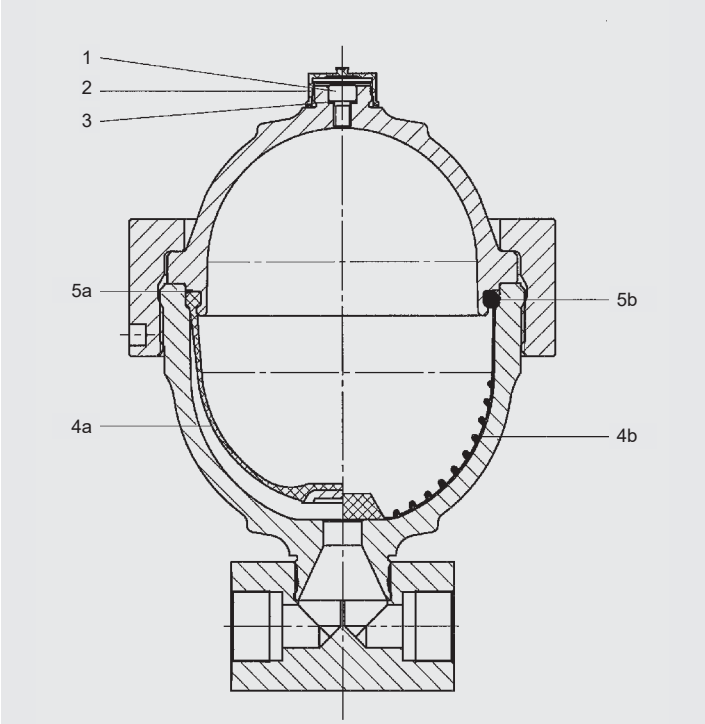
4.3.2 Pulsation damper diaphragm accumulator SBO...P...E



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

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

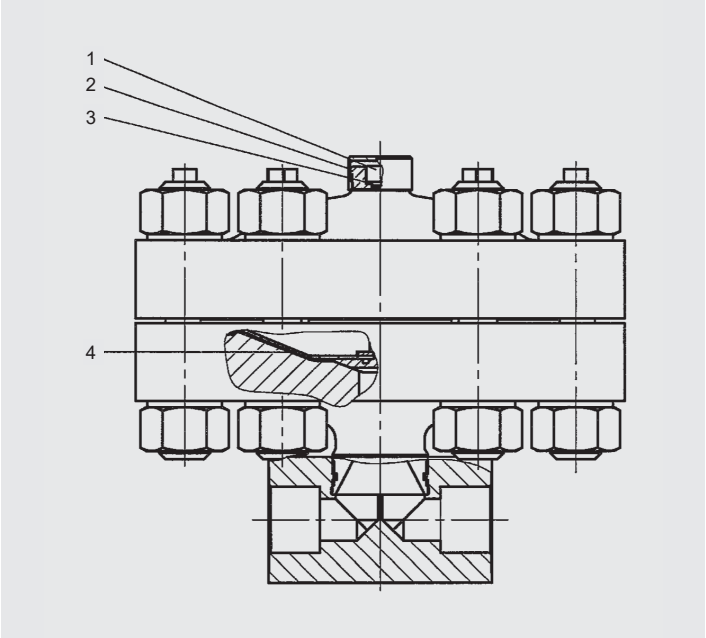
SBO...P...A6



Description	Qty.	Item
Spare parts set, gas side consisting of:		
Locking screw	20	1
Protective cap	20	2
Seal ring	20	3
Spare parts kit with elastomer diaphragm consisting of:		
Locking screw		1
Seal ring		3
Elastomer diaphragm		4a
Support ring		5a
Spare parts kit with full-PTFE diaphragm consisting of:		
Locking screw		1
Seal ring		3
Full-PTFE diaphragm		4b
O-ring		5b

Nominal volume	Part no.				
[l]	NBR	ECO	FKM	IIR	PTFE
Spare parts set for gas side					
0.075 - 4	3262845	-	-	-	-
Spare parts kit					
0.1	3042668	3182526	-	-	-
0.25	3042709	3042712	3042714	3042713	3504798
0.6	3042710	3042715	3042717	3042716	3550388
1.3	3042681	3042682	3042684	-	3446897
2	3042711	3042719	3042721	3042720	3464205
2.8	3042700	3042701	3042704	3042702	-
4	3042705	3042706	3042708	3042707	-

4.3.3 Pulsation dampers for aggressive media SBO...P-...A6/347...(PTFE)

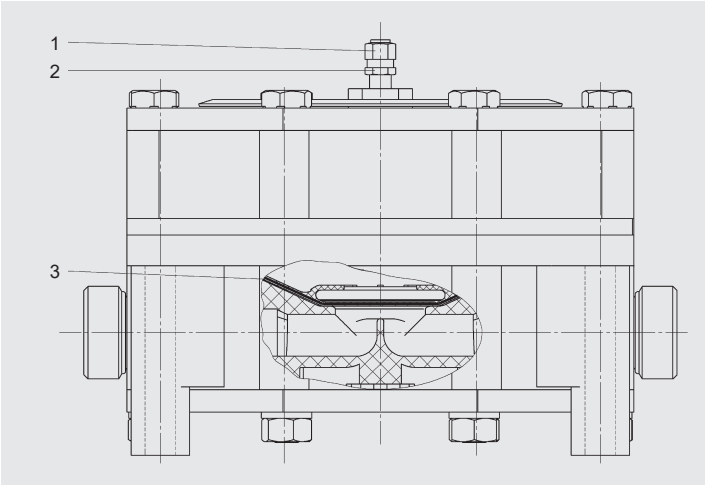


Description	Item
Spare parts kit, gas side consisting of:	
Locking screw	1
Seal ring	3
Diaphragm	4

Designation	Part no.
Spare parts kit for gas side	3196168

Protective cap (item) on request

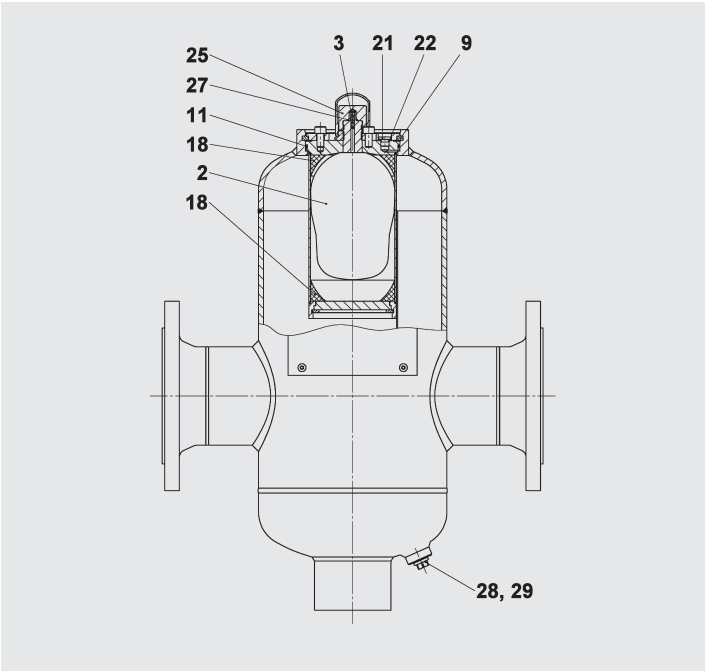
SBO...(P)-...A4/777... (PVDF/PTFE)



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

Designation	Material	Part no.
Gas valve assembly	Stainless steel 1.4571 FPM / PTFE / brass	3320800
Gas valve insert	FPM / PTFE / brass	629516
	FPM / PTFE / stainless steel 1.4571	632992
Diaphragm	PTFE / NBR	3279342

4.3.4 Suction flow stabiliser



Description	Item
Accumulator bladder	2
Gas valve insert	3
Anti-extrusion ring	9
O-ring	11
Insertion ring, 2x	18
Locking screw	21
Seal ring	22
Seal cap	25
O-ring	27
Seal ring	28
Locking screw	29

5. NOTE

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

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Silencers

1. DESCRIPTION

1.1. FUNCTION

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 only provide partial solutions to the problem as they do not prevent transmission to other areas.

In addition to fluid silencers, HYDAC supplies hydraulic dampers in various versions, see catalogue section:

- Hydraulic dampers
  No. 3.701

1.2. DESIGN

Design

The silencer consists of a housing, an internal tube and two pipe connections on opposite sides. It has no moving parts and no gas charge and is therefore absolutely maintenance free.
The silencer can be used for mineral oils, phosphate ester and water glycol. A stainless steel model is available for other fluids.

Mode of operation

The HYDAC fluid silencer is based on the principle of an expansion chamber with an interference line. .By reflecting the oscillations within the silencer the majority of the oscillations are dampened across a wide frequency spectrum.

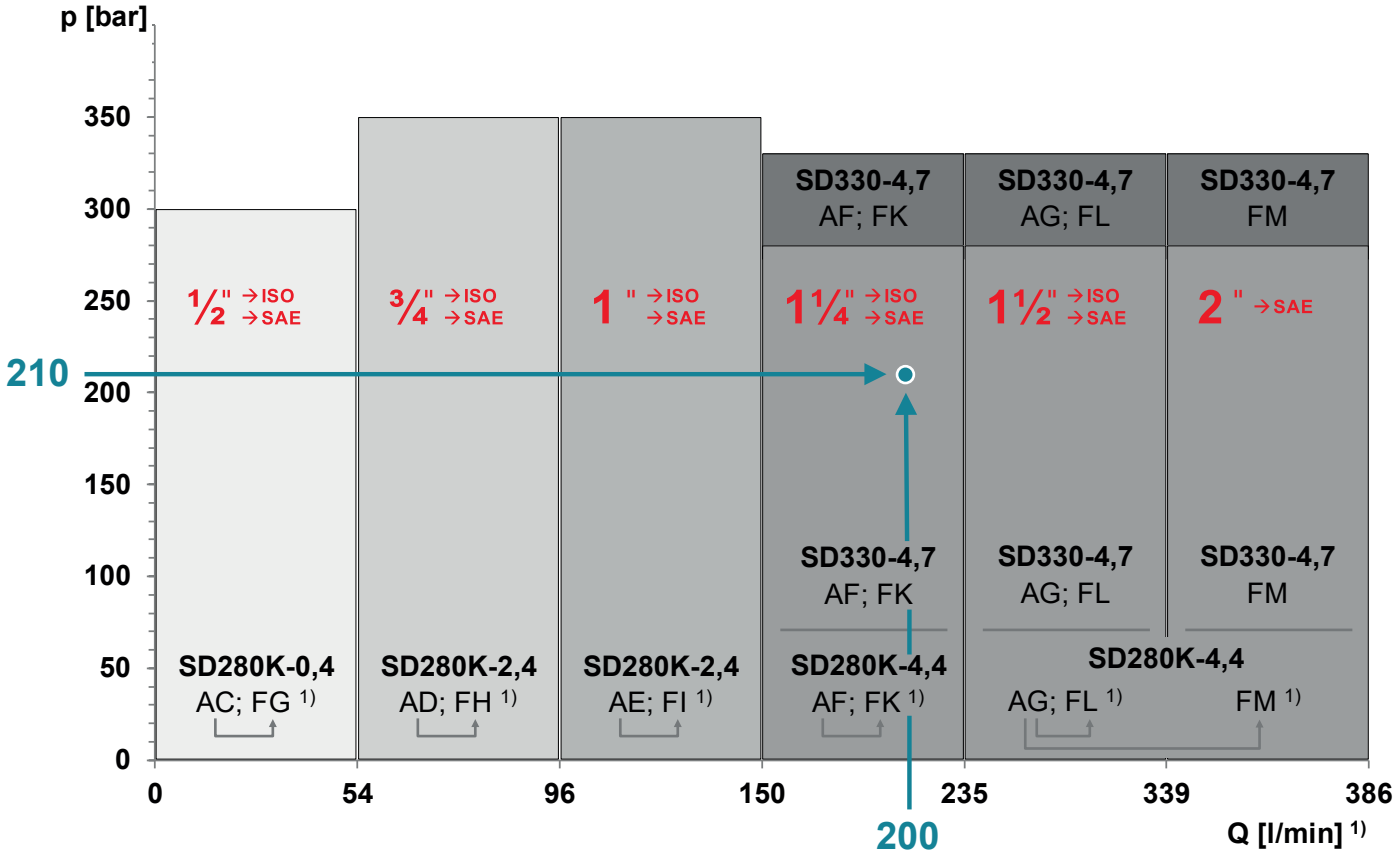
Applications

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.

1.3. SIZING

■ **Series SD330, SD280K**

With the aid of a few details (max. pressure and nominal flow), the appropriate silencer type for the particular application can easily be chosen by using the following pressure/flow rate matrix.



1) SD280K model: ISO connection can be converted to an SAE flange connection (see section 4.2.2)

Example of the selection process:

Max. operating pressure p = 210 bar

Flow rate Q = 200 l/min

The following versions can be selected, depending on the connection system available:

- SD330-4,7…AF/AF
- SD330-4,7…FK/FK
- SD280K-4,4…AF/AF
  → with SAE adapter (section 4.2.2), can be converted to FK/FK

■ **Customer-specific versions**

Customer-specific versions are available for special applications.
They can be dimensioned on the basis of a piston accumulator or a diaphragm accumulator.
To determine the transmission damping D, a starting basis of at least 20 dB must be chosen.

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

Δp_o = amplitude of pressure fluctuations without silencer

Δp_m = amplitude of pressure fluctuations with silencer

When selecting the damper, the size of the silencer body and the fundamental frequency f of the pump have to be taken into account.

f = i • n / 60 in Hz

i = number of displacement elements

n = rotational speed in rpm

By calculating the fundamental frequency and using the system data (e.g. pipe length, ball valves, pressure, temperature, etc.) we can determine the correct size of silencer for you.

Use the specification sheet to provide the required data quickly and conveniently on a PC and send it to us.
See www.hydac.com.

2. GENERAL INFORMATION

2.1. MATERIALS, CORROSION PROTECTION

2.1.1 Silencer body

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

2.2. INSTALLATION POSITION

The HYDAC silencer can operate in any position.

2.3. TYPE OF INSTALLATION

With any connection type, care must be taken to ensure that the silencer has enough mechanical support. Mounting elements can be found in the following catalogue section:

- Mounting elements for hydraulic accumulators
  No. 3.502

2.4. FURTHER INFORMATION

- Operating instructions for silencers
  No. 3.701.BA

The operating instructions must be observed!

All work on HYDAC silencers must only be carried out by suitably trained staff. Incorrect installation or handling can lead to serious accidents.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

SD280 (K) – 0.4 / 412 U – 300 AC/AC

Series

Type code*
No details = forged housing
K = piston accumulator base shell
M = diaphragm accumulator base shell

Nominal volume [l]

Silencer type*
0 = without pipe
4 = universal broadband silencer

Housing material*
1 = carbon steel
3 = stainless steel

Sealing material
0 = no seal
2 = NBR (-20 °C ... +80 °C)

Certification code
U = European Pressure Equipment Directive (PED)

Permitted operating pressure [bar]

Connections
See section 4.2.
e.g. AC = threaded connection ISO228 with G 1/2 on both sides

* Others on request

4. STANDARD ITEMS

The silencers and spare parts described below are manufactured in carbon steel/NBR.

The tables provide the most important data and dimensions for the following series: SD330, SD280K

The part numbers provided refer to silencers in accordance in accordance with PED (CC = U).

4.1. TECHNICAL DATA

4.1.1 Permitted operating temperature

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

-20 °C ... +80 °C

Other operating temperatures on request.

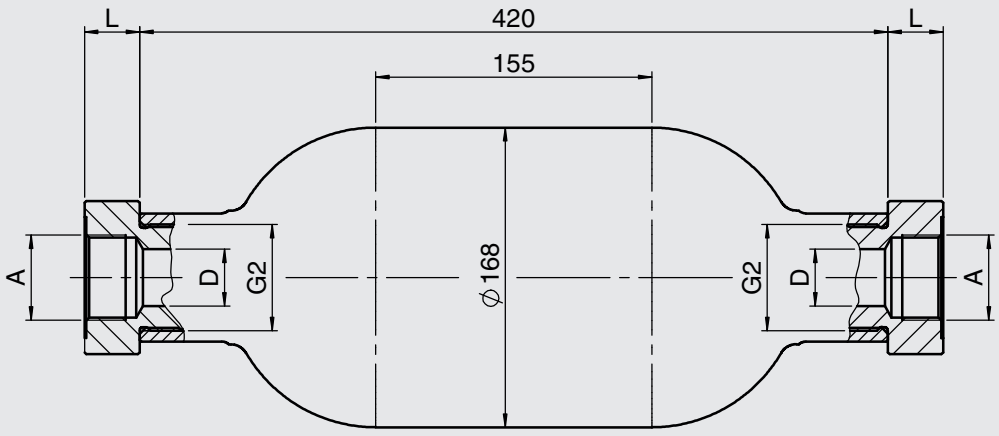
4.1.2 Permitted operating pressure

The permitted operating pressure may differ from the nominal pressure in the case of other certifications. The table in section 4.2. shows the permitted operating pressure in accordance with the European Pressure Equipment Directive.

4.2. TABLES AND DRAWINGS

4.2.1 SD330

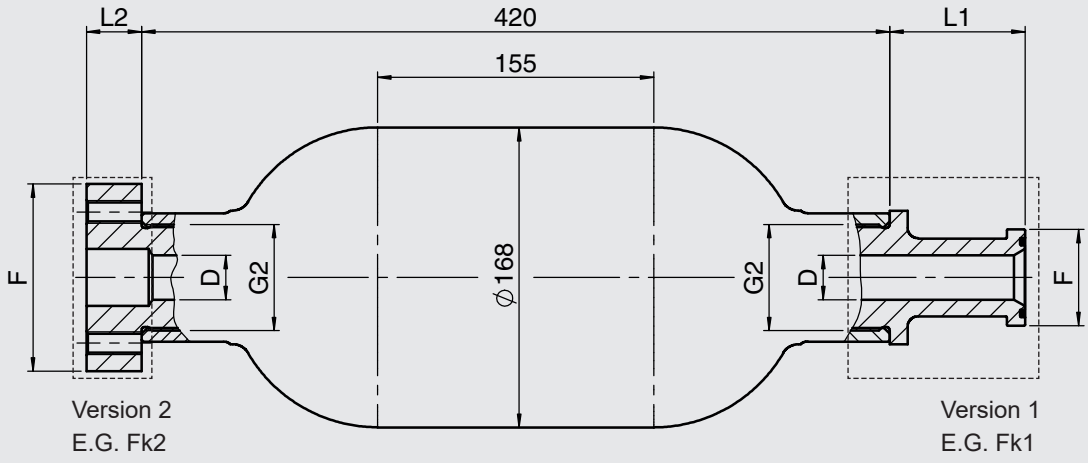
ISO 228 threaded connection A



Series	Vol. [l]	Perm. operating pressure [bar]	A ISO 228		L [mm]	D [1] [mm]	Weight [kg]	Part no.
SD330	4.7	330	AF/AF	G 1 1/4	31	25	14.8	4390237
			AG/AG	G 1 1/2	31	32	15.8	4388045

[1] Smallest internal diameter

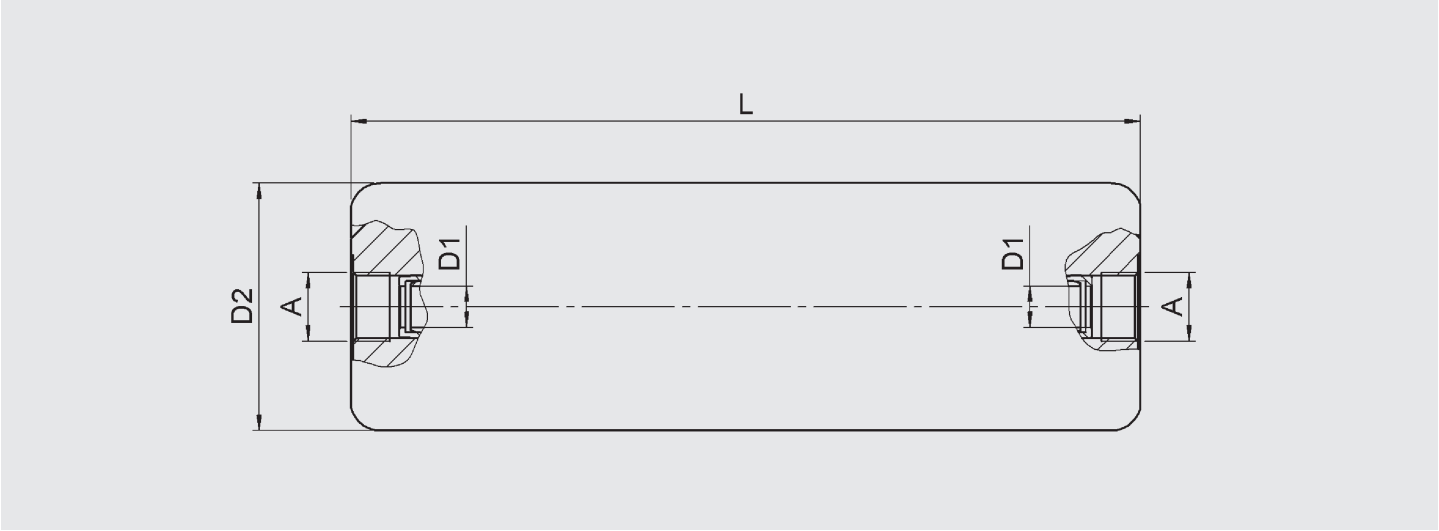
SAE J 518 compliant flange connection F



Series	Vol. [l]	Perm. operating pressure [bar]	F SAE J 518		L2 for FK2 [mm]	L1 for FK1 [mm]	D [1] [mm]	Weight [kg]	Part no.
SD330	4.7	330	FK2/FK2	SAE 1 1/4	31	–	25	16.9	4413180
			FK1/FK2	SAE 1 1/4	31	76	25	15.9	4402764
			FL2/FL2	SAE 1 1/2	36	–	30	18.2	4390978
			FL1/FL2	SAE 1 1/2	36	76	30	16.8	4413183
			FM2/FM2	SAE 2	41	–	32	22	4413377
			FM1/FM2	SAE 2	41	93	32	19.2	4413381

[1] Smallest internal diameter

4.2.2 SD280K

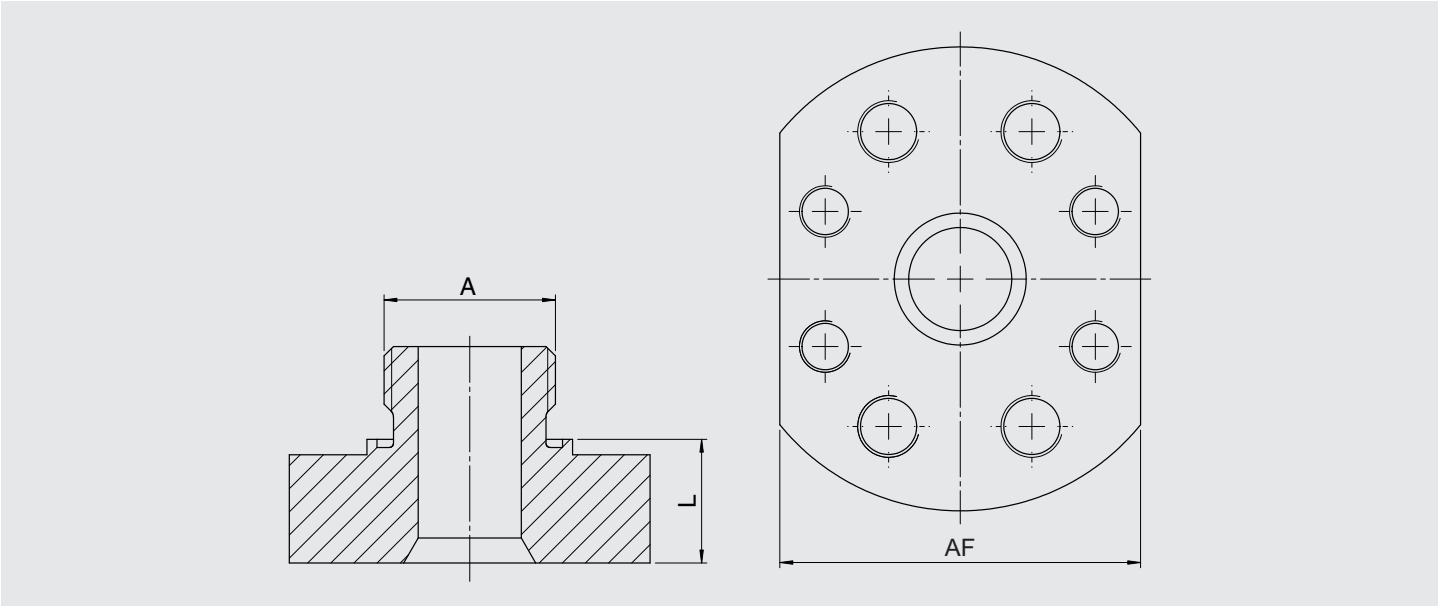


Series	Vol. [l]	Perm. operating pressure [bar]	A ISO 228		D1 [1] [mm]	D2 [mm]	L [mm]	Weight [kg]	Part no.
SD280K	0.4	300	AC/AC	G 1/2	12	60	250	2.4	4402343
	2.4	300	AD/AD	G 3/4	16	120	383	14.5	4392308
			AE/AE	G 1	20				4392310
	4.4	280	AF/AF	G 1 1/4	25	150	445	26	4392311
			AG/AG	G 1 1/2	32				4392312

[1] Smallest internal diameter

SAE adapter for SD280K

There is an option to convert the ISO 228 threaded connection on the SD280K model to an SAE J 518 flange connection. This applies to **3000 PSI** as well as **6000 PSI**.



Series	Vol. [l]	SD280K Part no.	Connection recoding	SAE adapter					
				Accumulator connection A ISO 228	Adapter connection SAE J 518	L [mm]	Weight [kg]	Part no.	AF
SD280K	0.4	4402343	AC → FG	G 1/2	SAE 1/2	18	0.3	4437591	55
	2.4	4392308	AD → FH	G 3/4	SAE 3/4	21	0.53	4416007	65
		4392310	AE → FI	G 1	SAE 1	24	0.85	4416008	70
	4.4	4392311	AF → FK	G 1 1/4	SAE 1 1/4	28	1.41	4416009	85
		4392312	AG → FL	G 1 1/2	SAE 1 1/2	28	1.86	4416010	100
			AG → FM	G 1 1/2	SAE 2	38	3.42	4416011	110

4.3. SPARE PARTS

NBR, others on request

Designation	Part no.
Seal kit SD280K NBR	4416121

4.4. ACCESSORIES

The following table lists the recommended mounting clamps. The choice of clamp depends on the external diameter of the silencer, see section 4.2.

Designation	Part no.	Series			
		SD330	SD280K		
		4.7	0.4	2.4	4.4
HyRac 167-175/178 H5 ST	445043	•			
HRGKSM 0 R 58-61/62 ST	3018442		•		
HRGKSM 1 R 119-127/124 ST	444505			•	
HRGKSM 1 R 146-154/151 ST	444321				•

5. NOTE

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

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Accumulator stations

1. GENERAL INFORMATION

HYDAC supplies fully assembled piston accumulator stations which are ready for operation, complete with all the necessary valve controls, pipe fittings and safety devices 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 of, for example, bladder or piston accumulator stations, by integrating individual HYDAC components.

An accumulator station can be composed of the following:

- Piston accumulators with nitrogen bottles
- Bladder accumulators with nitrogen bottles
- Nitrogen bottles

The modular design of the accumulator stations enables HYDAC to incorporate all customer requirements. Taking the customer's own operating data into account, HYDAC can calculate the required accumulator volumes using the accumulator simulation program:

- **ASP** – **A**ccumulator **S**imulation **P**rogram.

To increase the effective gas volume, HYDAC supplies hydraulic accumulators with back-up nitrogen bottles.

The above-mentioned back-up versions, suitable nitrogen bottles and information on charging and testing blocks for separating the accumulator and nitrogen bottle on the gas side can be found in catalogue section:

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

1.1. FURTHER INFORMATION

HYDAC accumulator stations are unique constructions tailored to customer requirements. They are supplied with operating instructions that have been adjusted accordingly.

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

- Operating instructions for bladder accumulators
  No. 3.201.BA
- Operating instructions for piston accumulators
  No. 3.301.BA
- Operating instructions for gas pressure vessels
  No. 3.553.BA

All work on HYDAC hydraulic accumulators must only be carried out by suitably trained staff. Incorrect installation or handling can lead to serious accidents.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

2. MODEL CODE

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

SS350 K – 4 x 250 / 12 x 320 (U)

Series

Type code letter
K = piston accumulator station
B = bladder accumulator station
N = station with nitrogen bottles

Number of hydraulic accumulators

Nominal volume [l] of the hydraulic accumulators

Number of nitrogen bottles

Nominal volume [l] of the nitrogen bottles

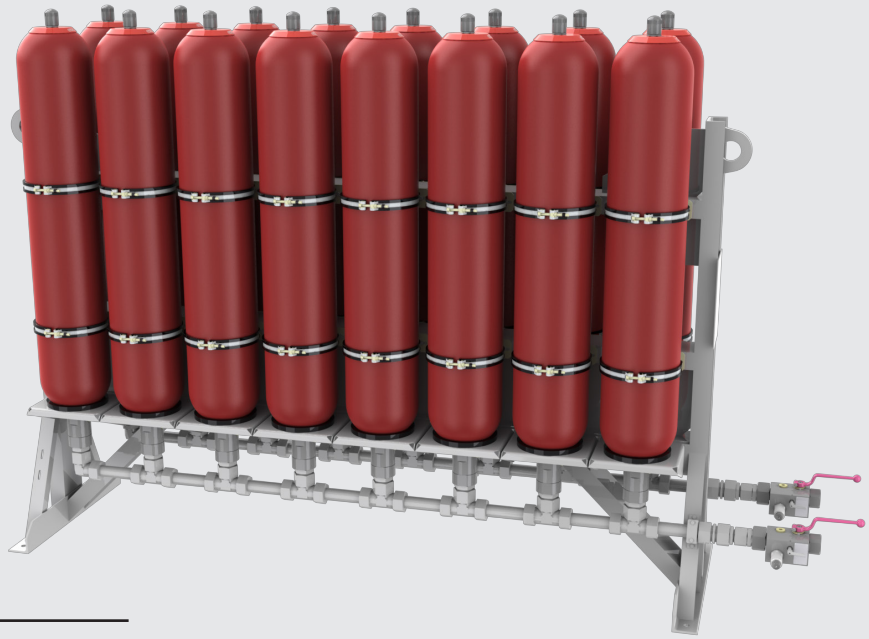
Certification code
U = European Pressure Equipment Directive (PED)

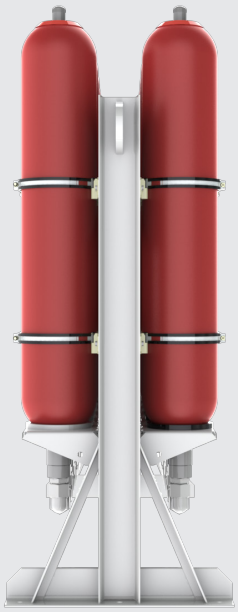
3. EXAMPLES OF ACCUMULATOR STATIONS

3.1. BLADDER ACCUMULATOR STATIONS

Example: SS330B-16x32(U)

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

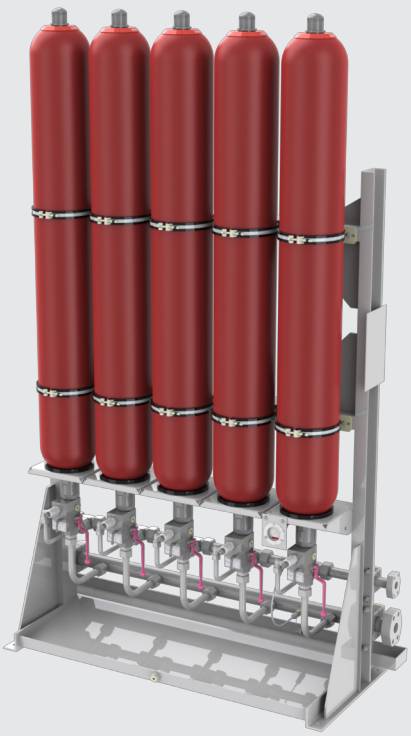




Dimensions		
Length [mm]	Width [mm]	Height [mm]
2780	660	1950

Example: SS330B-5x50(U)

Technical data:
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 data:
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

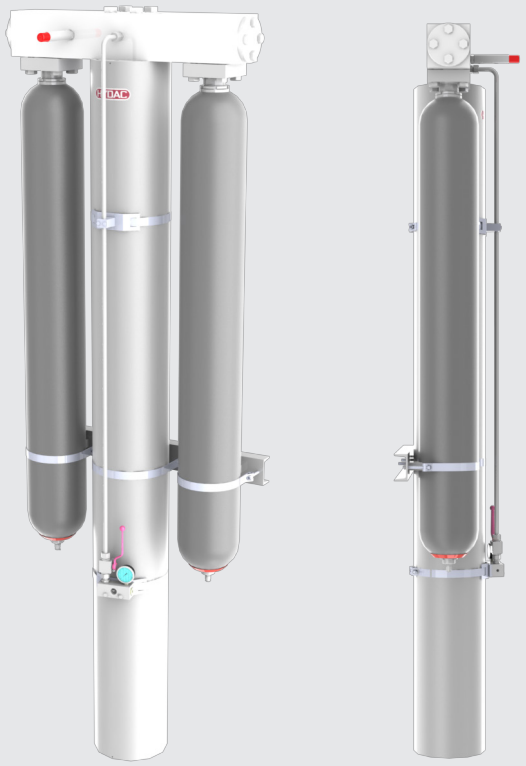
Example: SS220K-1x120/1x75(U)

Technical data:
1 piston accumulator, volume 120 l
1 N_2 bottles, each with a volume of 75 l
max. operating pressure: 220 bar

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

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

Technical data:
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 data:
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

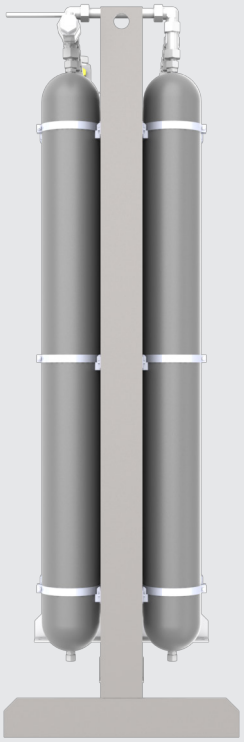
Nitrogen bottles in a modular design:
up to 24 bottles can be assembled on a frame in this version. For a larger quantity, a special design can be applied.

See catalogue section:

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

Example: SS350N-16x75(U)

Technical data:
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 fields of application 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 INFORMATION

To complete the accumulator range, HYDAC provides a variety of useful accessory products. They guarantee correct installation and optimum functioning of HYDAC hydraulic accumulators. They include nitrogen bottles which can be used to back up hydraulic accumulators. Nitrogen bottles used as back-ups increase the gas volume in the accumulator system. This means that smaller accumulators can be used for the same gas volume and costs can be reduced.

For further information, please turn to the sections:

- Bladder accumulators Standard design
  No. 3.201

- Piston accumulators Standard design
  No. 3.301

1.1. FURTHER INFORMATION

- Operating instructions for bladder accumulators
  No. 3.201.BA
- Operating instructions for diaphragm accumulators
  No. 3.100.BA
- Operating instructions for piston accumulators
  No. 3.301.BA

The operating instructions must be observed!

All work on HYDAC hydraulic accumulators must only be carried out by suitably trained staff. Incorrect installation or handling can lead to serious accidents.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

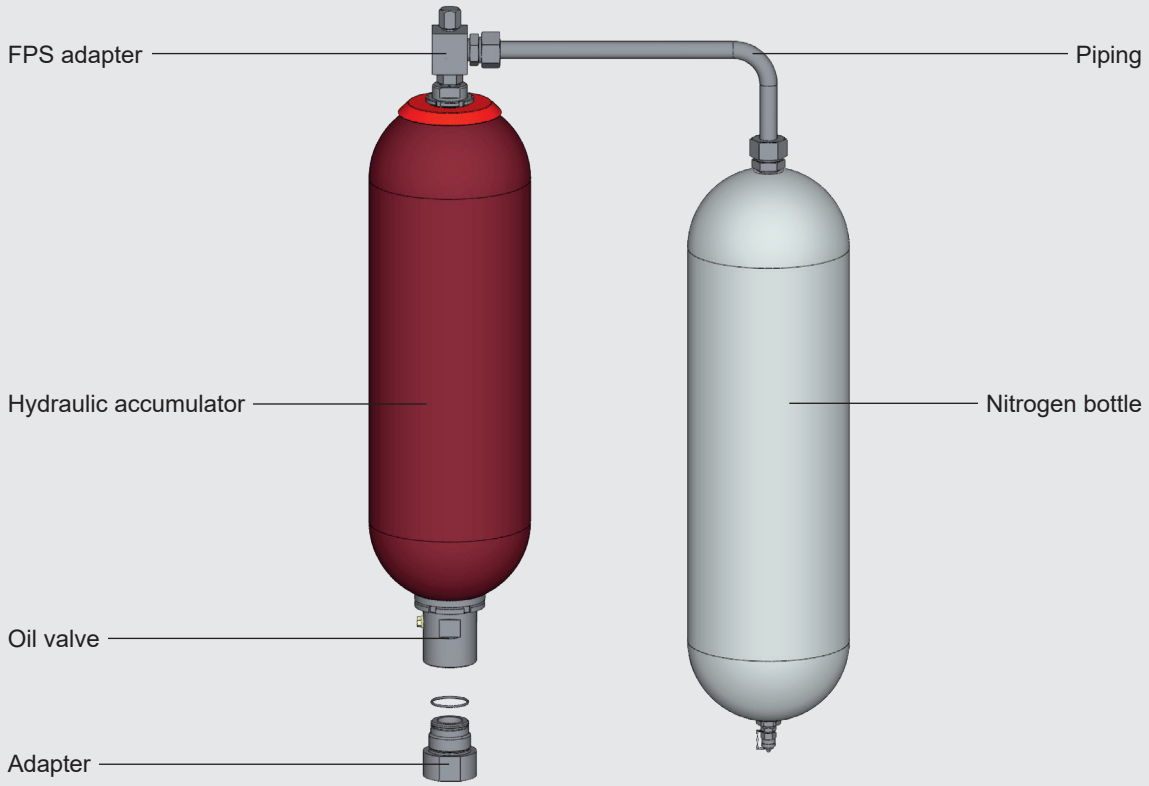
This document and others are available from our Download Center at www.hydac.com.

2. HYDRAULIC ACCUMULATORS AS BACK-UP VERSIONS

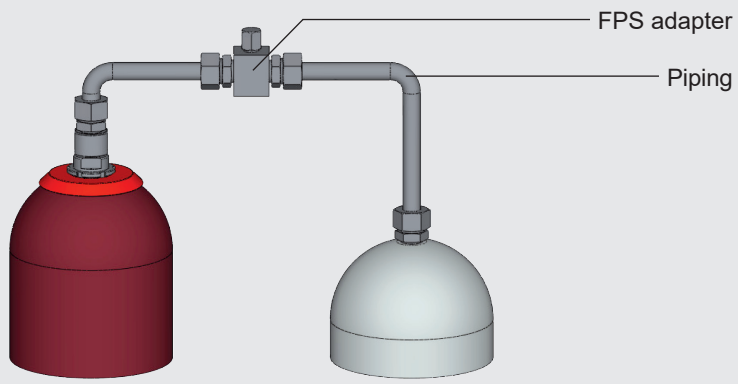
2.1. SET-UP USING THE EXAMPLE OF A BLADDER ACCUMULATOR

Based on bladder accumulator models 20 ... 50 l, the gas side of these accumulators has been specially designed to connect to nitrogen bottles. A diffuser rod prevents damage to the bladder when the accumulator is charged, see section 2.2. This design can also be used for the separation of fluids (taking into account the volume ratios which apply to bladder accumulators).

Example of back-up type 1

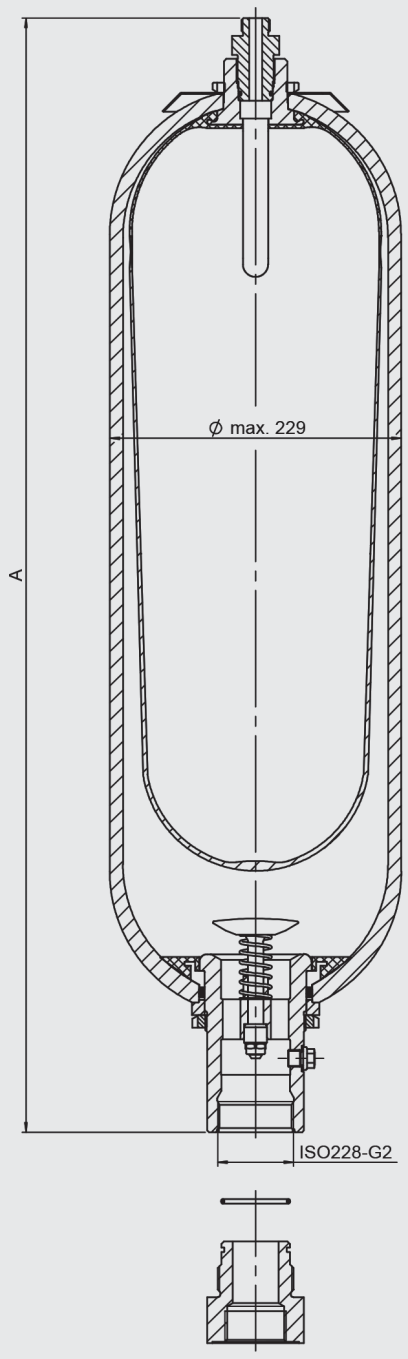


Example of back-up type 2

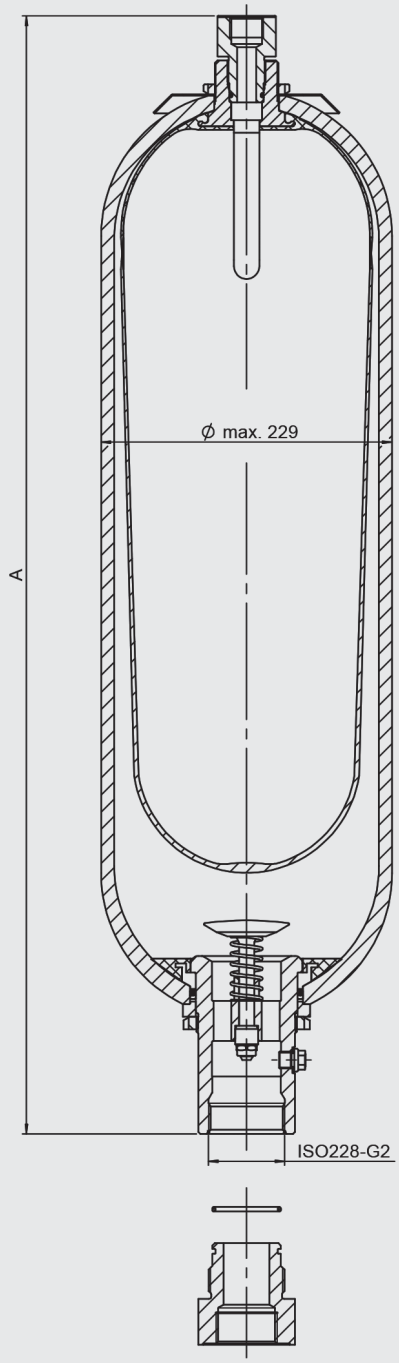


2.2. TABLES AND DRAWINGS

Type 1



Type 2

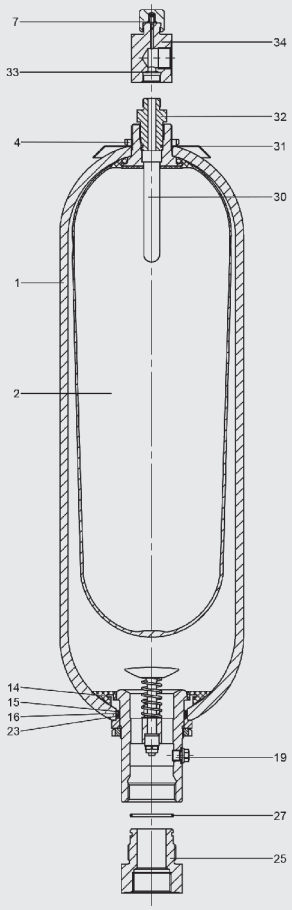


Nominal volume [l]	Effect. gas volume [l]	Weight [kg]	A max. [mm]	Part no.	
				Type 1	Type 2
20	17.5	53.5	905	3153006	3239334
24	24	72	1070	3280349	4481316
32	32.5	89	1420	3114824	3085838
50	47.5	119.5	1930	3079661	3082402

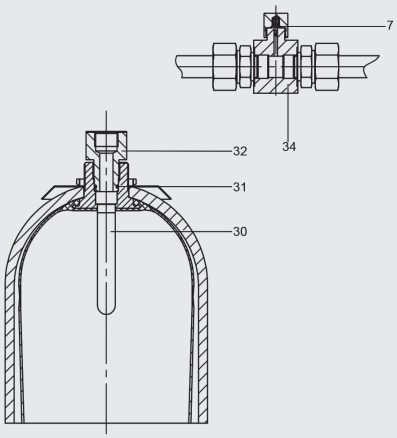
Others on request

2.3. SPARE PARTS

Type 1



Type 2



Description	Item
Bladder assembly consisting of:	
Bladder	2
Lock nut	4
Diffuser rod	30
O-ring 22x2.5 [1]	31
Adapter for type 1/2	32
Seal kit consisting of:	
O-ring 7.5x2 [1]	7
Washer	15
O-ring 80x5 [1]	16
Vent screw	19
Support ring	23
O-ring 48x3 [1]	27
Repair kit consisting of:	
Bladder assembly (see above)	
Seal kit (see above)	
O-ring 11x2 [1]	33
Anti-extrusion ring	14
FPS adapter for type 1/2 [2]	34

Recommended spare parts

[1] Different dimensions for code 663 and 665

[2] FPS adapter (item34) available as an accessory, see section 4.2.

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

Vent screw (item 19) for NBR/carbon steel: Seal ring (item 20) integrated

Adapter (item 25) incl. O-ring (item 27) available as an accessory, see catalogue section: Bladder accumulators, Standard design No. 3.201, section 4.

Adapter (item 32) for type 1 standard

For other spare parts, see section 3.

NBR, carbon steel, standard gas valve

Nominal volume of accumulator [l]	Seal kit Part no.	Repair kit Type 1 Part no.	Repair kit Type 2 Part no.
20	3079398	3119500	3897464
24		3119502	3897463
32		3119498	3897462
50		3119499	3897461

3. NITROGEN BOTTLES

3.1. DESCRIPTION

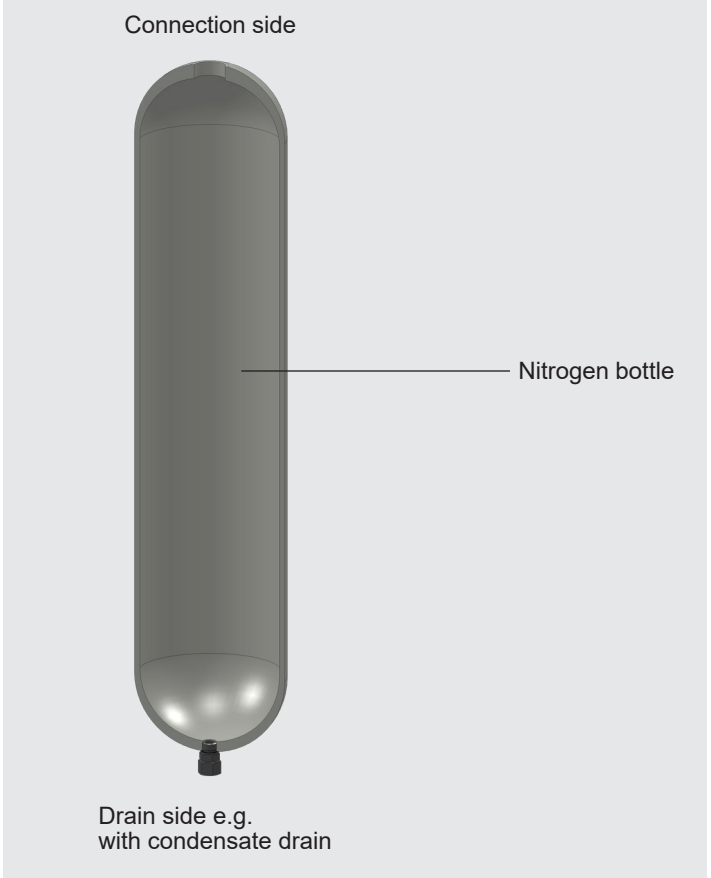
HYDAC nitrogen bottles are used for receiving and storing nitrogen.

HYDAC supplies various versions, such as standard nitrogen bottles made from forged vessels and special vessels based on bladder accumulator shells (SN...B), piston accumulator tubes (SN...K) and diaphragm accumulator halves (SN...M) – see catalogue sections:

- Bladder accumulators Standard design
  No. 3.201
- Piston accumulators Standard design
  No. 3.301
- Diaphragm accumulators
  No. 3.100

The following technical specifications refer to standard nitrogen bottles. Please ask us for information regarding other designs.

3.2. DESIGN



3.3. ADVANTAGES

Using HYDAC nitrogen bottles provides the following advantages:

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

3.4. MODEL CODE

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

SN360 __ – 50 AA / 010 U – 360 D G – C

Series

Code
No details = standard
Special types (see section 3.1.)

Nominal volume [l]

Connection type

Type on 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

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

Material code (MC)

Material (connection)
0 = no installed parts
1 = carbon steel
3 = stainless steel [1)]
4 = carbon steel with protective coating
6 = low temperature steel

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

Seal material (elastomer)
0 = no elastomer used
2 = NBR
4 = IIR
5 = low temperature NBR
6 = FKM

Certification code
U = European Pressure Equipment Directive (PED)

Permitted operating pressure [bar]

Size for drain side (see Table 3.5.1)

Size for connection side (see Table 3.5.1)

Version
No details = standard
C = compact

3.5. TABLES AND DRAWINGS

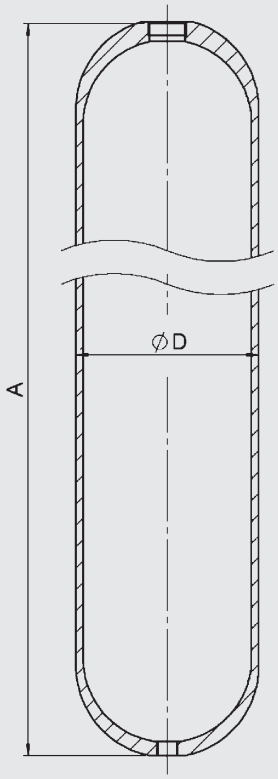


Fig. 1

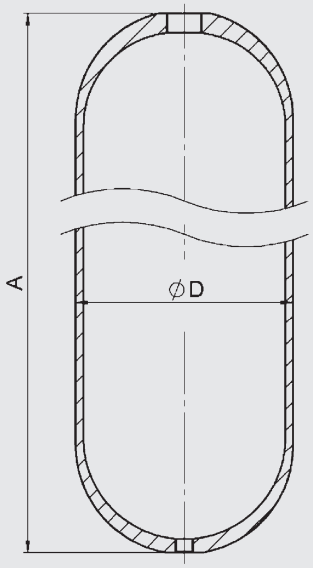


Fig. 2

Series	Volume [l]	Certification code	Connections to ISO 228 (Type AA)		A ± 25 [mm]	D ± 1% [mm]	Weight approx. [kg]	Part no.	Designation	Fig.
			Drain side	Connection side						
SN360	50	U	G 3/4	G 3/4	1590	229	89	3176324	SN360-50AA/010U-360DD	1
			G 3/4	G 1 1/2				3418347	SN360-50AA/010U-360DG	
		S	G 3/4	G 1 1/2				3987605	SN360-50AA/010S-210DG	
	75	U	G 3/4	G 1 1/2	2280	229	126	3561595	SN360-75AA/010U-360DG	1
		S	G 3/4	G 1 1/2				3987606	SN360-75AA/010S-210DG	
		U	G 3/4	G 1 1/2	1690	273	124	3987162	SN360-75AA/010U-360DG-C	2
		S	G 3/4	G 1 1/2				3987163	SN360-75AA/010S-200DG-C	
SN600	50	S	G 3/4	G 1 1/2	1730	241	143	3987613	SN600-50AA/010S-345DG	1
	75	S	G 3/4	G 1 1/2	2500	232	197	3987614	SN600-75AA/010S-345DG	1

3.5.1 Connections for SN360

The following connections are available for standard nitrogen bottles (see section 3.5.).

Standard connections are highlighted in grey. All other versions available on request (not all combinations are possible).

Type / Size	**A** BSP ISO228	**B** Metric DIN13 ISO965/1	**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"-16UNF	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"-14UNF	5/8"	1 1/2"	
M	-	-	-	-	2"	
S	Special design					

4. ACCESSORIES

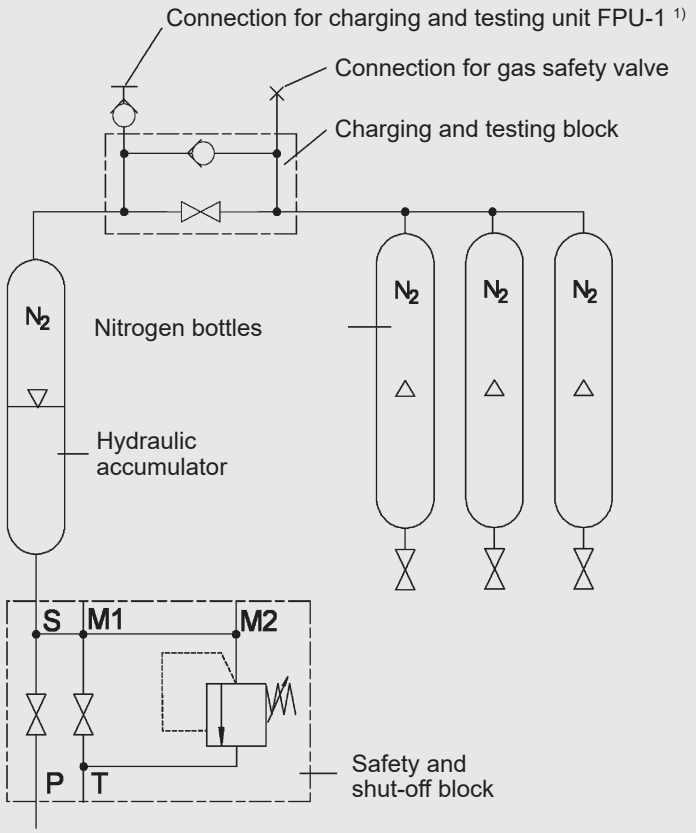
4.1. F + P CHARGING AND TESTING BLOCK

4.1.1 Description

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



1) For further information, see catalogue section:

- FPU charging and testing unit
  No. 3.501

4.1.3 Model code

F+P – 16 – 20SR – 6112 – 12X – A – ...

Series

Nominal size

Connection type
To DIN 2353

Material code (MC)

Housing material
6 = carbon steel

Material of ball and spindle
1 = carbon steel

Material of sealing cups (ball seal)
1 = POM

Material of seals
2 = NBR

Switching handle
02X = enclosed unassembled
12X = mounted

Protective coating
No details = no protective coating
A = zinc-plated

Additional details
e.g. GSV-MV = with redundant protection against excessive pressure increase. For further technical details, see product information No. 10000794442

4.1.4 Standard item

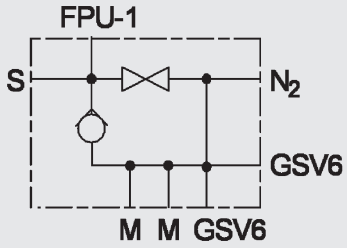


Fig 1

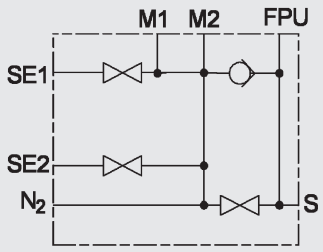


Fig 2

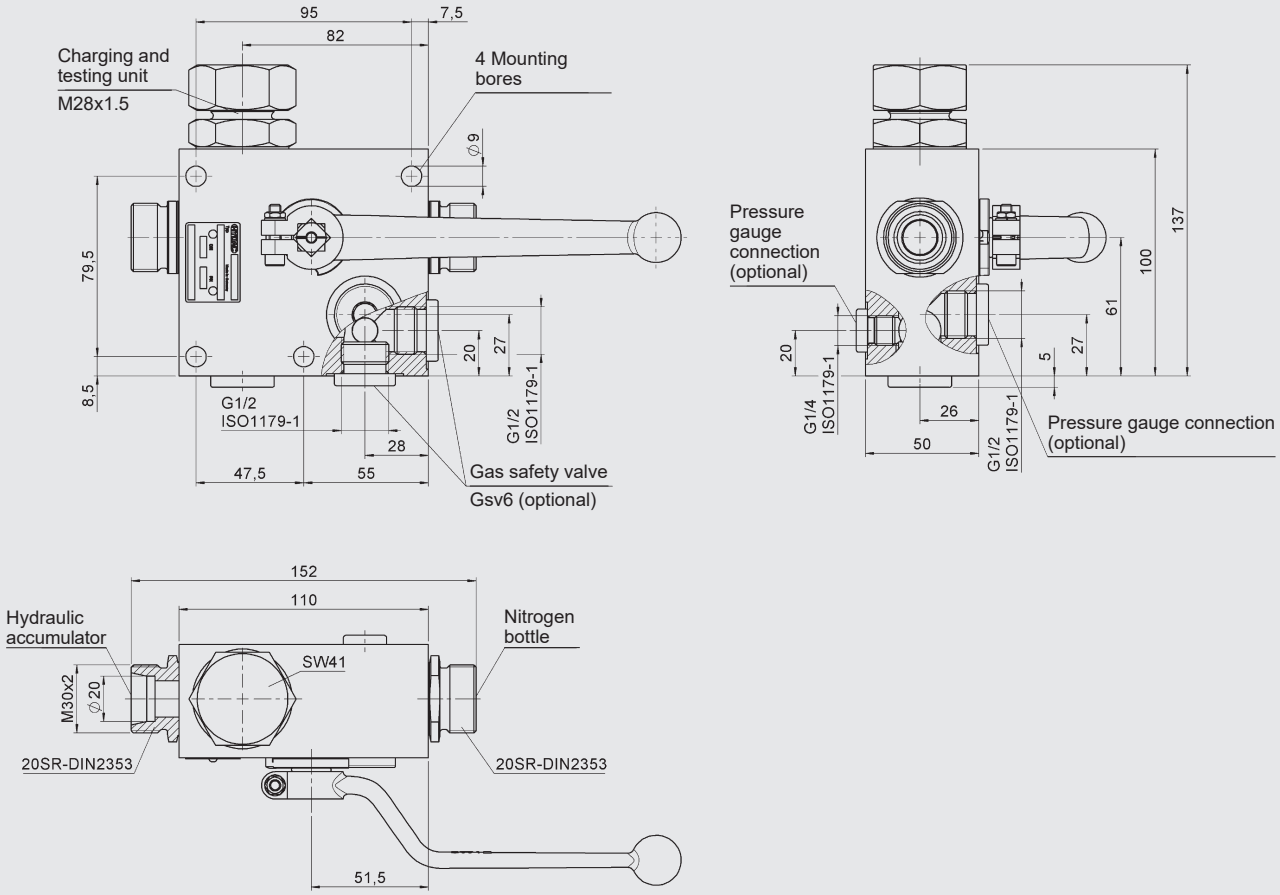
Carbon steel, NBR

Designation	Max. operating pressure [bar]	Weight [kg]	Part no.	Seal kit [1]	Fig.
F+P-16-20SR-6112-12X	400	4.3	850233	2115776	1
F+P-32-38SR-6112-12X	350	14	552193	2112088	1
F+P-32-38SR-6112-12X-A-GSV-MV	350	21.4	4241832	2112088	2

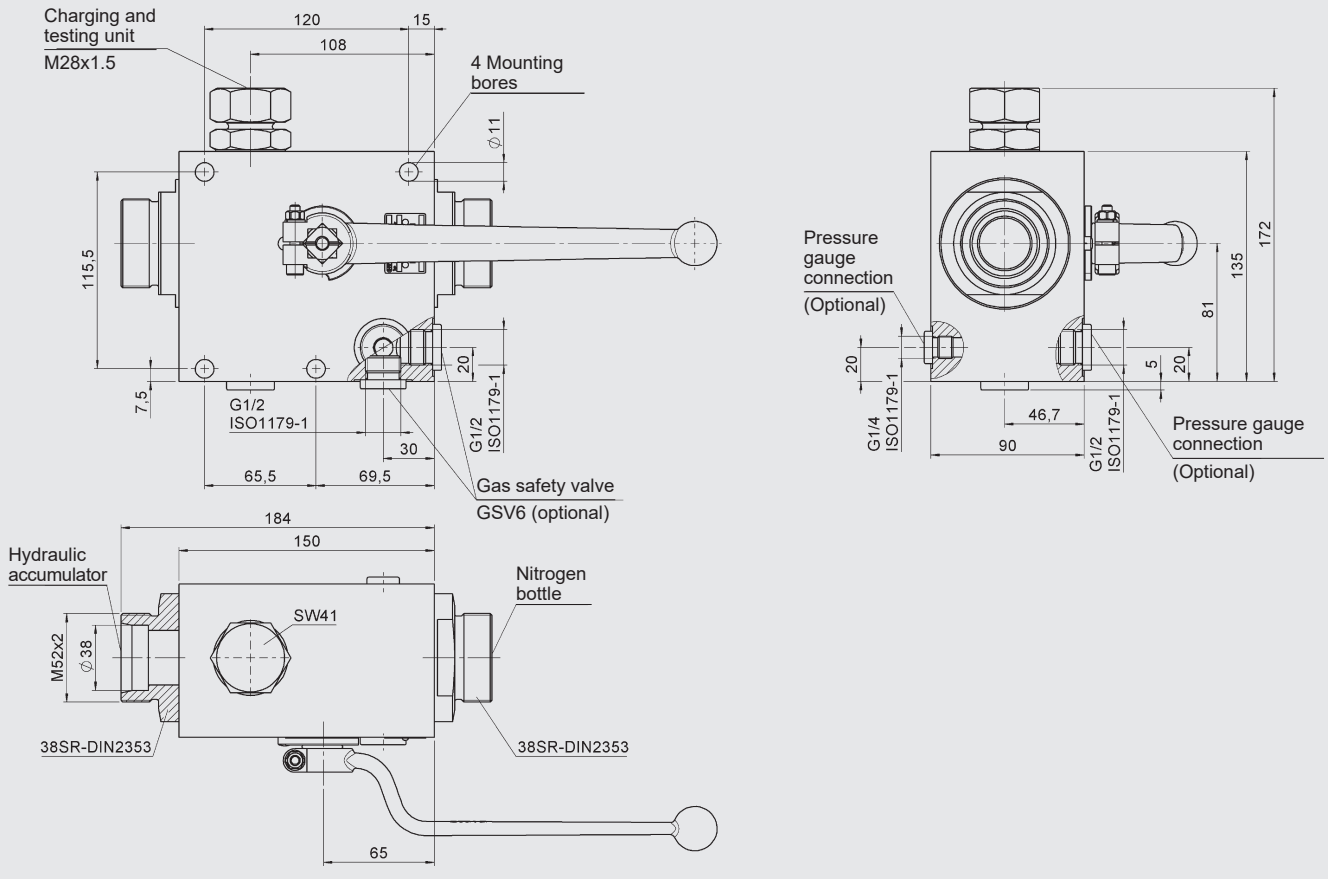
[1] Recommended spare parts

4.1.5 Dimensions

Charging and testing block dn 16



Charging and testing block dn 32



4.2. FPS ADAPTER

The HYDAC FPS adapter is used to charge back-up type hydraulic accumulator systems. For this purpose, it has a connection for the FPU-1 charging and testing unit.

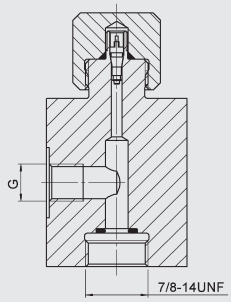


Fig 1

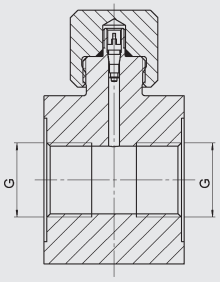
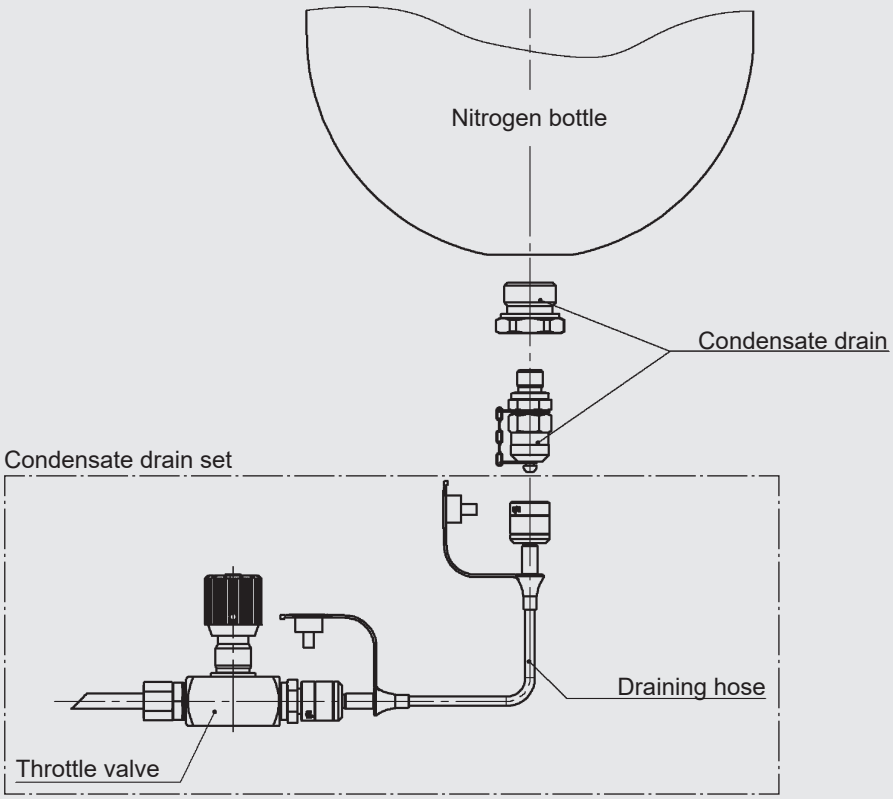


Fig 2

Designation	G ISO 228	Part no.	Fig.
Adapter FPS 7/8-14UNF	G 3/4	363226	1
Adapter FPS	G 3/4	243218	2

4.3. CONDENSATEDRAIN 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.



Designation	Length [m]	Part no.
Condensate drain G 3/4 – Minimess M16x1.5	–	3219496
Condensate drain set	0.4	3472820
	1	3472823
	1.6	3472824

4.4. NITROGEN CHARGING UNIT

HYDAC nitrogen charging units make it possible to rapidly and inexpensively charge or test the required gas pre-charge pressures in bladder, piston and diaphragm accumulators. They guarantee an optimal utilisation of standard commercial nitrogen bottles up to a residual pressure of 20 bar and a maximum pre-charge pressure of 350 bar. Portable, mobile and stationary N_2-Server versions are available.

For further details and technical data, see the following brochure:

- Nitrogen charging units N_2-Server
  No. 2.201

Higher pressures available on request.

5. NOTE

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

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FPU
Charging and testing unit

1. DESCRIPTION

1.1. FUNCTION

The HYDAC FPU charging and testing unit is used to charge accumulators with nitrogen or to check or 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 to a nitrogen bottle via a flexible hose with a pressure reducer, see section 1.3.

To help you set the correct pre-charge pressure, you can use our online p_0-calculator tool: Calculate the charging pressure that should be applied at a measured accumulator temperature or the charging pressure that is charged at a reference temperature.

www.hydac.com » Service » Online tools » Tools for Hydraulic Accumulators

HYDAC nitrogen charging units make it possible to rapidly and inexpensively charge or test the required gas pre-charge pressures in bladder, piston, diaphragm and metal bellows accumulators. They guarantee an optimal utilisation of standard commercial nitrogen bottles up to a residual pressure of 20 bar and a maximum pre-charge pressure of 350 bar. Portable, mobile and stationary N2-Server versions are available.

For further information and technical data, see catalogue section:

- Nitrogen charging units N2-Server
  No. 2.201

Higher pre-charge pressures up to 470 bar available on request.

1.2. FURTHER INFORMATION

- Operating instructions for FPU charging and testing unit
  No. 3.501.BA

The operating instructions must be observed!

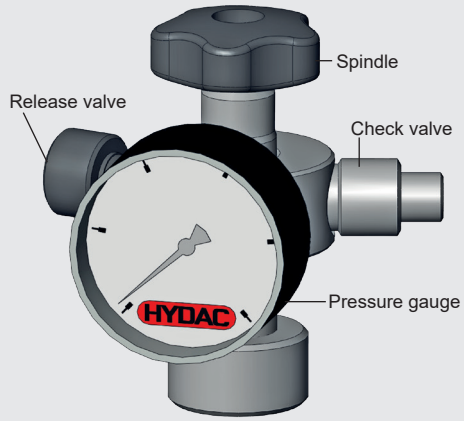
All work with HYDAC charging and testing units must only be carried out by suitably trained staff. Incorrect installation or handling can lead to serious accidents.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

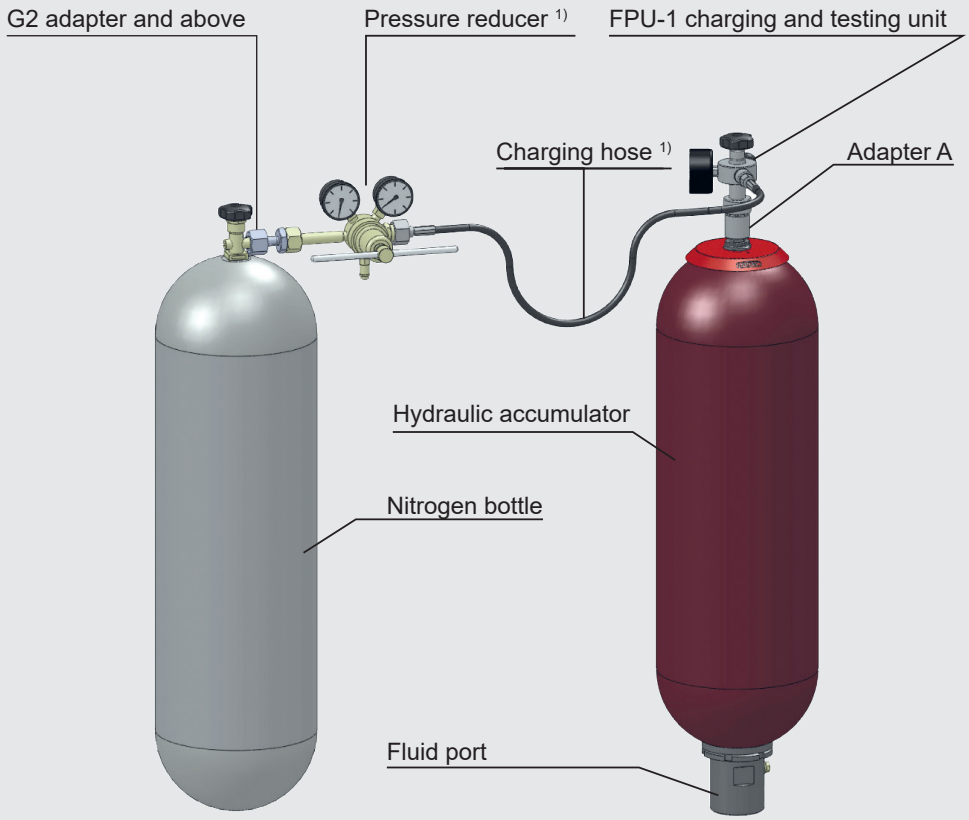
1.3. DESIGN



The HYDAC charging and testing unit FPU-1 for bladder, piston and diaphragm accumulators consists of a primary body with the following:

- Spindle
- Check valve
- Release valve
- Pressure gauge

The following illustration shows the typical design of the charging and testing procedure for a HYDAC bladder accumulator used in connection with a nitrogen bottle (200 bar).



1) G1 connection permanently integrated

2. MODEL CODE

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

FPU-1-350 / 250 F 2.5 G2 A3 DM200/100 K

Charging and testing unit
FPU-1-350 = standard (p_{max} = 350 bar)
FPU-2-800 = high-pressure version (p_{max} = 800 bar)

Pressure gauge display range

10	= 0 - 10 bar	(0 - 145 psi)
25	= 0 - 25 bar	(0 - 363 psi)
100	= 0 - 100 bar	(0 - 1450 psi)
250	= 0 - 250 bar	(0 - 3625 psi)
400	= 0 - 400 bar	(0 - 5800 psi)
1000	= 0 - 1000 bar	(0 - 14500 psi high-pressure version)

Charging hose
F = for nitrogen bottle 200 bar with connectionW24.32x1/14 (DIN 477, Part 1)
FW = for nitrogen bottle 300 bar with connectionW30x2 (DIN 477, Part 5 from April 2002)
FH = for pressure booster systems with connection 9/16-18UNF

Charging hose length
Standard
2,5 = 2.5 m
4,0 = 4 m
High pressure version
6,0 = 6 m
Others on request

G adapter for nitrogen bottles (only FPU-1)
No details = G1 (already permanently integrated at hose F or FW and at pressure reducer)
For adapter G2 to G13, see section 4.5.

A adapter
A3 = 7/8-14UNF, inc. in FPU-1 scope of delivery as standard
A3H = 7/8-14UNF (high pressure version), not included in FPU-2 scope of delivery
For others, see table, section 4.4.

Pressure reducer
e.g. DM200/20 = 200 bar starting pressure, 20 bar back pressure

Accessories
K = protective case
For other accessories, see section 5.

3. STANDARD ITEMS

3.1. FPU-1

The basic version of the FPU-1 is the minimum equipment required to test and set the pre-charge pressure (p_0) at the hydraulic accumulator. It comprises of the FPU-1, the charging hose and the A3 adapter for bladder accumulators and is supplied in a practical protective case.

The following versions are available:

Part no. [1]	Pressure gauge display up to [bar]	Pressure reducer [bar]	Charging hose [m]	G adapter
2114305	0 ... 25	–	2.5	–
2114401				G2
2121210				G3
2116738			4	–
4082127				G2
4426522				G3
4426524	0 ... 25	200/20	2.5	–
3652830				G2
3814960				G3
4426653			4	–
4426654				G2
3365217				G3
2115314	0 ... 100	–	2.5	–
2122515				G2
3243316				G3
2114842			4	–
3043585				G2
2120359				G3
4427109	0 ... 100	200/100	2.5	–
4427114				G2
4427126				G3
4427128			4	–
4427157				G2
4427158				G3
2114302	0 ... 250	–	2.5	–
2114309				G2
2114308				G3
2114303			4	–
2116743				G2
2116779				G3
3187297	0 ... 250	200/100	2.5	–
4427160				G2
4427161				G3
4427162			4	–
4427163				G2
4427164				G3
4427304	0 ... 250	200/170	2.5	–
4328598				G2
4427335				G3
4427336			4	–
4427339				G2
4427341				G3
2114307	0 ... 400	–	2.5	–
2114605				G2
2115692				G3
2114304			4	–
2122119				G2
2115656				G3
4427342	0 ... 400	200/170	2.5	–
4427344				G2
4427355				G3
4427356			4	–
4427357				G2
4427358				G3

[1] Preferred models, others on request

In addition to the standard FPU-1, HYDAC supplies special designs, such as:

- designs with a digital pressure gauge
- designs with additional ports (e.g. Minimess M16x2)
- designs for aggressive media

We are able to provide detailed information on request.

3.1.1 Technical data

Max. operating pressure
350 bar

Pressure gauge display range
See section 3.1.

Material
Carbon steel

Operating temperature
-10 °C ... +80 °C

3.2. FPU-2

The FPU-2 was specifically designed for high-pressure applications. Just like the FPU-1, the FPU-2 can be used for universal applications.
It can be screwed on directly for charging and/or testing HYDAC piston and diaphragm accumulators.
In connection with a HYDAC bladder accumulator, the A3H high pressure adapter must be used. This is not included in standard delivery.

The FPU-2 is exclusively suitable for use with a pressure booster system. The following versions are available (others on request):

Models without protective case

Designation	Part no.
FPU-2-800/1000FH6	4043456
FPU-2-800/1000FH6A3H	4043455

Models with protective case

Designation	Part no.
FPU-2-800/1000FH6K	4029954
FPU-2-800/1000FH6A3HK	4023260

3.2.1 Technical data

Max. operating pressure
800 bar

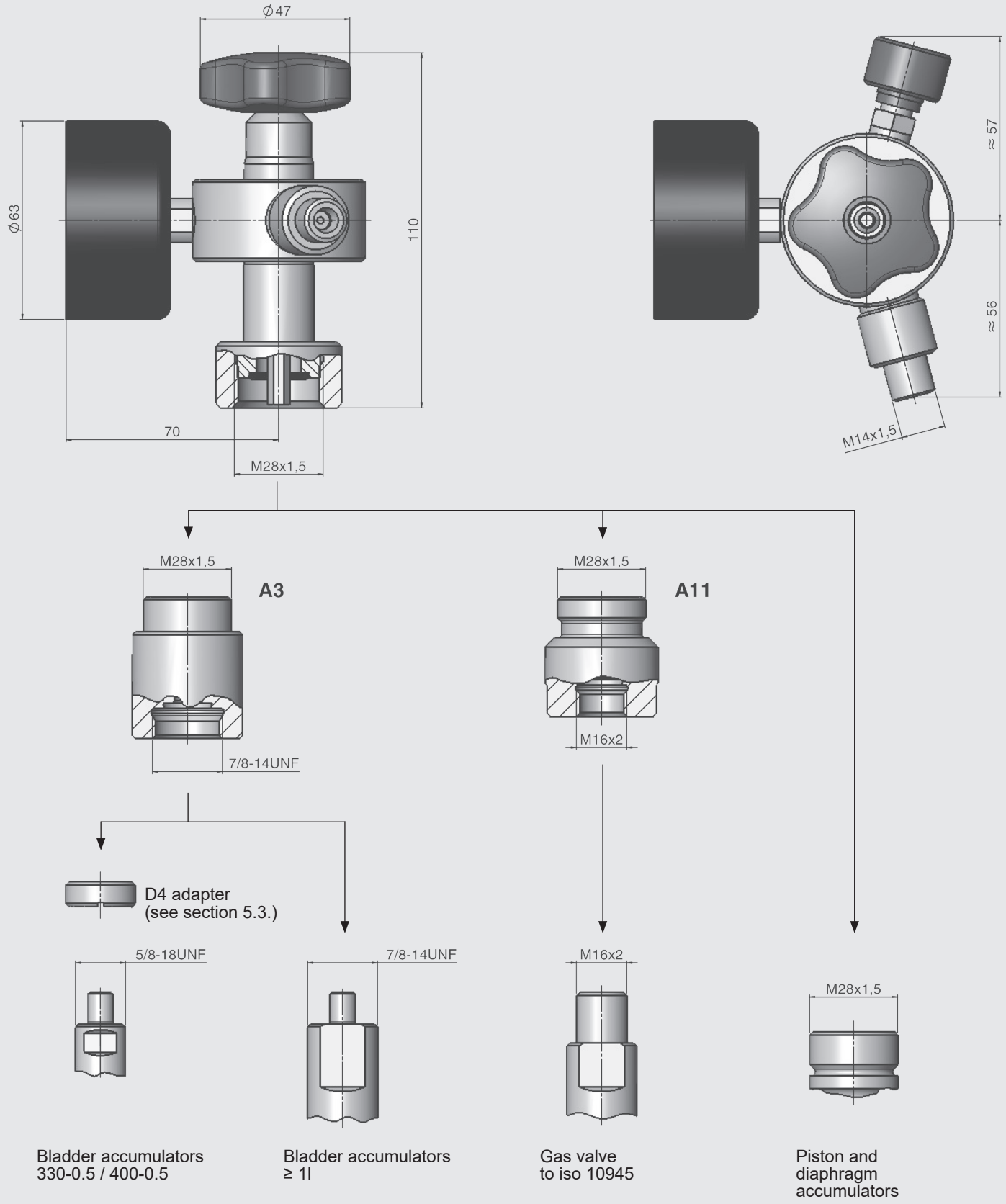
Pressure gauge display range
0 - 1000 bar (0 – 14500 psi)

Material
Stainless steel 1.4313

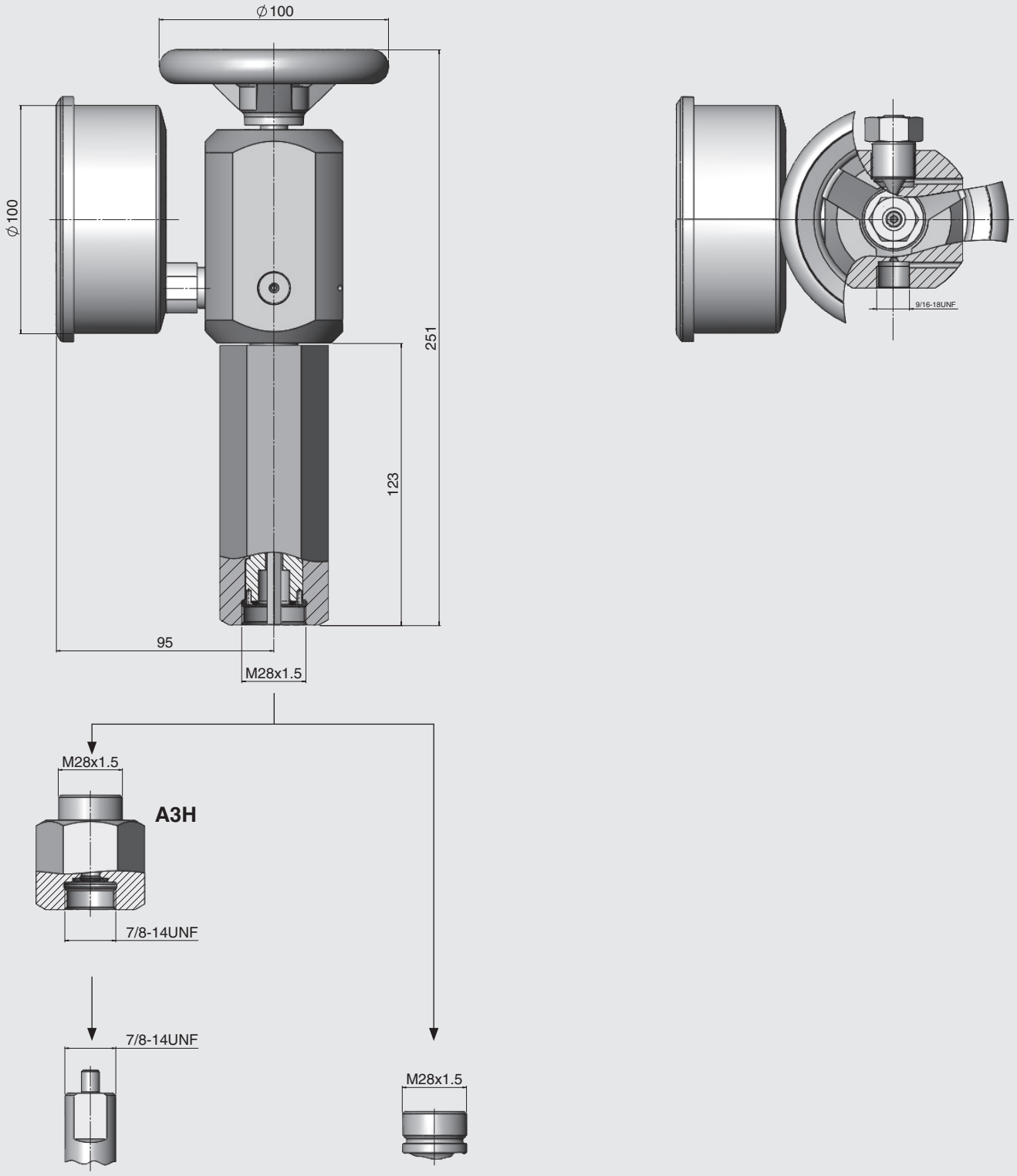
Operating temperature
-10 °C ... +80 °C

4. DIMENSIONS AND CONNECTIONS

4.1. DESIGN OF FPU-1 CHARGING AND TESTING UNIT WITH ADAPTER FOR HYDAC HYDRAULIC ACCUMULATOR



4.2. DESIGN OF FPU-2 CHARGING AND TESTING UNIT WITH ADAPTER FOR HYDAC HYDRAULIC ACCUMULATOR



Bladder accumulators
≥ 1l

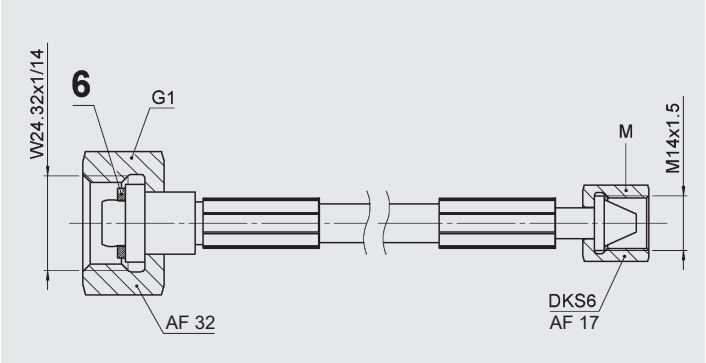
Piston and diaphragm accumulators

4.3. CHARGING HOSES

Charging hoses are designed for the particular maximum permitted operating pressure marked on them and 10,000 charging processes.
(HYDAC charging hoses comply with DIN EN ISO 4413 and DIN EN 853 to 857)

4.3.1 Charging hoses for nitrogen bottles up to 200 bar

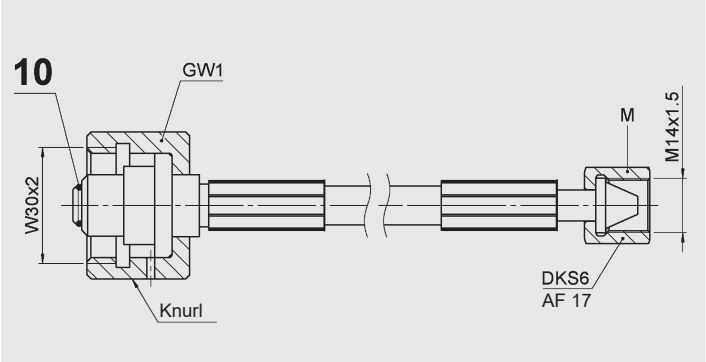
Connection to DIN 477, Part 1



Type	Length [m]	Part no.
F charging hose	2.5	236514
	4	236515
	10	373405
	15	2115552
	20	2109765
	28	2109574

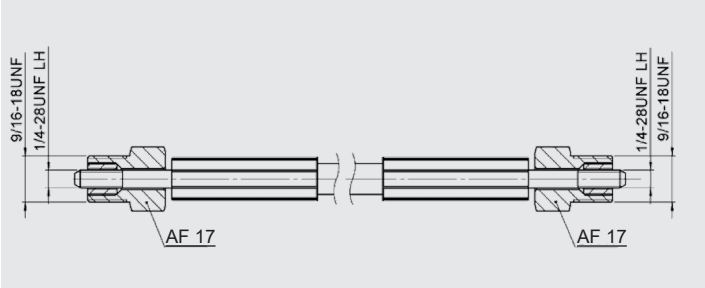
4.3.2 Charging hoses for nitrogen bottles up to 300 bar

Connection to DIN 477, part 5



Type	Length [m]	Part no.
FW charging hose	2.5	3019419
	4	3019420

4.3.3 Pressure hose for pressure booster systems



Type	Length [m]	Part no.
FH charging hose	6	6169682

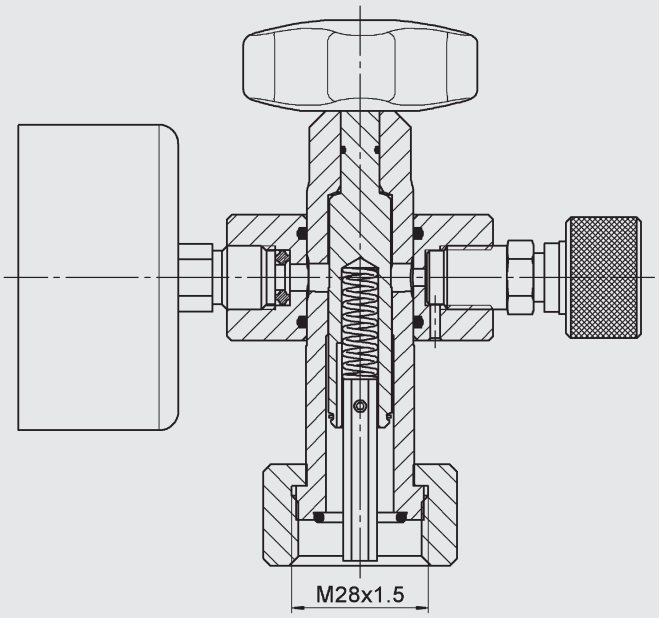
4.4. ADAPTERS FOR FPU

4.4.1 FPU-1

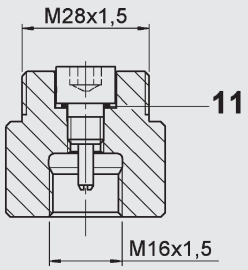
The FPU-1 can be screwed onto piston and diaphragm accumulators directly. In connection with a bladder accumulator, the A3 adapter must be used. The A3 adapter is included in the scope of delivery as standard.

Additional adapters can be used to charge and test other brands of accumulator.

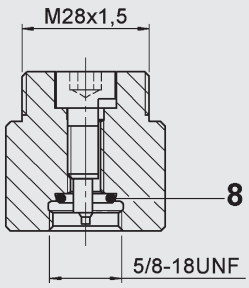
The following adapters are to be used exclusively with the FPU-1, see also section 3.1.



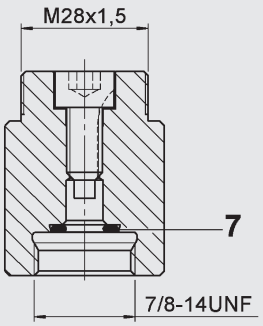
A1 (part no. 361619)



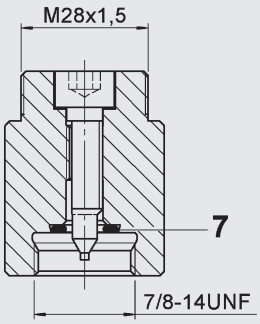
A2 (part no. 361605)



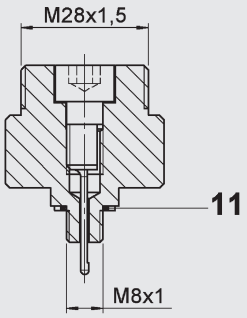
A3 (part no. 291533)



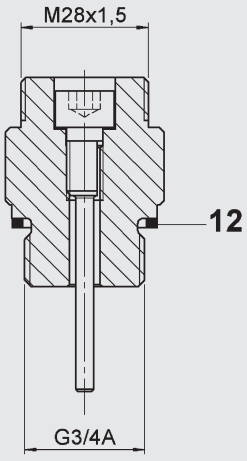
A4 (part no. 291536)



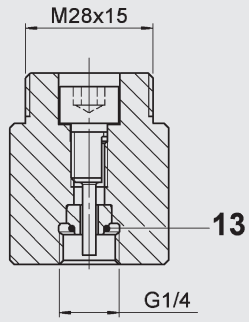
A5 (part no. 291531)



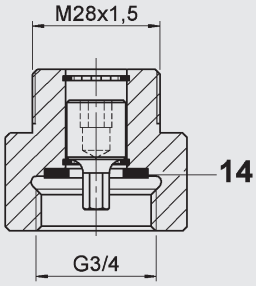
A6 (part no. 2108819)



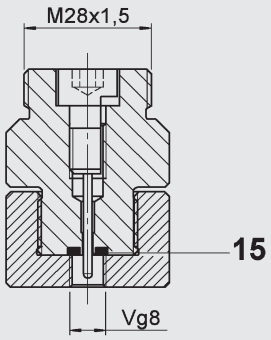
A7 (part no. 2110629)



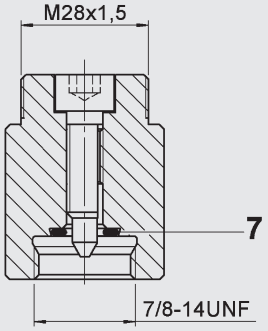
A8 (part no. 2124524)



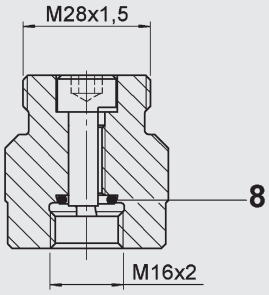
A9 (part no. 2128638)



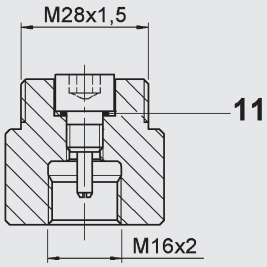
A10 (part no. 2128849)



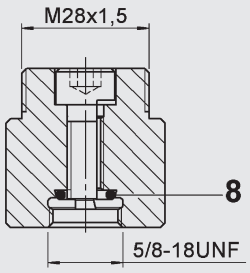
A11 (part no. 3018210)



A12 (part no. 3203185)



A13 (part no. 3911267)

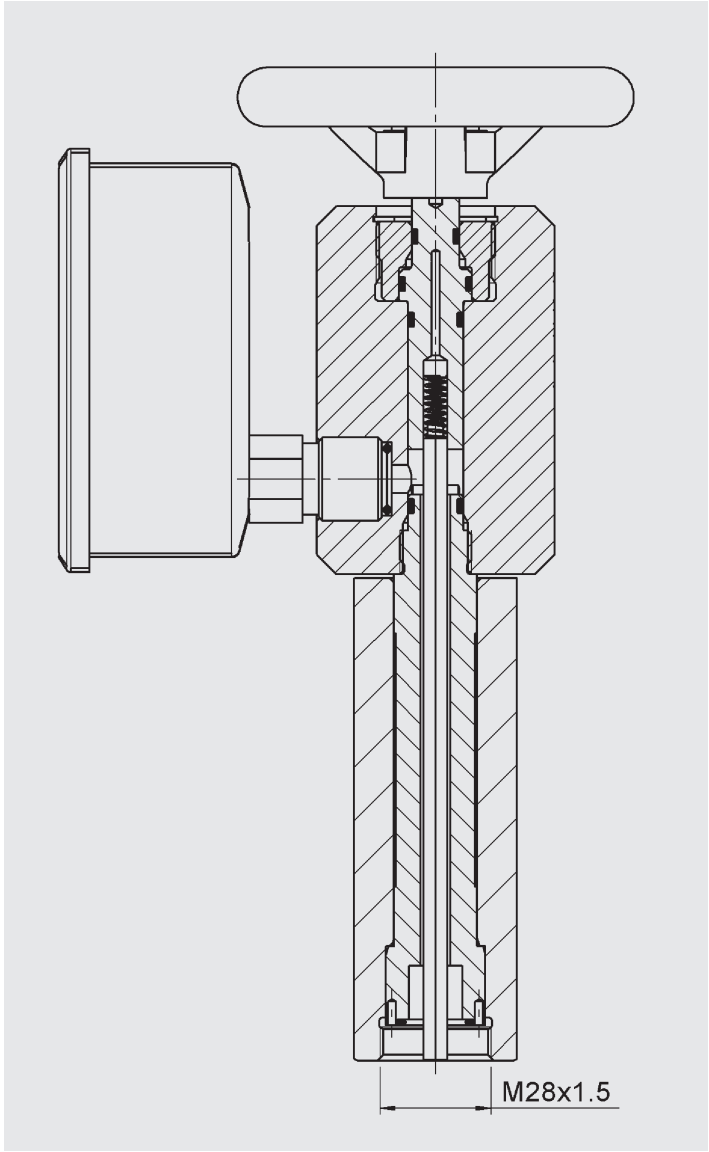


4.4.2 FPU-2

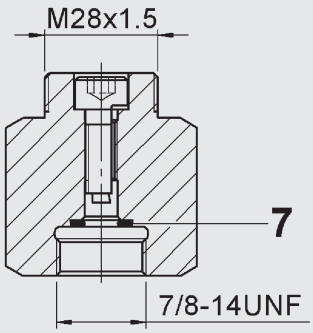
The FPU-2 can be screwed onto piston and diaphragm accumulators directly. In conjunction with a bladder accumulator, the A3H adapter must be used. This is not included in standard delivery.

Additional adapters can be used to charge and test other brands of accumulator.

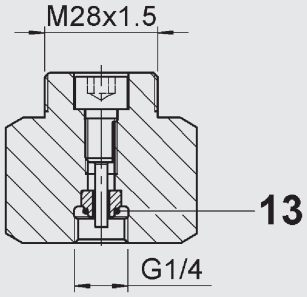
The following adapters are to be used exclusively with the FPU-2, see also section 3.2.



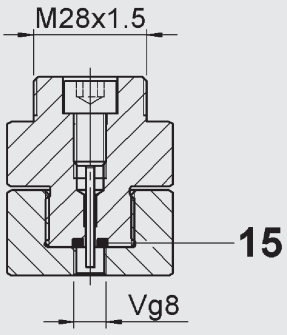
A3H (part no. 3963048)



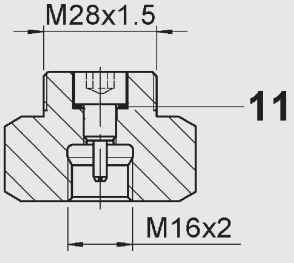
A7H (part no. 4237124)



A9H (part no. 4322422)



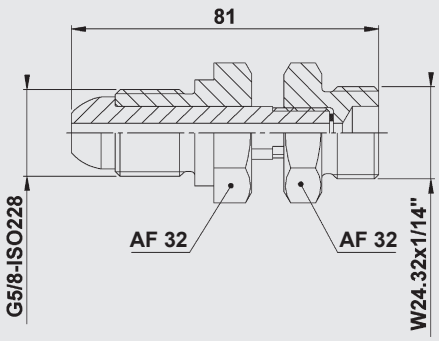
A12H (part no. 4237689)



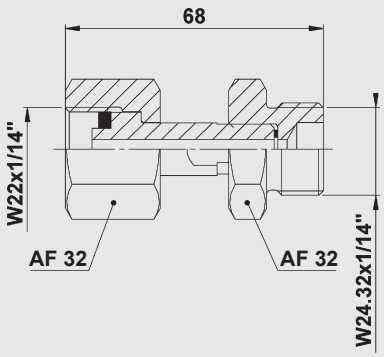
4.5. ADAPTER FOR FPU-1

Depending on the particular country of manufacture for the nitrogen bottles (see list of countries), HYDAC offers the following G adapters, exclusively for use with the FPU-1. The FPU-2 is connected to a pressure booster system.

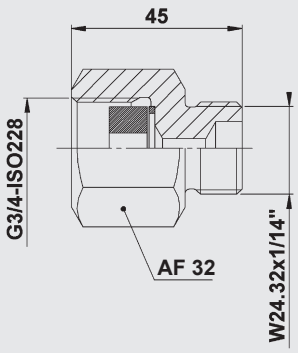
G2 (part no. 236376)



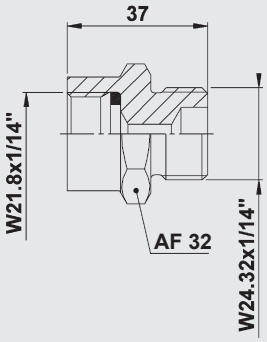
G6 (part no. 2103423)



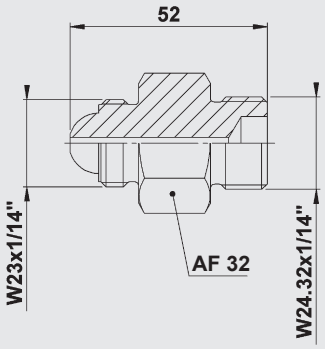
G10 (part no. 2103427)



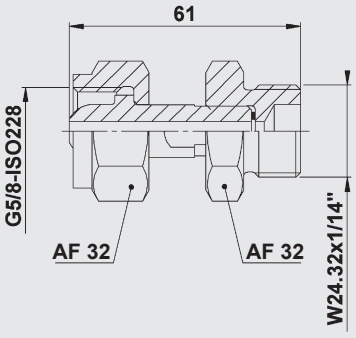
G3 (part no. 2103421)



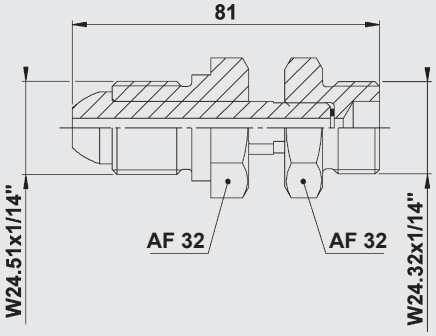
G7 (part no. 236377)



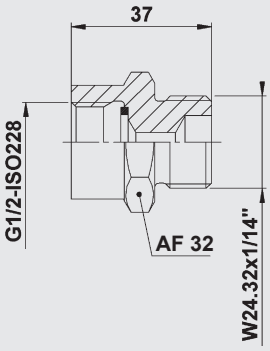
G11 (part no. 3018678)



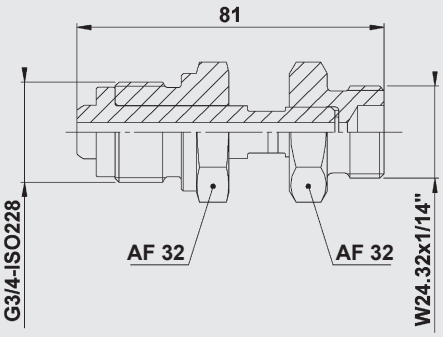
G4 (part no. 236374)



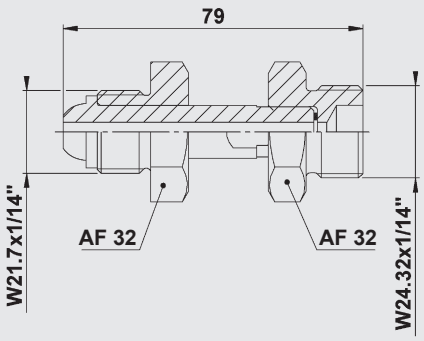
G8 (part no. 2103425)



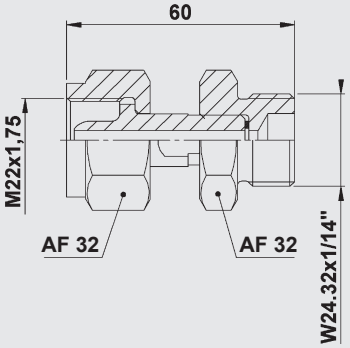
G12 (part no. 3195556)



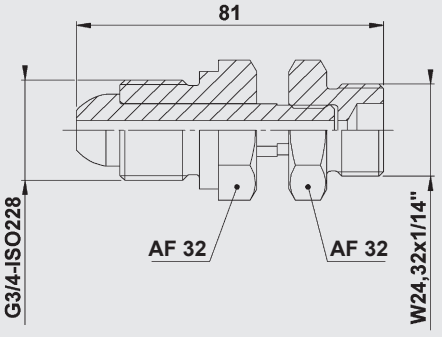
G5 (part no. 236373)



G9 (part no. 241168)



G13 (part no. 3787884)



4.5.1 List of countries

The following list of countries only serves as a guide. Before an order is placed, the connection of the nitrogen bottle used must be checked. G1 adapter already provided at charging hose F and at pressure reducer.

Country	Type / part no.												
	G1	G2 236376	G3 2103421	G4 236374	G5 236373	G6 2103423	G7 236377	G8 2103425	G9 241168	G10 2103427	G11 3018678	G12 3195556	G13 3787884
Africa [1]													•
Albania										•			
Algeria			•										
Argentina		•											
Australia												•	
Austria	•												
Bahamas		•											
Bahrain			•										
Bangladesh		•											
Barbados		•											
Belgium	•												
Bolivia								•					
Brazil				•									
Bulgaria			•										
Burma		•											
Canada				•									
Chile								•					
China											•		
Colombia								•					
Costa Rica		•											
Cyprus		•											
Czech Republic	•												
Denmark	•												
Djibouti			•										
Dominican Republic								•					
Ecuador								•					
Egypt			•										
Ethiopia		•											
Fiji		•											
Finland	•												
France			•										
Gabon			•										
Gambia		•											
Germany	•												
Ghana		•											
Greece		•											
Guatemala								•					
Guinea			•										
Guyana								•					
Honduras								•					
Hong Kong		•											
Hungary			•										
India		•											
Indonesia		•											
Ireland		•											
Italy					•								
Ivory Coast			•										
Jamaica		•											
Japan						•							
Jordan			•										
Kenya		•											
Korea							•						
Kuwait			•										
Lebanon			•										
Libya			•										
Malawi		•											
Malaysia		•											
Malta		•											
Mauritius			•										
Mexico			•										
Morocco			•										
Netherlands	•												
New Zealand		•											
Nigeria			•										
Norway	•												
Oman			•										
Pakistan		•											
Paraguay								•					
Peru								•					
Philippines		•											
Poland	•												
Portugal		•											
Puerto Rico				•									
Qatar			•										
Romania			•										
Russia										•			
Saudi Arabia			•										
Singapore		•											
Spain			•										
Sri Lanka		•											
Sudan		•											
Suriname		•											
Sweden	•												
Switzerland	•												
Taiwan									•				
Tanzania		•											
Thailand		•											
Trinidad/Tobago										•			
Tunisia			•										
Turkey		•											
UK		•											
Ukraine										•			
United Arab Emirates			•										
Uruguay								•					
USA				•									
Venezuela										•			
Vietnam		•											
Yugoslavia [2]										•			
Zambia		•											

[1] = Angola, Botswana, Lesotho, Mozambique, Namibia, Somalia, South Africa, Zimbabwe, Swaziland

[2] = Bosnia, Herzegovina, Croatia, Macedonia, Slovenia

5. ACCESSORIES

5.1. PROTECTIVE CASE

To protect the FPU from becoming contaminated or damaged, with foam insert and prefabricated recesses to hold all parts and any accessories (adapters, tools, etc.).

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

	Weight approx. [kg]		Outer dimensions [mm]
FPU-1 (basic version)	Without case	1.4	–
	With case	3	460x350x120
FPU-2	Without case	8.2	–
	With case	14.2	530x430x180

5.2. GAS SAFETY VALVE FOR FPU-1

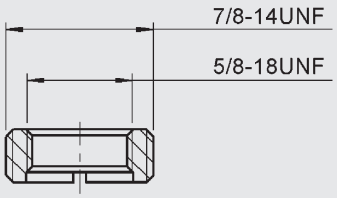
Provides protection by reducing the pressure in a controlled way if pressure exceeds the permitted level unexpectedly, see catalogue section:

- Safety equipment for hydraulic accumulators No. 3.552

5.3. D4 ADAPTER FOR FPU-1

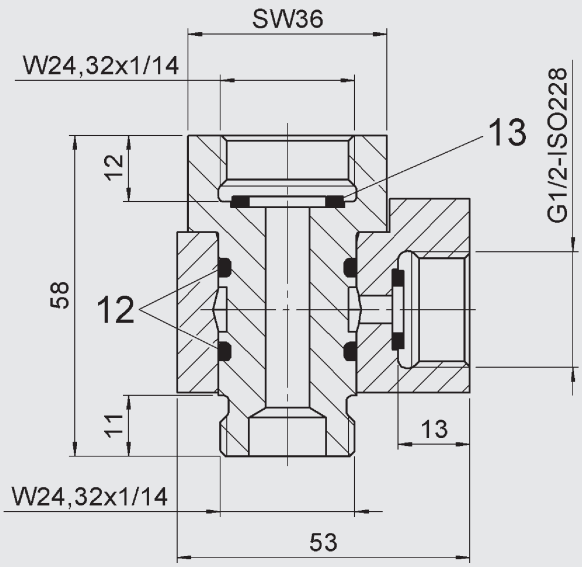
D adapter for bladder accumulator < 1 litre (see section 4.1.)

D4 = 5/8-18UNF (part no. 366374)



5.4. GSV6-10-CE INTERMEDIATE PIECE FOR FPU-1

Intermediate piece for installing the GSV 6 gas safety valve between the 200 bar nitrogen bottle and the FPU-1 Charging and Testing Unit.



Weight: 0.5 kg

Description	Quantity	Item	Part no.
GSV6-10-CE intermediate piece	-	-	242558
Seal kit for intermediate piece consisting of:	-	-	2117287
O-ring 20x2.5x2	2	12	-
Seal ring 20x11.5x2	1	13	-

5.5. PRESSURE REDUCING VALVE

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

5.5.1 Pressure reducing valve for 300 bar nitrogen bottles

Inlet: lock nut W24, 32x1/14-DIN477, Part 1

Outlet: external thread W24, 32x1/14-DIN477, Part 1

Starting pressure [bar]	Back pressure [bar]	Part no.
200	20	635409
	100	635411
	170	635412

5.5.2 Pressure reducing valve for 300 bar nitrogen bottles

Inlet: lock nut W30x2-DIN477, Part 5

Outlet: external thread W24, 32x1/14-DIN477, part 5

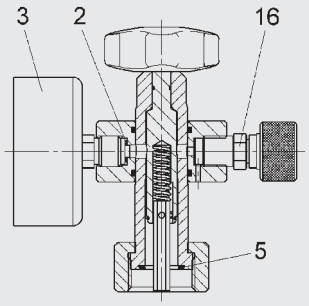
Starting pressure [bar]	Back pressure [bar]	Part no.
300	20	6004020
	100	6004021
	170	6004022
	300 [1)]	6004023

[1)] For back pressures > 200 bar the outlet has an external thread W30x2-DIN477, Part 5

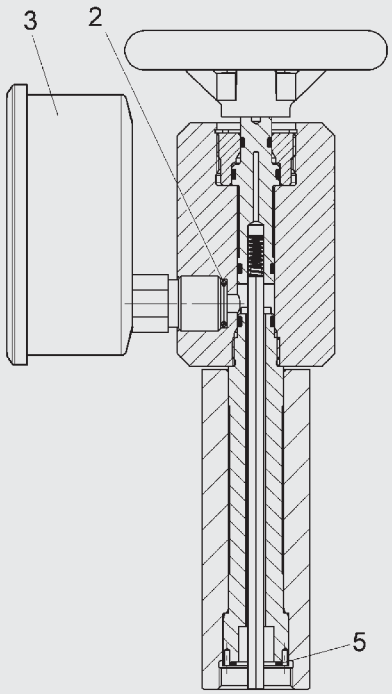
6. SPARE PARTS, ADAPTERS AND TOOLS

6.1. SPARE PARTS FOR FPU-1 AND FPU-2

FPU-1



FPU-2



Description		Item	FPU-1		FPU-2	
			Part no.	Quantity	Part no.	Quantity
Seal kit FPU consisting of:			2117669	1	4295673	
	Rhombic seal	2	–	1	–	1
	O-ring 15x2	5	–	1	–	1
	Seal ring	6	–	1	–	–
	O-ring 11x2	7	–	1	–	–
	O-ring 11x2.5	9	–	1	–	–
	O-ring 5.7x1.9	10	–	1	–	–
Pressure gauge	0 - 10 bar	3	635139	1		
	0 - 25 bar	3	635140	1		
	0 - 100 bar	3	635141	1	–	
	0 - 250 bar	3	635142	1		
	0 - 400 bar	3	635143	1		
	0 - 1000 bar	3	–		6167756	1
Release valve		16	3103471	1	–	

6.2. SPARE PARTS FOR ADAPTER

Description	Item	FPU-1, FPU-2	
		Part no.	Quantity
Seal kit for FPU adapter consisting of:	–	3269153	
O-ring 11x2	7	–	3
O-ring 9x2	8	–	3
Seal ring 9.3x13.3x1	11	–	3
Seal ring 27x32x2	12	–	1
O-ring 6x1.2	13	–	1
O-ring 19x2	14	–	1
Seal ring for adapter A9	15	–	1

6.3. TOOLS FOR FPU-1

Designation	Part no.
Wrench14x15	1011065
Allen key AF6	1005164
Torque wrench	3136470
Gas valve removal tool	616886

7. NOTE

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

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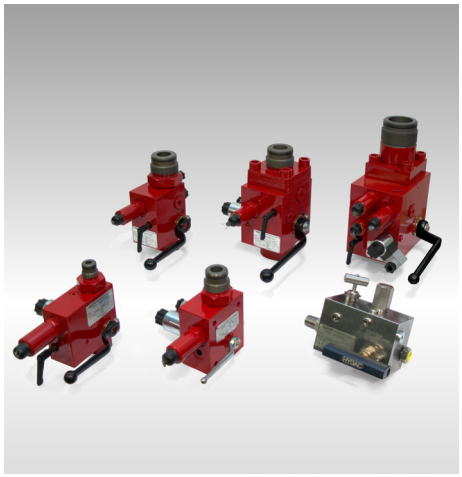


Safety and shut-off block
SAF/DSV

1. DESCRIPTION

1.1. FUNCTION

The HYDAC safety and shut-off block is a hydraulic accessory element that is used to protect against excess pressure on the fluid side and to shut-off and relieve hydraulic accumulators.
It takes into account the applicable safety regulations according to DIN EN ISO 4413 and the German Industrial Safety Regulation (BetrSichV).

The HYDAC pressure relief valve (DB12) is used in the SAF series. It is a direct-acting pressure relief valve in a poppet valve construction with excellent opening and closing characteristics. This version of the DB12 complies with the requirements of the European Pressure Equipment Directive (PED) with CE marking and is supplied with a declaration of conformity and operating instructions.

The operating instructions must be observed!
No. 5.169.B

Product advantages

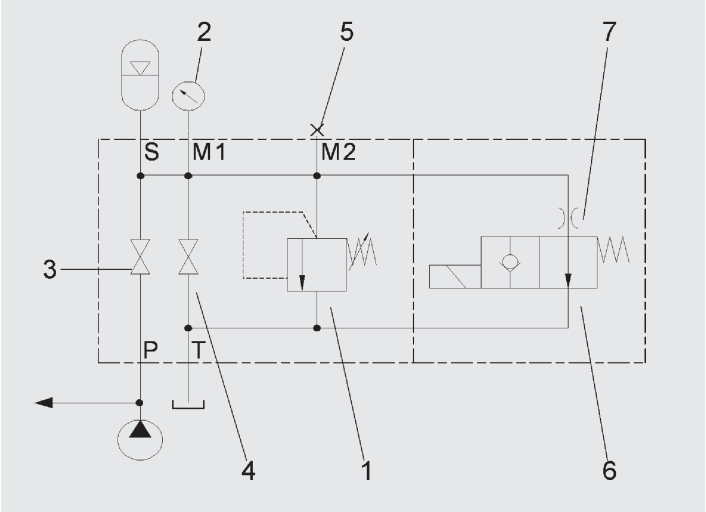
The compact combination of components considerably simplifies the connection of a consumer to the hydraulic system and provides the following benefits:

- Minimum of space, maintenance and piping required. Up to 10 fewer pipe fittings are necessary compared to individual piping.
- Considerable reduction in installation time.
- Connections for various accumulator designs and manufacturers are available – all imperial and metric thread types as well as manifold-mounted and weld nipple connections.
- Additional valves such as pilot-operated check valves, flow control valves and combined flow control and check valves can be fitted to system connection P.

1.2. DESIGN

The SAF safety and shut-off block consists of a valve block, an integrated HYDAC pressure relief valve, a main shut-off valve and a manually operated pressure release valve. The necessary pressure 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.

1.2.1 Circuit diagram



1 DB12 pressure relief valve, see brochure:
- DB12120A-01X-CE
  No. 5.169

2 M1 connection (optional pressure gauge available)
ISO 228 - G 1/4 (SAF10, SAF8)
ISO 228 - G 1/2 (all others)

3 Shut-off valve

4 Pressure release valve

5 M2 connection (e.g. for p_0-Guard)
ISO 228 – G 1/4 (all sizes)

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

6 Solenoid-operated release valve (optional for type E)

7 Throttle

S Hydraulic accumulator connection

P Pump connection

T Tank connection

1.2.2 Connections

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

S – Hydraulic accumulator connection

P – Pump connection
Connection of the SAF to the system

T – Tank connection
The piping leading to the tank must be installed separately. This ensures that the flow can be channelled away to the tank unpressurised when the DB12 pressure relief valve is opened.

M1 – With optional pressure gauge
ISO 228 – G 1/4 (SAF10, SAF8)
ISO 228 – G 1/2 (all others)

M2 – e.g. for p_0-Guard
ISO 228 – G 1/4 (all sizes)

1.3. SPECIFICATIONS

1.3.1 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 ISO 4406 Class 21/19/16 or SAE AS 4059 Class 11.
We recommend a filter with a minimum retention rate of $ß_{20} \geq 100$.
The fitting of filters and regular replacement of the filters guarantees correct operation, reduces wear and extends the service life.

1.3.2 Permitted operating temperature

Standard design
-10 °C ... +80 °C
(ambient temperature for E type limited to
-10 °C ... +60 °C)

Low-temperature version
-40 °C ... +80 °C

1.3.3 Max. operating pressure

400 bar

1.3.4 Model with solenoid-operated pressure release

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

Voltage tolerance
± 15 % of the 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 cycle
100 % DC = CO (continuous operation)

Switching time
This depends on the symbol, pressure at the individual connections and the flow rate

WSM06020Y:
on: 50 ms
off: 35 ms

WSM06020Z:
on: 35 ms
off: 50 ms

1.3.5 Notice

All work with HYDAC safety and shut-off blocks must only be carried out by suitably trained staff.

Incorrect installation or handling can lead to serious accidents.

The operating instructions must be observed!
No. 3.551.BA

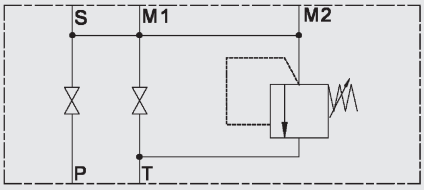
Relevant PDF documents are available from our Download Center at www.hydac.com.

1.4. STANDARD DESIGNS

1.4.1 Manual pressure release via pressure release valve (model M)

The basic version of the safety and shut-off block is equipped with a direct-acting relief valve and a manually operated pressure release valve for manual pressure release.

Sizes: SAF10, SAF20, SAF32

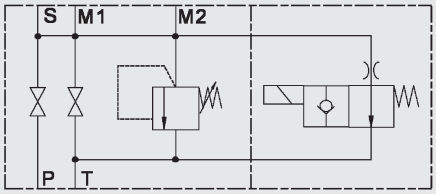


1.4.2 Solenoid pressure release (E type)

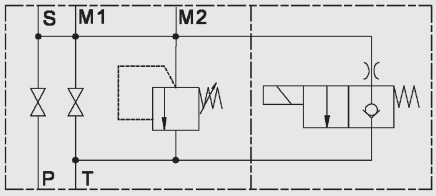
The E type safety and shut-off block has a solenoid-operated 2-way directional valve for automatic pressure release of the accumulator and the hydraulic system.

Sizes: SAF10, SAF20, SAF32

Normally open "Y"



Normally closed "Z"

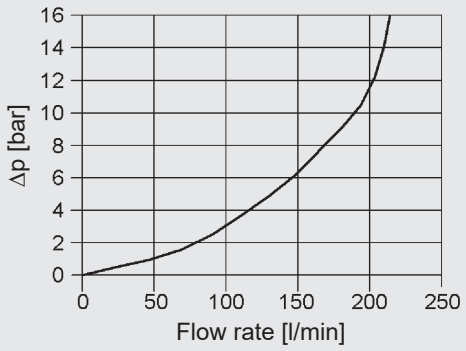


1.5. ΔP-Q GRAPHS FOR SAF

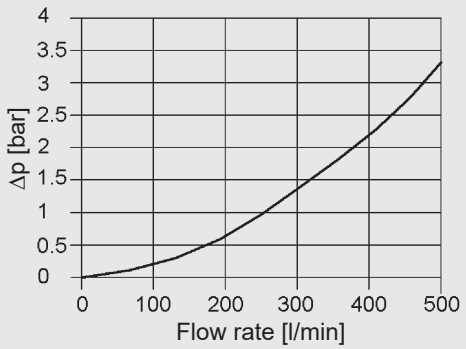
Measured at:
v = 32 mm²/s
t_{oil} = 40 °C
Operating pressure = 400 bar

1.5.1 Flow from the pump to the accumulator

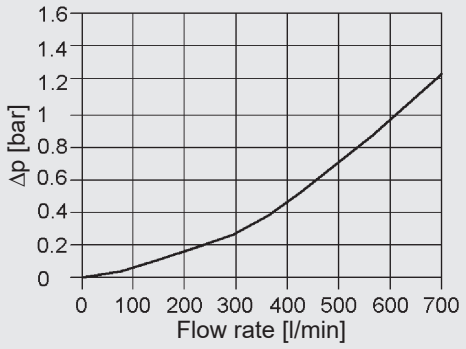
SAF10M/E



SAF20M/E

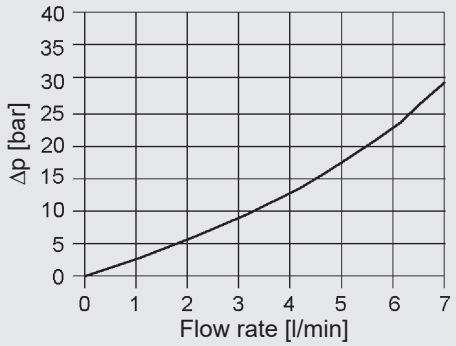


SAF32M/E; SAF32-3M/E

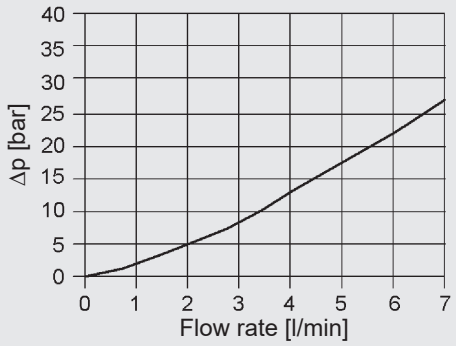


1.5.2 Flow from the accumulator via the solenoid-operated pressure release valve to the tank

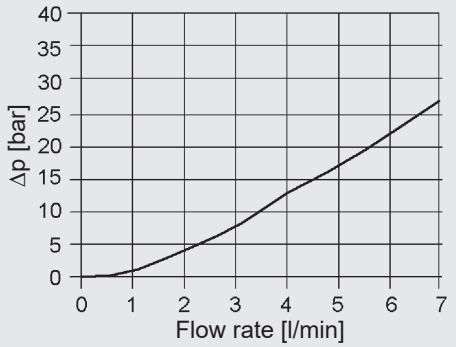
SAF10E



SAF20E

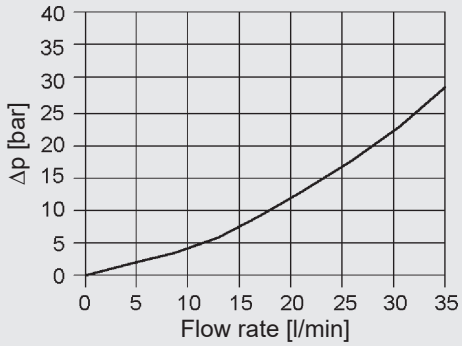


SAF32E; SAF32-3E

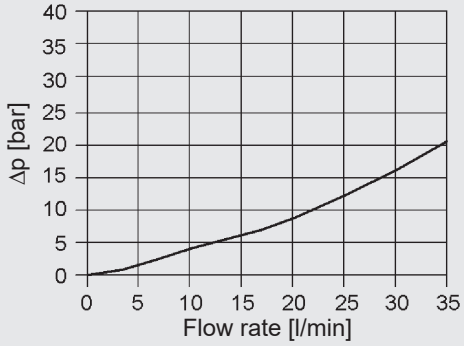


1.5.3 Flow from the accumulator via the pressure release valve to the tank

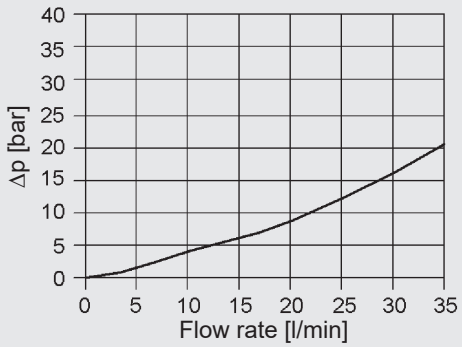
SAF10M/E



SAF20M/E



SAF32M/E; SAF32-3M/E



2. MODEL CODE FOR SAF

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

SAF 20 E 1 2 Y 1 T 210 A – S 13 – LPI – A9

Safety and shut-off block
Series SAF

Nominal size of main shut-off valve
8 = DN8
10 = DN10
20 = DN20
32 = DN32
32-3 = DN32 with 3 size 12 pressure release valves
50 = DN50

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

Block material [1)]
1 = carbon steel
3 = stainless steel
6 = carbon steel (low temperature)

Seal material (elastomer)
2 = NBR
5 = EPDM [6)]
6 = FKM
7 = other

Type – poppet valve [4)]
Y = normally open (2/2 directional valve WSM06020Y)
Z = normally closed (2/2 directional valve WSM06020Z, only up to 350 bar)

Voltage type – poppet valve [4)]
1 = 24 V DC (standard)
2 = 115 V AC
3 = 230 V AC
7 = other

Pressure relief valve
T = pressure setting with TÜV
N = pressure setting without TÜV [6)]

Pressure setting
e.g. 210 bar

Standard threaded connection
A = ISO 228 (BSP) [3)]
B = DIN 13, to ISO 965/1 (metric) [2)]
C = ANSI B1.1 (UNF, O-ring seal to SAE) [2)]

Adapter
to accumulator (see section 8.)
e.g. S13 = ISO 228 – G 2A

Additional equipment (see section 4.)
L = lockable main shut-off valve (locking device)
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 pressure release valve

Certification code DB12 [5)]
No details = European Pressure Equipment Directive (PED)
A6 = Russia, and others
A9 = China

Accessories – please give full details when ordering, see section 6.

[1)] Dependent on type and pressure rating
[2)] On request
[3)] In conjunction with SAF8 = 9/16-18UNF or ISO 228 - G 1/4 (BSP)
[4)] Only for type E
[5)] For furtherinformation, see catalogue section Accumulator Technology, No. 3.000, section 4.
[6)] Only with pressure relief valve N

3. STANDARD ITEMS

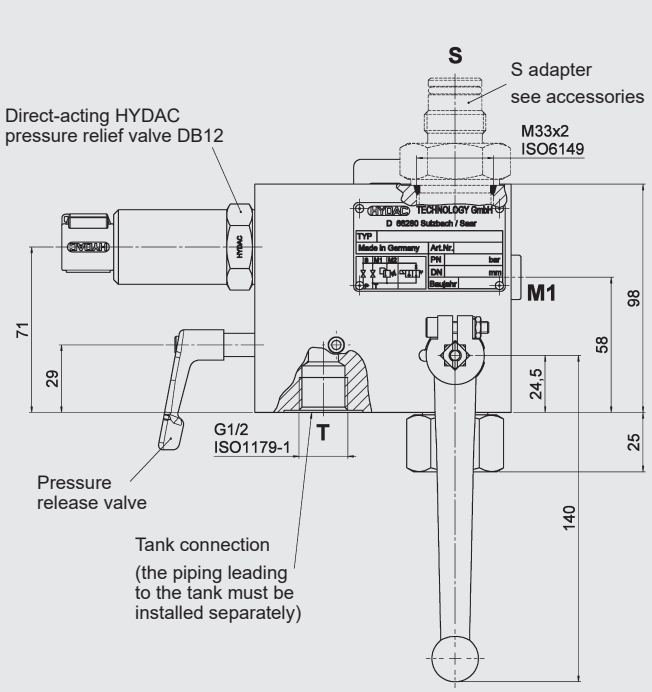
Part no. [1]	Product designation	Nominal size	Type [2]	Pressure rating	Adapter
2121346	SAF10M12T210A	10	M	210	-
2121403	SAF10M12T210A-S12				S12
2121419	SAF10M12T210A-S13				S13
2121236	SAF10M12T330A			330	-
2121443	SAF10M12T330A-S12				S12
2121444	SAF10M12T330A-S13				S13
2121662	SAF10E12Y1T210A	10	E	210	-
2125975	SAF10E12Y1T210A-S12				S12
2126796	SAF10E12Y1T210A-S13				S13
2122211	SAF10E12Y1T330A			330	-
2121949	SAF10E12Y1T330A-S12				S12
2122050	SAF10E12Y1T330A-S13				S13
2120319	SAF20M12T210A	20	M	210	-
2120455	SAF20M12T210A-S12				S12
2120376	SAF20M12T210A-S13				S13
2120323	SAF20M12T330A			330	-
2120522	SAF20M12T330A-S12				S12
2120457	SAF20M12T330A-S13				S13
2120320	SAF20E12Y1T210A	20	E	210	-
2121895	SAF20E12Y1T210A-S12				S12
2120380	SAF20E12Y1T210A-S13				S13
2120394	SAF20E12Y1T330A			330	-
2120879	SAF20E12Y1T330A-S12				S12
2120383	SAF20E12Y1T330A-S13				S13
2120321	SAF32M12T210A	32	M	210	-
2120377	SAF32M12T210A-S309				S309
2122231	SAF32M12T330A			330	-
2120375	SAF32M12T330A-S309				S309
2120318	SAF32E12Y1T210A	32	E	210	-
2120448	SAF32E12Y1T210A-S309				S309
2120371	SAF32E12Y1T330A			330	-
2120379	SAF32E12Y1T330A-S309				S309

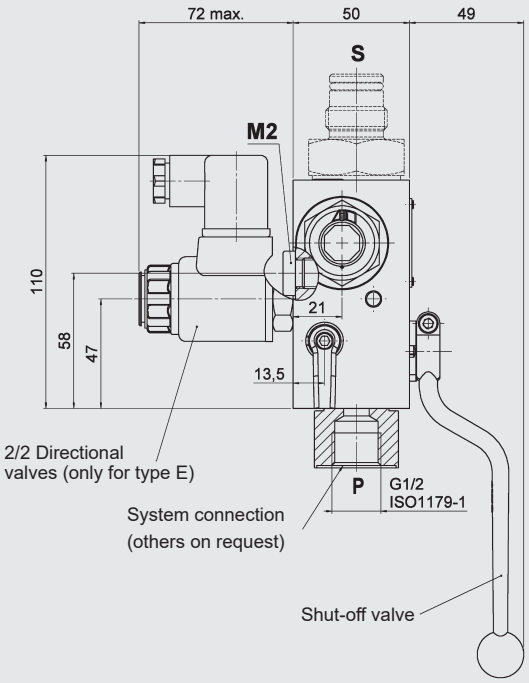
[1] Preferred models

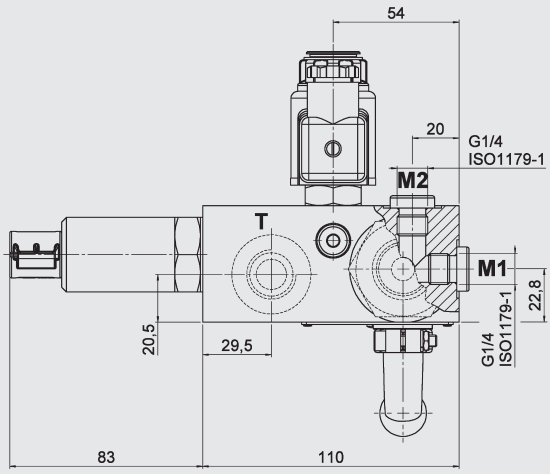
[2] Type E: Poppet valve, normally open (Y)

3.1. TABLES AND DRAWINGS

3.1.1 SAF10





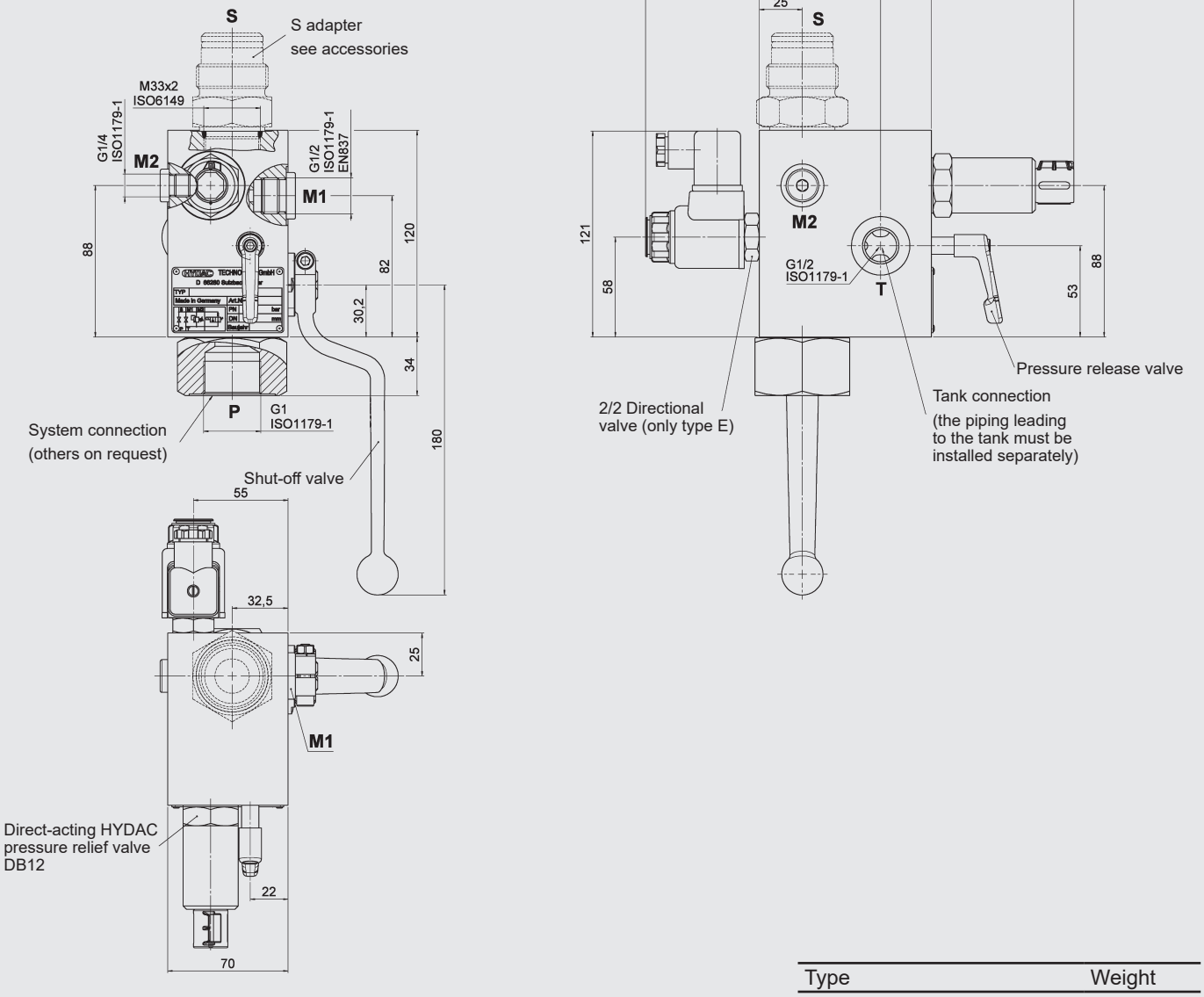


Type	Weight
SAF10M...	4.2 kg
SAF10E...	4.6 kg

Other SAF10

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

3.1.2 SAF20

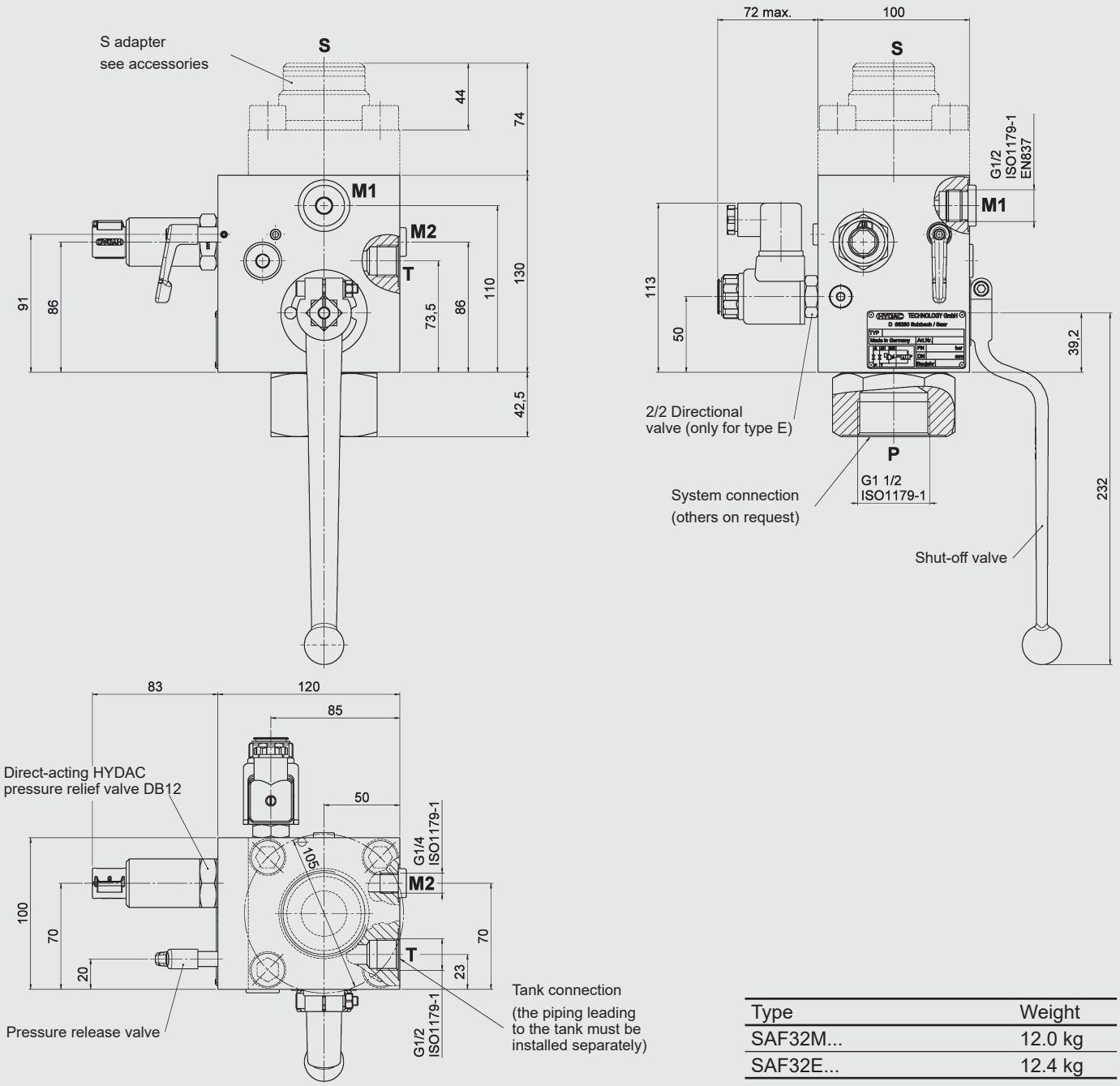


Type	Weight
SAF20M...	6.8 kg
SAF20E...	7.2 kg

Other SAF20

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

3.1.3 SAF32

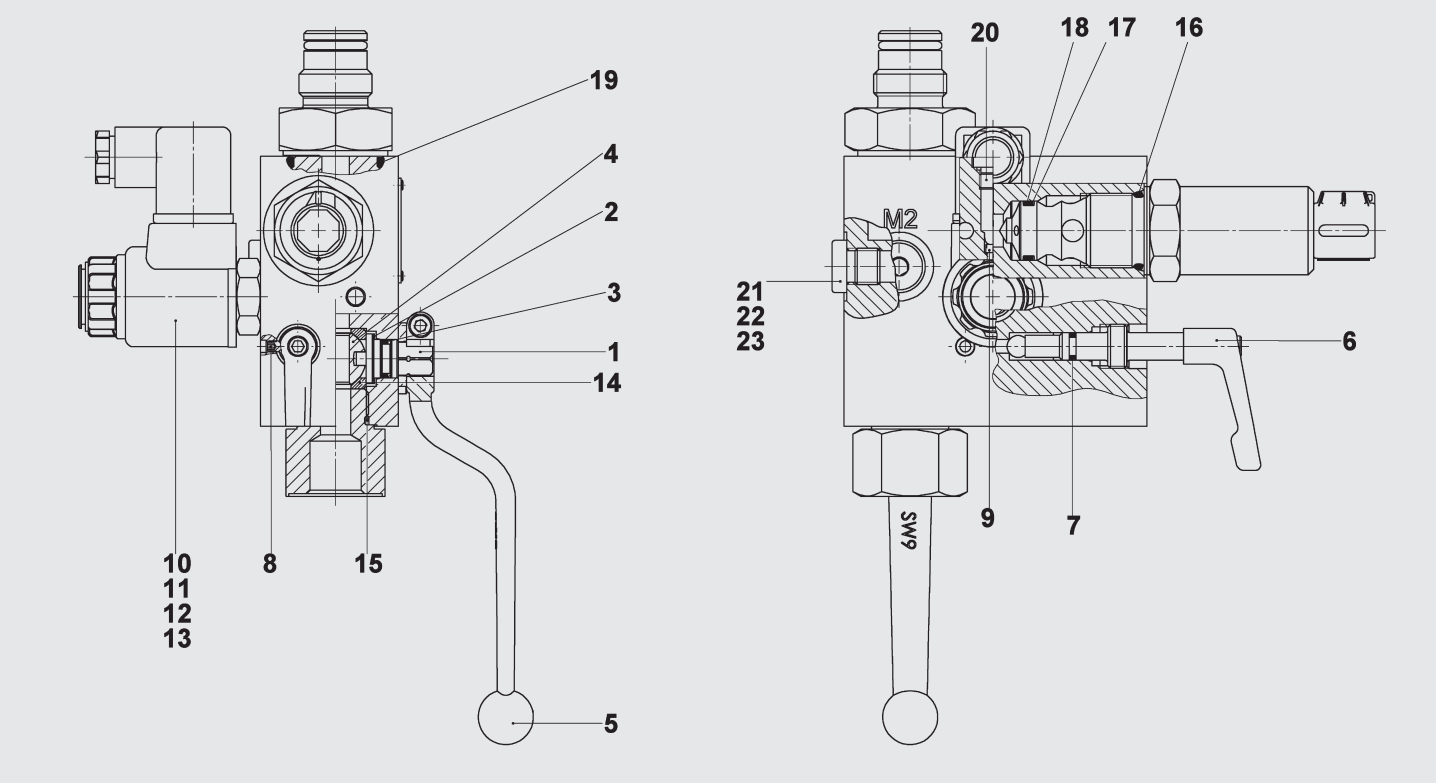


Type	Weight
SAF32M...	12.0 kg
SAF32E...	12.4 kg

Other SAF32

Type	Part no.	Type	Part no.
SAF32M12T400A	2125856	SAF32E12Y1T400A	2123123
SAF32M12T350A	2122230	SAF32E12Y1T350A	3125142
SAF32M12T315A	2121136	SAF32E12Y1T315A	2122222
SAF32M12T300A	2120837	SAF32E12Y1T300A	2120834
SAF32M12T250A	2122233	SAF32E12Y1T250A	2122223
SAF32M12T200A	2121135	SAF32E12Y1T200A	2122224
SAF32M12T150A	2121134	SAF32E12Y1T150A	2122225
SAF32M12T100A	2121129	SAF32E12Y1T100A	2122226
SAF32M12T070A	2122234	SAF32E12Y1T070A	2122227
SAF32M12T050A	2121137	SAF32E12Y1T050A	2122228
SAF32M12T035A	2121125	SAF32E12Y1T035A	2122229

3.2. SPARE PARTS

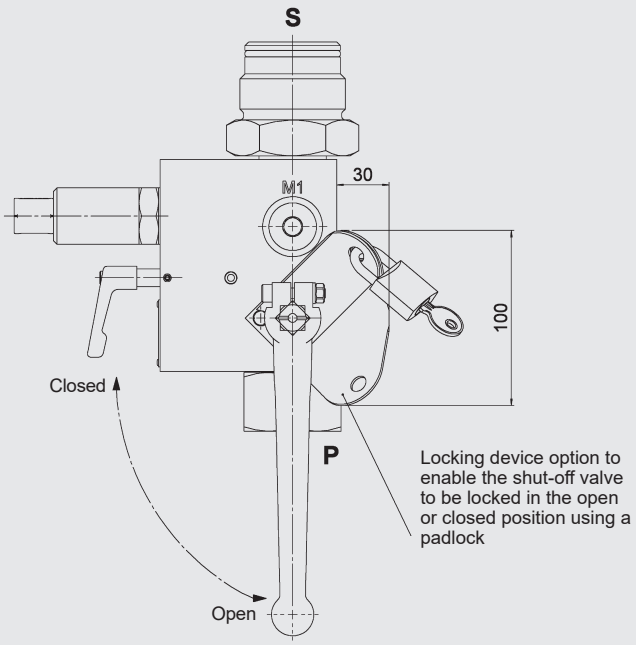


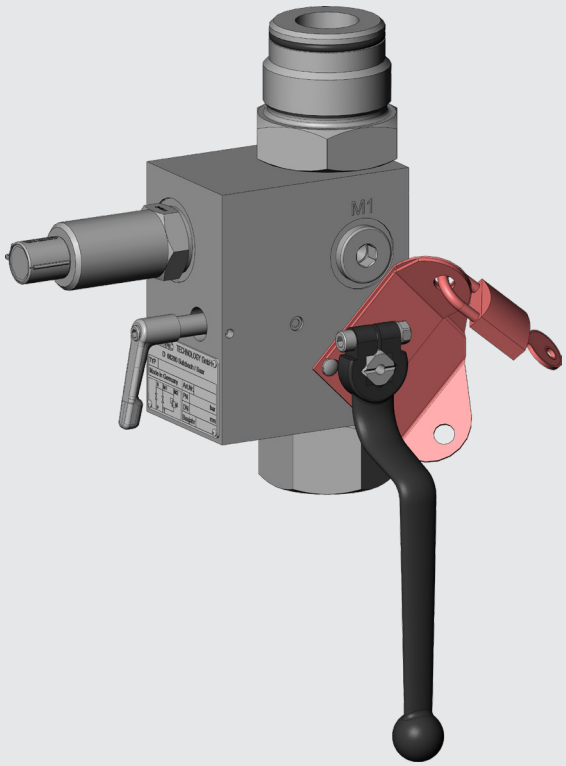
Type of safety and shut-off block		SAF10M, SAF10E	SAF20M, SAF20E	SAF32M, SAF32E
Description	Item	Dimensions or part no.		
Repair kit consisting of:		2122238 (NBR) 2122240 (FKM)	2122242 (NBR) 2122244 (FKM)	2122246 (NBR) 2122248 (FKM)
Spindle	1			
Disc	2			
O-ring	3	10x2	15x2.5	20x3
Ball	4			
Switching handle	5			
Spindle (incl. ball)	6			
O-ring	7	6x2		
Threaded pin	8	M4x6	M4x10	
Orifice	9	Ø1.5 mm (Q_{max} - 25.5 l/min)		
O-ring	11	17x2		
Support 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		
Support ring	17	18.3x21.5x1		
O-ring	18	18x2		
O-ring	19	29.7x2.8	29.7x2.8	37.2x3
Locking screw	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 type, voltage 24 V DC)	10	WSM06020Y – normally open WSM06020Z – normally closed	3153871 (350 bar); 3153874 (350 bar);	3156869 (400 bar) 3156873 (400 bar)
Locking screw assembly (converts "E" type to "M" type)		277645		
Seal kit consisting of: No. 3, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23		2121699 (NBR) 2121701 (FKM)	2121703 (NBR) 2121705 (FKM)	2121707 (NBR) 2121709 (FKM)
Spindle repair kit consisting of: No. 6, 7, 8		2115648 (NBR) 2115649 (FKM)		

4. ADDITIONAL EQUIPMENT FOR SAFETY AND SHUT-OFF BLOCKS

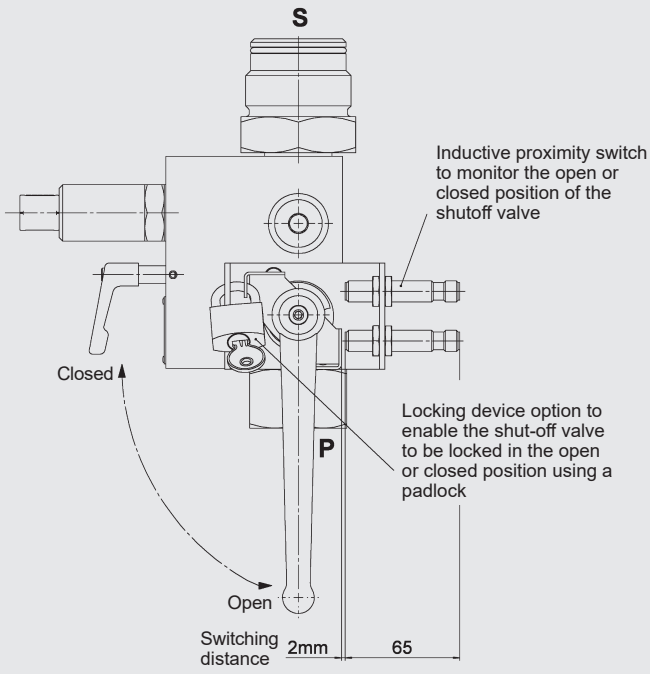
In safety and shut-off blocks, the position of the shut-off valve/the pressure release valve can be secured.
HYDAC supplies various additional devices for this (retrofit options, see section 8.):

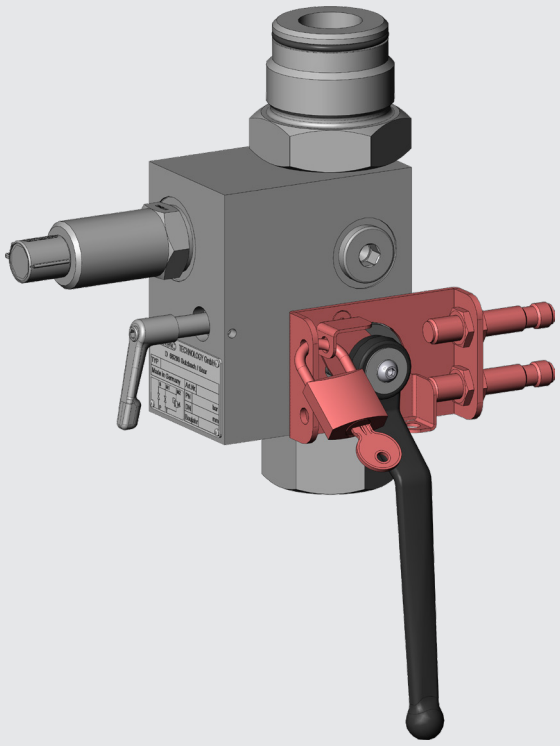
Additional device L



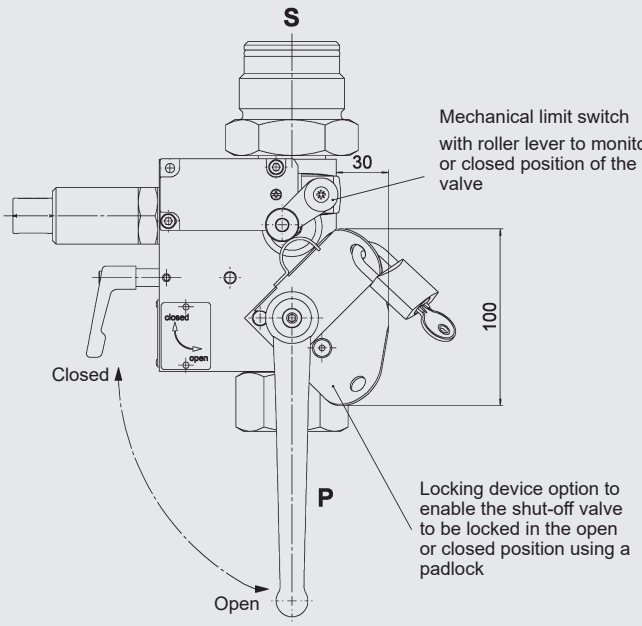


Additional device LPI



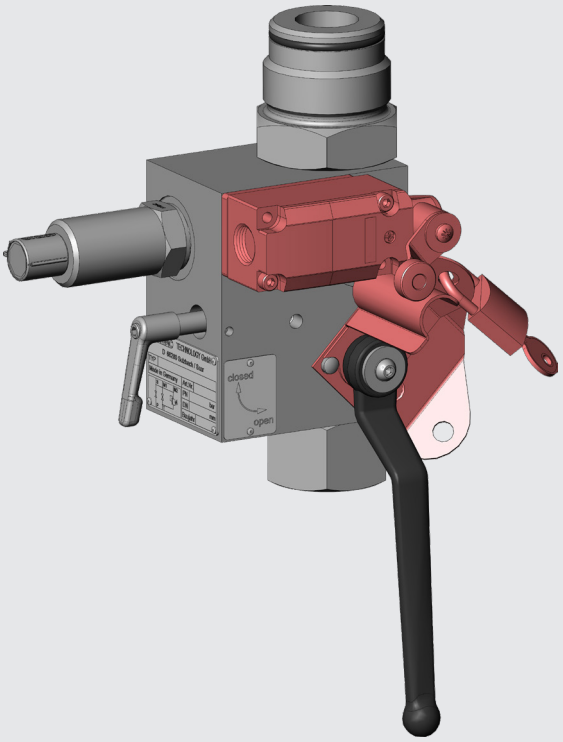


Additional device LPM

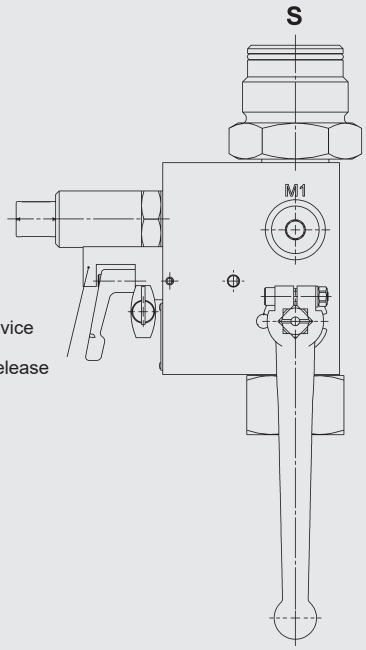


Mechanical limit switch
with roller lever to monitor the open or closed position of the shut-off valve

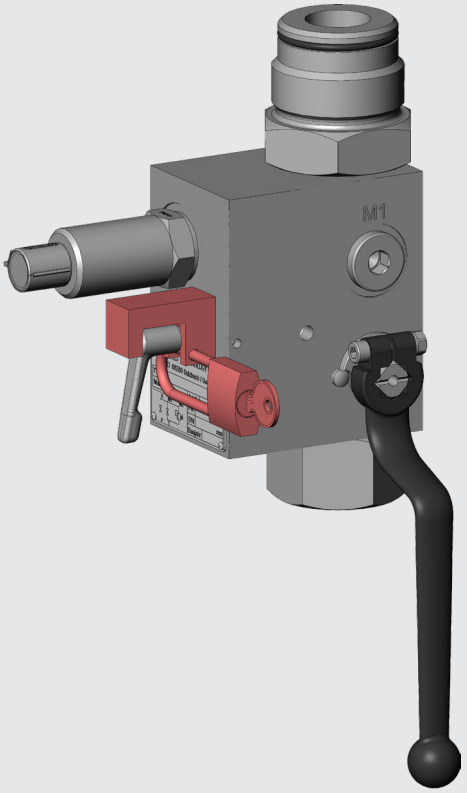
Locking device option to enable the shut-off valve to be locked in the open or closed position using a padlock



Additional device LS



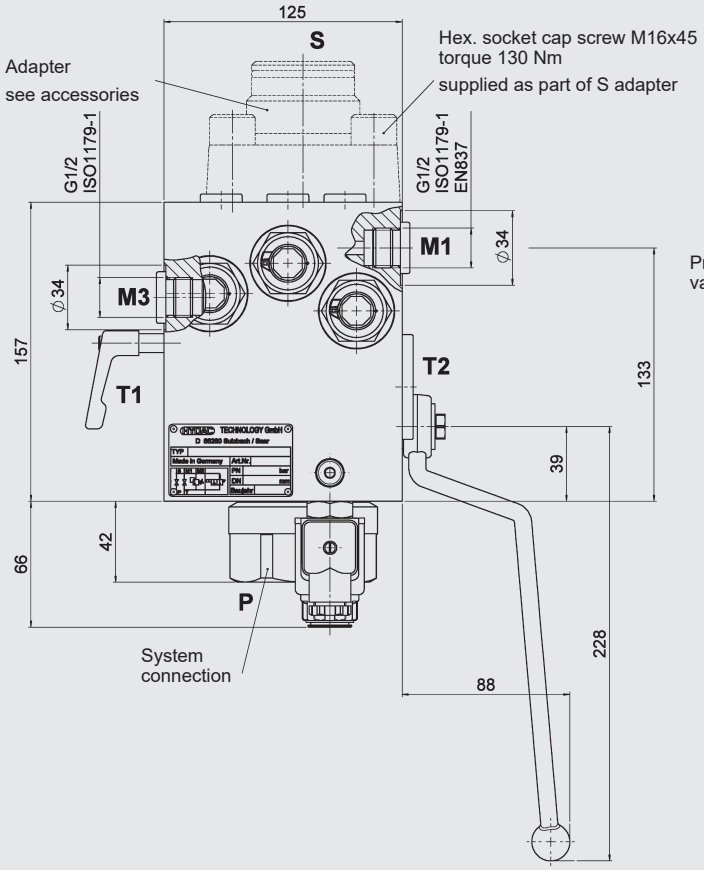
Locking device option for pressure release valve

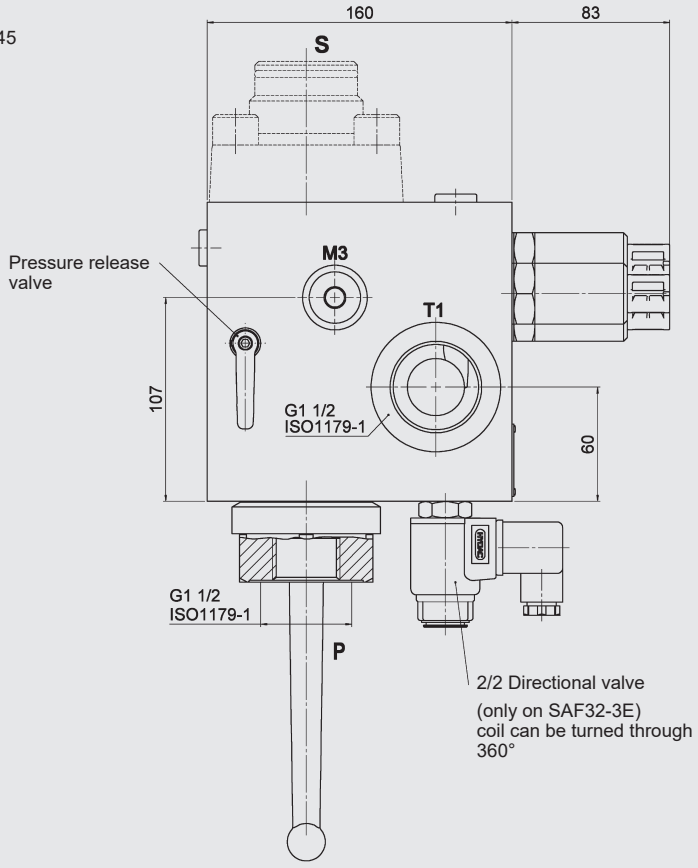


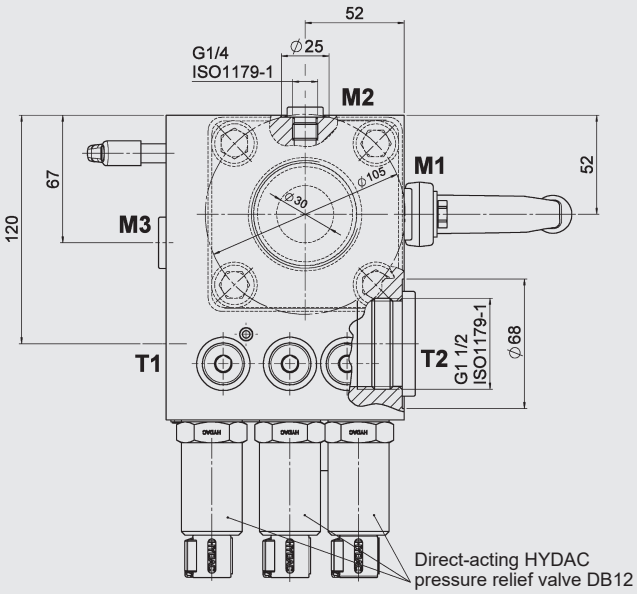
5. SPECIAL MODELS

5.1. SAF32-3M(E)

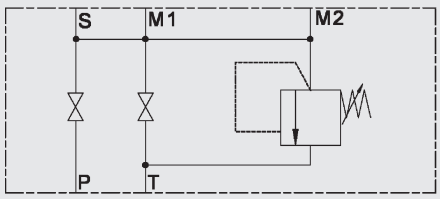
with 3 direct acting pressure relief valves DB12
(max. operating pressure 400 bar)



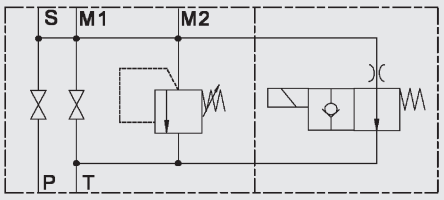




SAF32-3M



SAF32-3E

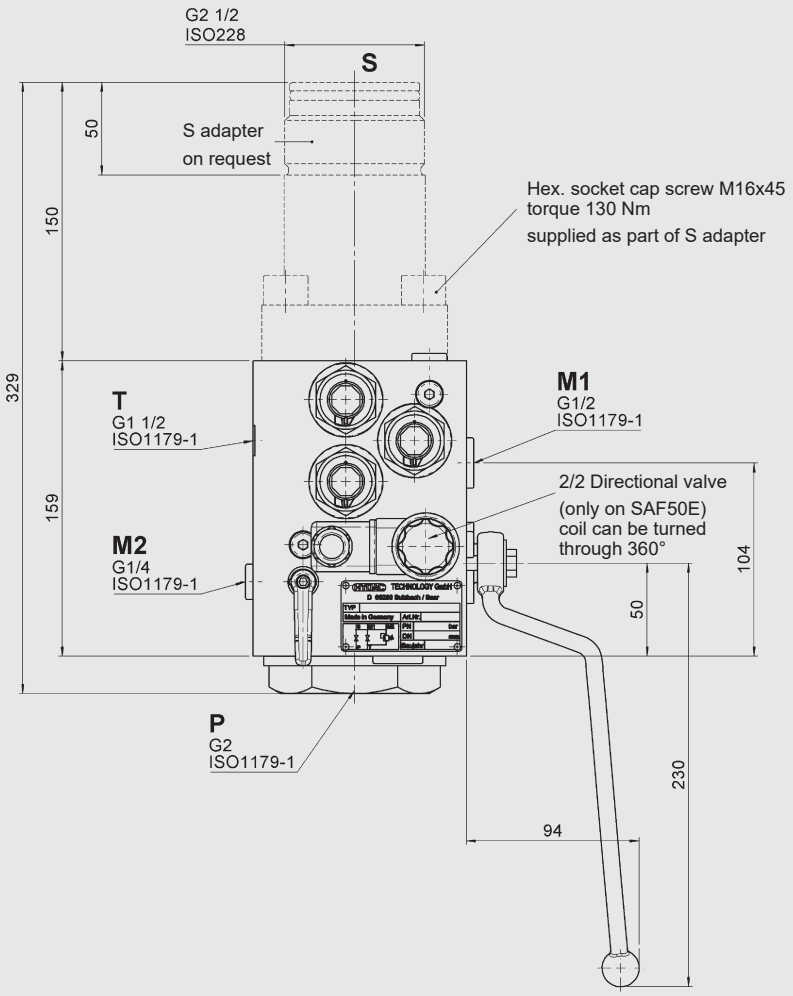


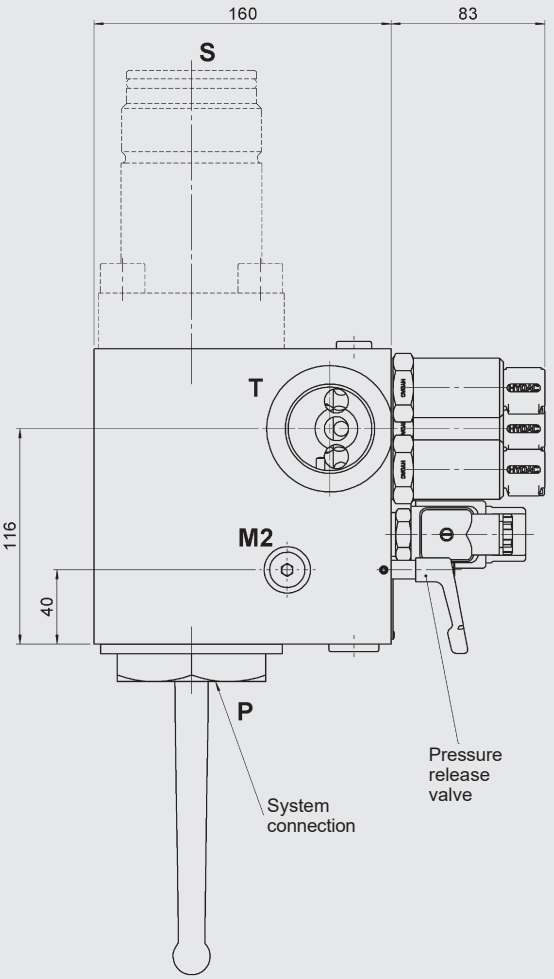
Type	Weight
SAF32-3M...	24 kg
SAF32-3E...	25 kg

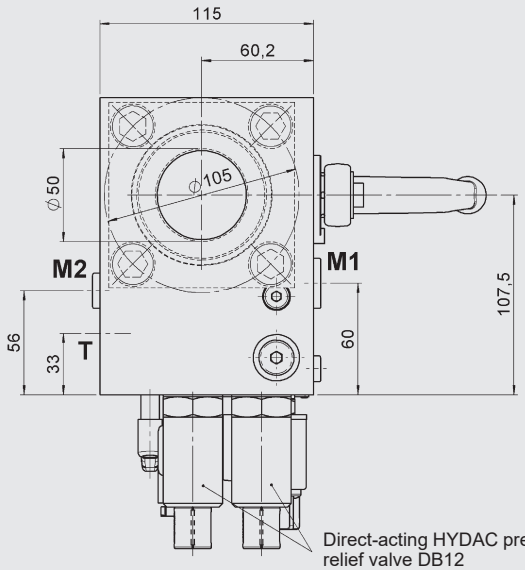
5.2. SAF50M(E)

for high flow rates
with 3 direct-acting pressure relief valves DB12

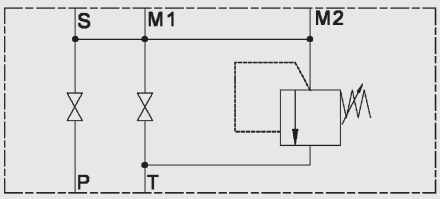
Max. operating pressure
Type M: 400 bar
Type E: 350 bar



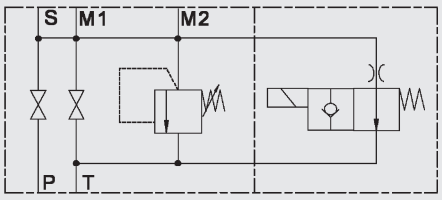




SAF50M



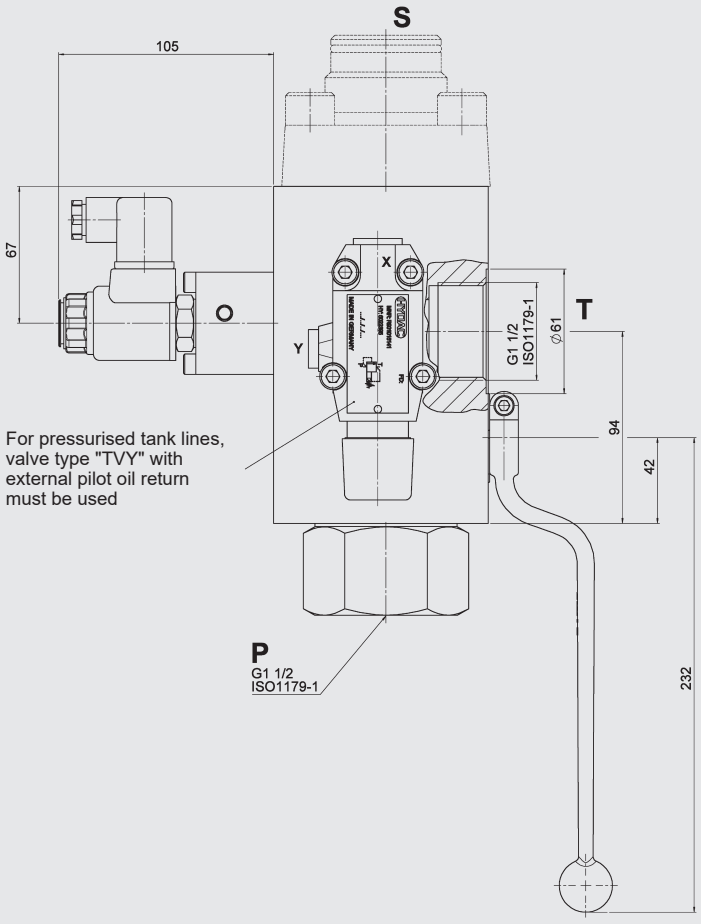
SAF50E

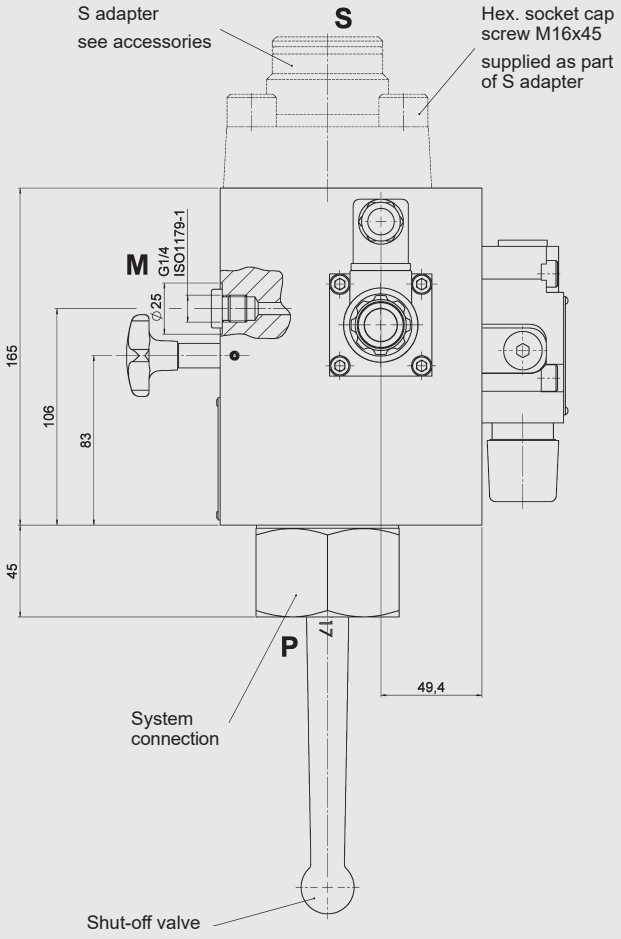


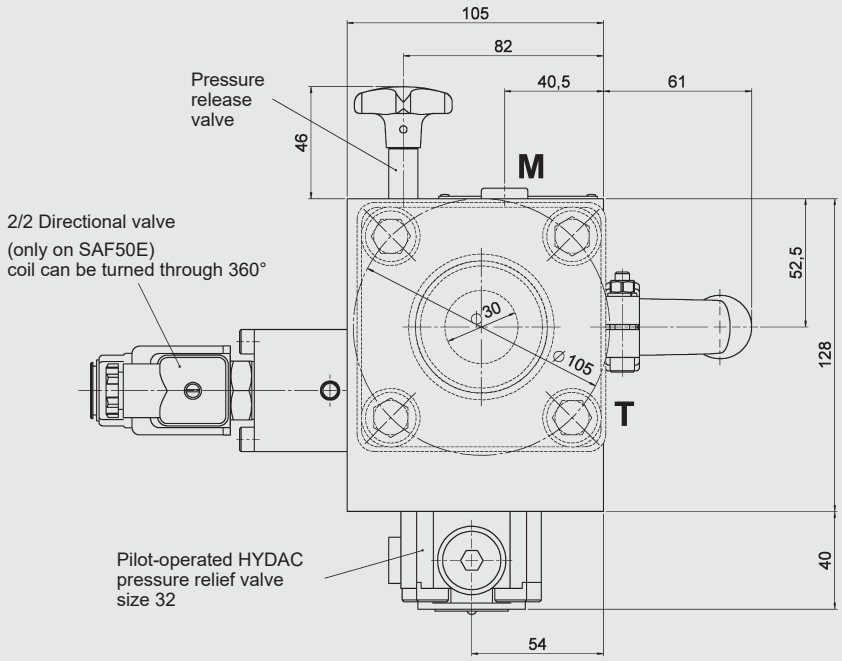
Type	Weight
SAF50M...	25 kg
SAF50E...	26 kg

5.3. SA32M(E)29

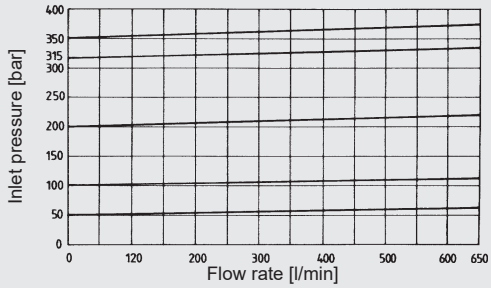
with pilot-operated pressure relief valve (Q_{max} = 600 l/min)
(max. operating pressure 330 bar)



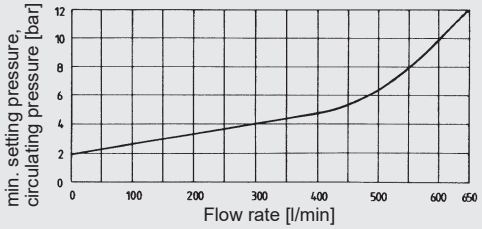




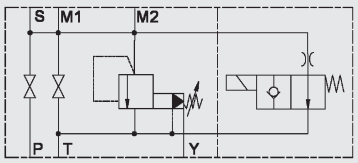
Pilot-operated HYDAC pressure relief valve size 32



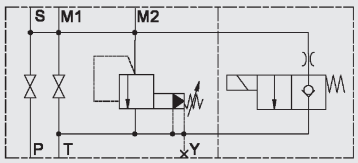
Lowest setting pressure [bar]



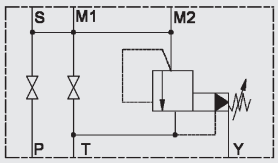
SA32E29TVY



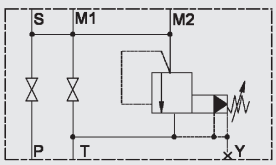
SA32E29TV



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

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

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

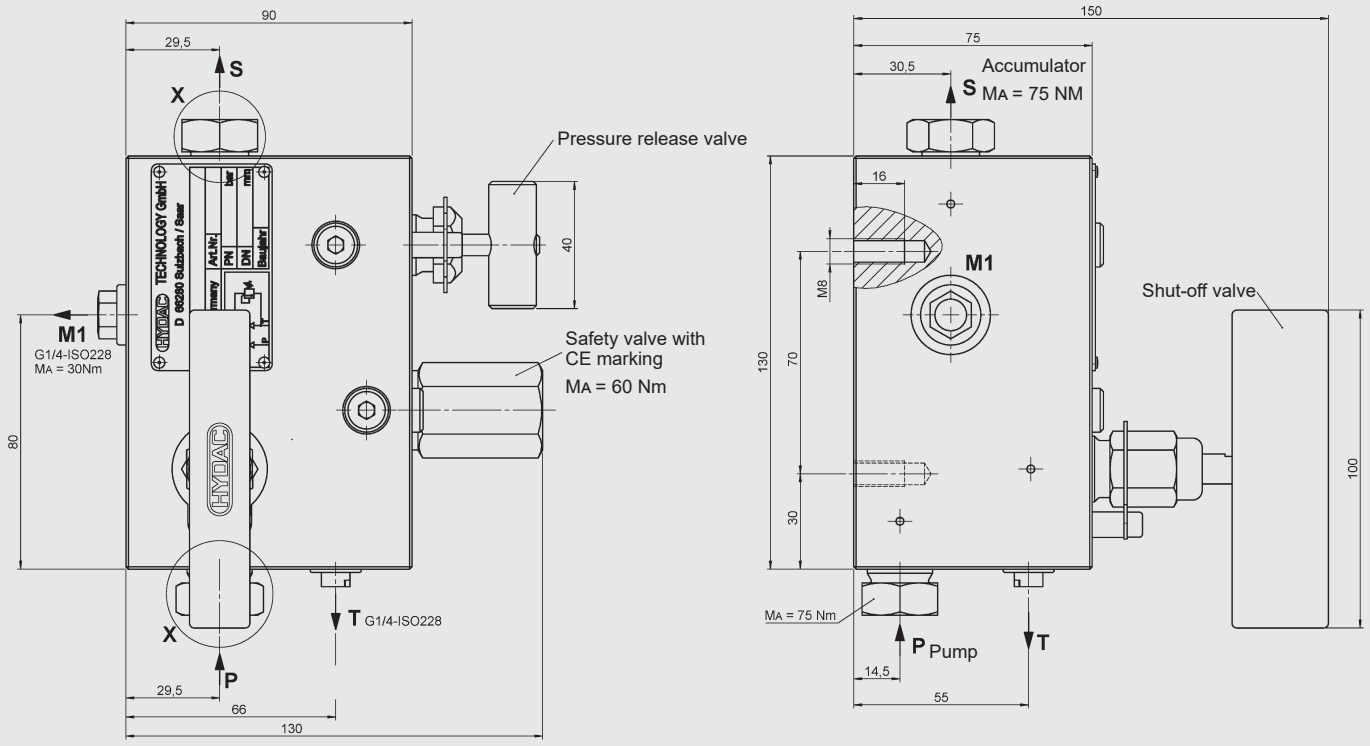
– WSM06020Y (normally open)

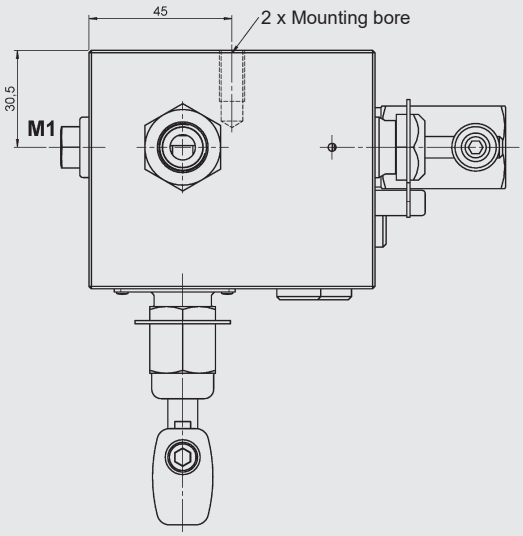
– WSM06020Z (normally closed)

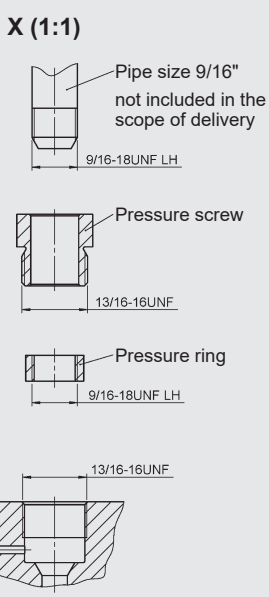
Type	Weight
SA32M29...	22.5 kg
SA32E29...	23.5 kg

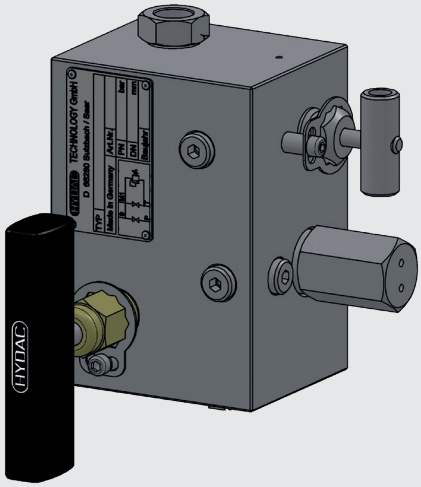
5.4. SAF8M

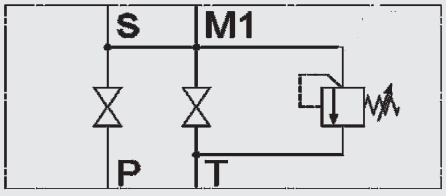
For pressures of 400 bar and above in stainless steel with high-pressure ports
(max. operating pressure 800 bar, max. perm. flow rate safety valve: 0.95 l/min)











Type	Weight
SAF8M	7.5 kg

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

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

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

5.5.1 Function when using 4/2 direction valve

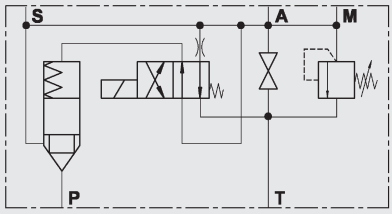
When the 4/2 directional valve is in the switching position shown (open when de-energised), the spring chamber of the logic element is pressurised via the accumulator pressure; the path from P to S is blocked and the hydraulic accumulator is automatically shut off from the system. By connecting the accumulator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

Specifications:

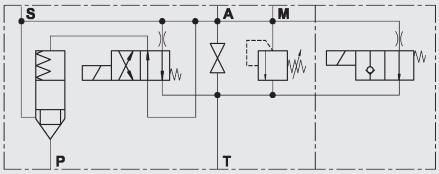
Type	Nominal size	Max. operating pressure	Pressure relief valve [1]
SA20A50T...	DN20	400 bar	DB12 (2)
SA32A50T...	DN30	400 bar	DB12 (3)

[1] Number of pressure relief valves



Type	Nominal size	Max. operating pressure	Pressure relief valve [1]
SA20E50T...	DN20	400 bar	DB12 (2)
SA32E50T...	DN30	400 bar	DB12 (3)

[1] Number of pressure relief valves



5.5.2 Function when using 3/2 directional poppet valve

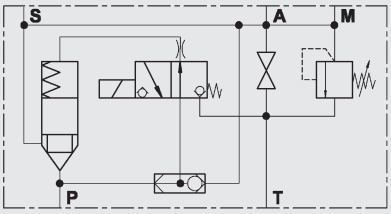
When the 3/2 directional poppet valve is in the switching position shown (open when de-energised), the spring chamber of the logic element is pressurised via the system pressure; the path from P to S is blocked and the hydraulic accumulator is shut off from the system. When the 3/2 directional poppet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

Specifications:

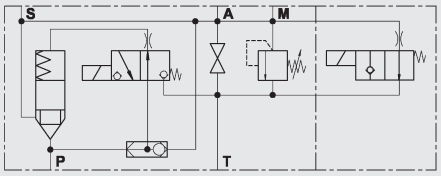
Type	Nominal size	Max. operating pressure	Pressure relief valve [1]
SA20A51T...	DN20	400 bar	DB12 (2)
SA32A51T...	DN30	400 bar	DB12 (3)

[1] Number of pressure relief valves



Type	Nominal size	Max. operating pressure	Pressure relief valve [1]
SA20E51T...	DN20	400 bar	DB12 (2)
SA32E51T...	DN30	400 bar	DB12 (3)

[1] Number of pressure relief valves



5.6. DSV10 PRESSURE RELIEF VALVE

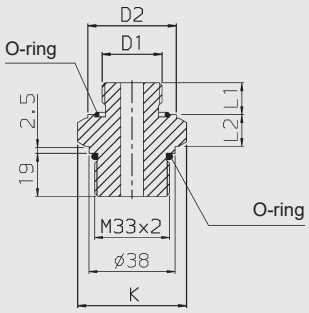
The three-way DSV10 safety block is used to isolate and discharge hydraulic accumulators and consumers. It complies with the relevant safety standards in accordance with DIN EN 4413 and the German Industrial Safety Regulation BetrSichV.
The HYDAC DB12 pressure relief valve is used with the DSV series. It is a direct-acting pressure relief valve in a poppet valve design with excellent opening and closing characteristics.
This version of the DB12 complies with the requirements of the European Pressure Equipment Directive (PED) with CE marking.

For further details and technical data, see brochure:

- 3-way safety block – DSV
  No. 5.251

6. ACCESSORIES

6.1. ADAPTERS FOR DIAPHRAGM ACCUMULATORS



Type	Accumulator type	Nominal volume [l]	D1 thread	Adapter	Part no. [1] NBR/carbon steel	K AF	L1 [mm]	L2 [mm]	D2 [mm]	O-ring
SAF10/20 DSV10	SBO...E-	0.075 ... 1.4	G 1/2 A	S 30	**369485***	41	14	17.5	33	22x3
	SBO...A6-	0.1 ... 0.6								
	SBO...E-	2.0 ... 3.5	G 3/4 A	S 31	**369486***		16		40	28x3
	SBO...A6-	1.3 ... 4								

* Preferred models

[1] Others on request

6.2. ADAPTERS FOR PISTON ACCUMULATORS

6.2.1 Standard piston accumulator

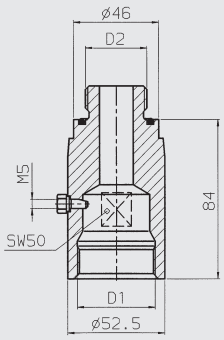


Fig. 1

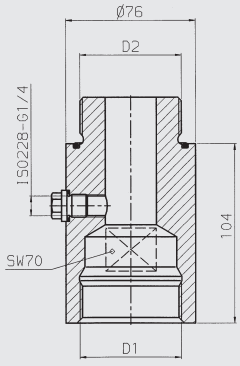
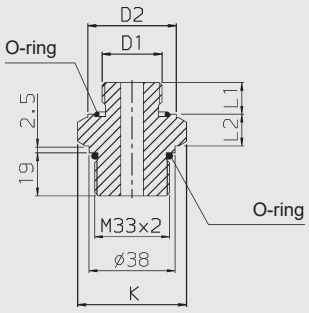


Fig. 2

Type	Accumulator type	Nominal volume [l]	Adapter	Part no. [1] NBR/carbon steel	D1 [mm]	D2 [mm]	O-ring	Corresponding S adapter	Part no. [1] NBR/carbon steel	Fig.
SAF10/20 DSV10	SK210/350 -	2.5 ... 7.5	K 406	374929	G 1 1/4	G 1	35x3	S 12	369480	1
	SK210/350 -	10 ... 45	K 408	374931	G 2	G 1 1/2	53x3	S 13	369481	2
SAF32	SK210/350 -	50 ... 120	K 409	374933		G 2	62x3	S 309	366715	

[1] Others on request

6.2.2 SK280



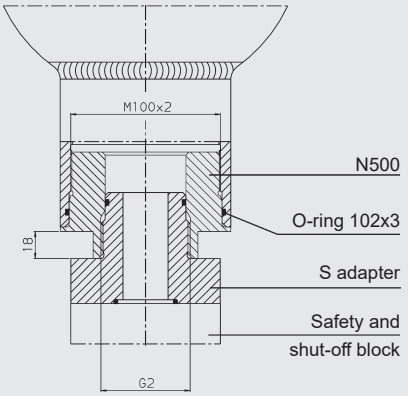
Type	Accumulator type	Fluid port SK280	D1 thread	Adapter	Part no. [1] NBR/carbon steel	K AF	L1 [mm]	L2 [mm]	D2 [mm]	O-ring
SAF10/20 DSV10	SK280	AAD	G 1/2 A	S 30	**369485***	41	14	17.5	33	22x3
		AAE	G 3/4 A	S 31	**369486***		16		40	28x3
		AAF	G 1 A	S 32	369487	46	18	18.5	45	35x3

* Preferred models

[1] Others on request

6.3. ADAPTERS FOR BLADDER ACCUMULATORS

6.3.1 Low pressure bladder accumulators



Type	Accumulator type	Nominal volume [l]	Adapter	Part no. [1] NBR/carbon steel	Corresponding S adapter	Part no. [1] NBR/carbon steel
SAF10/20 and DSV10	SB40	2.5 ... 50	N500	367229	S 13	369481
SAF32					S 309	366715

[1] Others on request

6.3.2 Standard/high pressure bladder accumulators, threaded connection

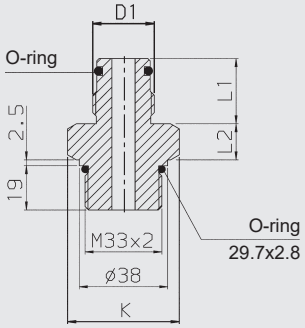


Fig. 1

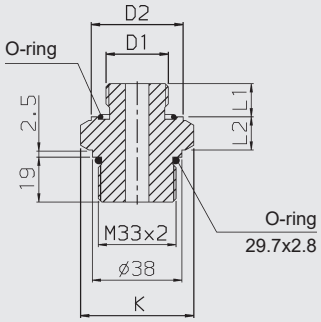


Fig. 2

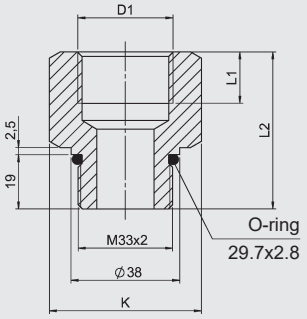


Fig. 3

Type	Accumulator type	Nominal volume [l]	D1 thread	Adapter	Part no. [1] NBR/carbon steel	K AF [mm]	L1 [mm]	L2 [mm]	D2 [mm]	O-ring [mm]	Fig.
SAF10 SAF20 DSV10	SB330/400-	0.6 ... 1	G 3/4A	S 10	**369479***	41	28	16	–	17x3	1
	SB550/690-	1 ... 5	G 1A	S 11	372750	46	34	17	–	22x3	
	SB330/400-	2.5 ... 6	G 1 1/4A	S 12	**369480***		37		–	30x3	
	SB330/400/ 550/600-	10 ... 50	G 2A	S 13	**369481***	65	44	21	–	48x3	
	Connection with metric fine thread	–	M30x1.5	S 20	369482	41	15	18	40	32x2	2
		–	M40x1.5	S 21	369483	55	20	21	54	43x3	
		–	M50x1.5	S 22	369484	65			64	53x3	
	SB330/400-	2.5 ... 50	G 3/4	S 367861	369489	41	18	50	–	–	3
			G 1	S 379766	369490	46	20	55	–	–	
			G 1 1/4	S 379767	369498	65	22	60	–	–	

* Preferred models

[1] Others on request

6.3.3 Standard/high pressure bladder accumulators, flange connection

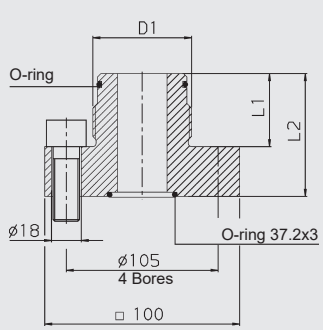


Fig. 4

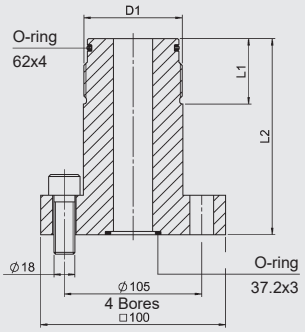


Fig. 5

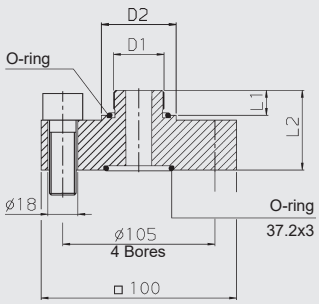


Fig. 6

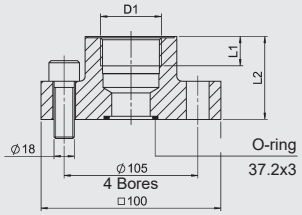


Fig. 7

Type	Accumulator type	Nominal volume [l]	D1 thread	Adapter	Part no. [2] NBR/carbon steel	L1 [mm]	L2 [mm]	D2 [mm]	O-ring [mm]	Fig.
SAF32	SB330/400-	0.6 ... 1	G 3/4A	S 305 [1]	366723	28	58	–	17x3	4
	SB550/690-	1 ... 5	G 1A	S 306 [1]	2102855	34	64	–	22x3	
	SB330/400-	2.5 ... 6	G 1 1/4A	S 307 [1]	366724	37	67	–	30x3	
	SB330/400/600-	10 ... 50	G 2A	S 309 [1]	**366715***	44	74	–	48x3	
	SB550-	10 ... 50		S 308 [1]	376813		115	–		5
	SB330H-	10 ... 50	G 2 1/2A	S 365922	377283	50	150	–	62x4	
	Connection with metric fine thread	–	M30x1.5	S 330 [1]	366735	15	47	45	32x2	6
		–	M40x1.5	S 340 [1]	366736	20	51	60	43x3	
		–	M50x1.5	S 350 [1]	366737			75	53x3	
	SB330/400-	10 ... 50	G 1	S 365637	2106583	20	60	–	–	7
			G 1 1/4	S 369658	2106578	22		–	–	
			G 1 1/2	S 237838	2103869	24	65	–	–	

* Preferred models

[1] Adapter supplied with 4 hex. socket cap screws M16x45 (part no. 6032726) torque 130 Nm

[2] Others on request

6.3.4 High pressure bladder accumulators

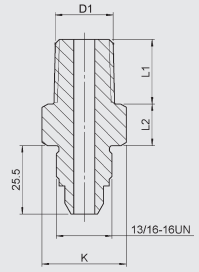


Fig. 8

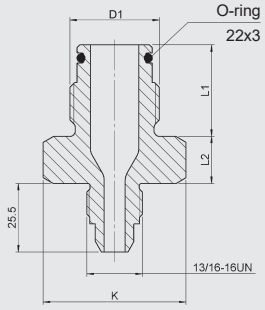


Fig. 9

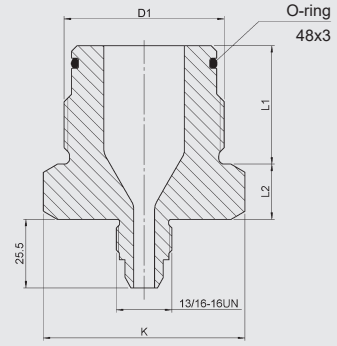


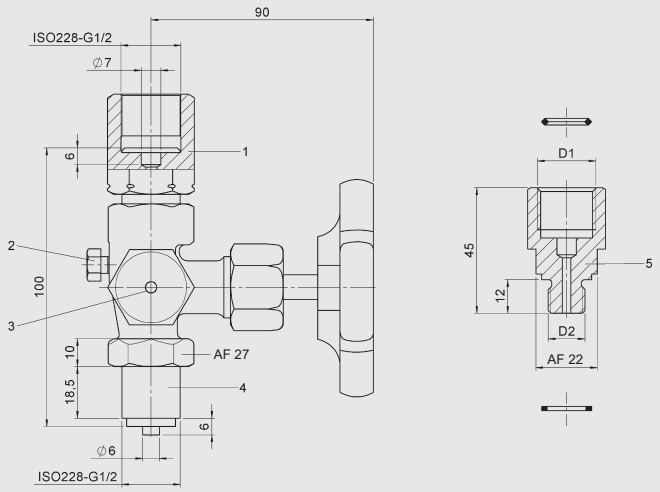
Fig. 10

Type	Accumulator type	Nominal volume [l]	D1 thread	Adapter	Part no. [2] Stainless steel	K AF [mm]	L1 [mm]	L2 [mm]	D2 [mm]	O-ring [mm]	Fig.
SAF8	SB690	1 ... 54	1/2" NPT	S3936571	3936571	27	27	15.5	–	–	8
	SB550	≤ 5	G 1	S3956412	4158378 [1]	46	34	17.5	–	22.3	9
	SB500	≥ 10	G 2	S3961814	4158379 [1]	65	44	20.5	–	48.3	10

[1] NBR O-ring

[2] Others on request

6.4. GAUGE SHUT-OFF VALVE



Part no.	Description	Thread		Consisting of:	Item
		D1	D2		
611903	Shut-off valve AG DIN 16271	–	–	Pressure release valve	2
				Female to female threaded connection	1
				Female to male threaded connection	4
				Test point	3
370754	Adapter PA G1/4A-G1/2	G 1/2	G 1/4A		5

6.5. ADDITIONAL DEVICES FOR RETROFITTING

HYDAC supplies the following additional devices for retrofitting to prevent accidental alteration of the position of the shut-off valve or the pressure release valve on the SAF block. For mounting onto the SAF, see section 5. Additional equipment for safety and shut-off blocks.

6.5.1 Lockable main shut-off valve (locking device) - L

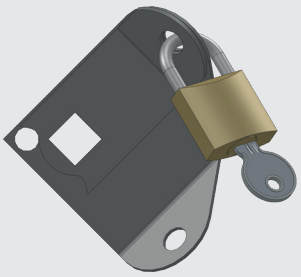


Fig. 1

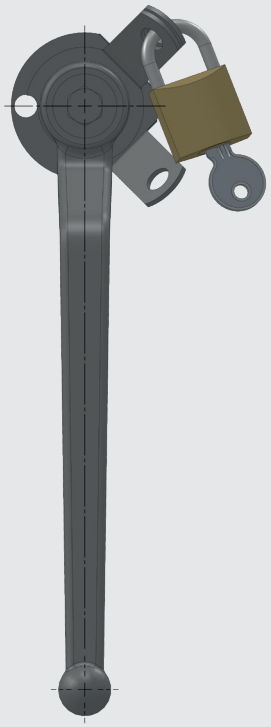
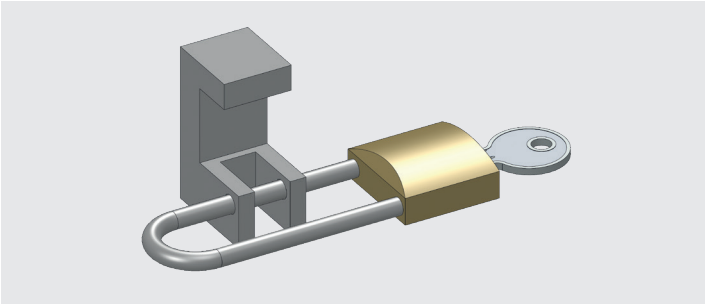


Fig. 2

Part no.	Designation	Consisting of:	Fig.
4334727	Lockable main shut-off valve for SAF10	Plates	1
		Padlock	
4334730	Lockable main shut-off valve for SAF20	Plates	
		Padlock	
4334731	Lockable main shut-off valve for SAF32	Plates	2
		Padlock	
		Switching handle	
		Screw	

6.5.2 Lockable pressure release valve - LS



Part no.	Designation	Consisting of:
3580490	Spindle lock SAF	– Spindle lock SAF – Padlock

6.6. ACCUMULATOR CHARGING VALVE

HYDAC accumulator charging valves control the charging of the accumulator within an adjustable switching range. By combining the charging valve with an accumulator, pumps and motors on oil-hydraulic systems with fluctuating flow requirements can be sized smaller. This saves costs and energy - thus preventing unnecessary heat generation.

For further information and technical specifications, see brochures:

- DLHSD DLHSR Accumulator charging valve
  No. 5.190.1
- Accumulator charging valve DL10-01
  No. 5.199.9

7. NOTE

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

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Safety equipment for hydraulic accumulators

1. DESCRIPTION

1.1. SECURING PRESSURE VESSELS

Hydraulic accumulators are pressure equipment, as defined by the European Pressure Equipment Directive (PED), and as such their manufacture is subject to the statutory regulations.

For safety in the workplace, system manufacturers and operators must draw up risk assessments for the particular site. These must take possible risks at the installation site into account as well as risks in combination with external factors.

Fundamental risks affecting hydraulic accumulators are:

- Excessive pressure
- Temperature increase (e.g. in event of an external fire)

HYDAC provides the appropriate safety equipment to protect hydraulic accumulators from the maximum permitted operating pressure PS being exceeded on the gas and fluid side; see also catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

When selecting safety equipment, consideration must be given to the material (elastomers and housing material) in terms of the material compatibility with the application.

The response pressure of safety equipmentmust **not** exceed the max. permitted operating pressure PS of a hydraulic accumulator.

1.2. FURTHER INFORMATION

- Operating instructions for GSV/GMP
  No. 3.504
- Operating instructions for GSB
  No. 3.505.BA

The operating instructions must be observed!

All work with HYDAC safety devices must only be carried out by suitably trained staff. Incorrect installation or handling can lead to serious accidents.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview catalogue section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

1.3. OVERVIEW

1.3.1 Protection on the gas side

Type of protection	What is protected?
Burst disc	Excessive pressure increase
Temperature fuse	Excessive temperature increase
Gas safety valve	Unexpected pressure increase

Gas safety block

A gas safety block simplifies the handling of hydraulic accumulators on the gas side and thanks to its diverse connection options it is also able to hold the above-mentioned safety devices.

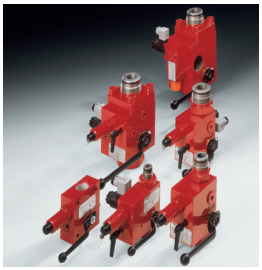
1.3.2 Protection on the fluid side

The fluid side must be protected from pressures exceeding the permitted operating pressures by installing approved and appropriate safety valves.

HYDAC offers pressure relief valves (DB12) which have a response pressure of up to 400 bar (set by HYDAC). The valve bears the CE marking, is built into safety and shut-off blocks in the series DSV10 and SAF in nominal sizes DN10 to DN50 and is lead-sealed.

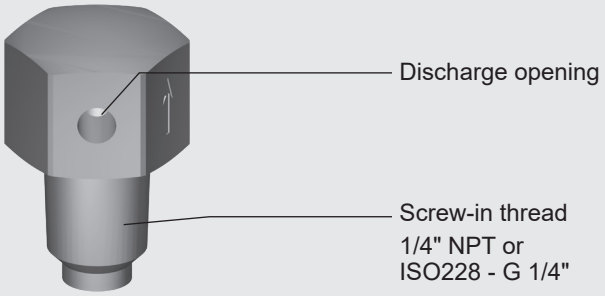
Further information is available from the following catalogue section:

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



2. BURST DISC

2.1. DESIGN



2.2. FUNCTION

If the pressure exceeds the permitted level, the burst disc is destroyed, permanently opening the port. This reduces the gas pressure by discharging the nitrogen completely.

Burst discs are designed for different response pressures and are supplied with a declaration of conformity.

Burst discs are made either entirely of stainless steel, or from an alloy based on stainless steel and nickel.

2.3. STANDARD ITEM

Burst disc, welded, with declaration of conformity to PED DN5

Designation	Burst pressure ± 10 % at 50 °C	Part no.	Mass flow [2]
Burst disc plug 1/4" NPT	210 bar	3156148	1950
	250 bar	3156150	2320
	300 bar	3156151	2782
	330 bar	**3341280** [1]	3059
	350 bar	3156152	3244
Burst disc plug ISO 228 G 1/4"	210 bar	3516441	1950
	330 bar	3560189	3059
	400 bar	3358418	3706

[1] Preferred models

[2] Theoretically calculated values

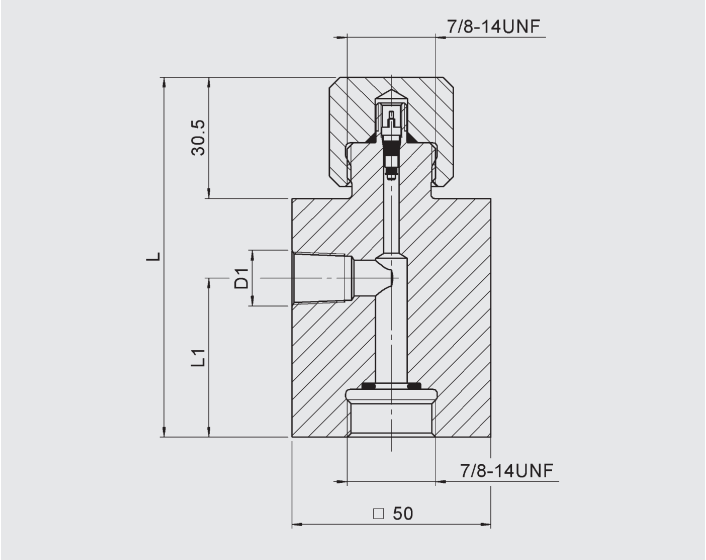
Others on request

Burst disc, clamped, with declaration of conformity to ASME VIII, Div. 1 and UD stamp
DN 15, 1/2" NPT
on request

2.4. ACCESSORIES

2.4.1 Adapter for bladder accumulators

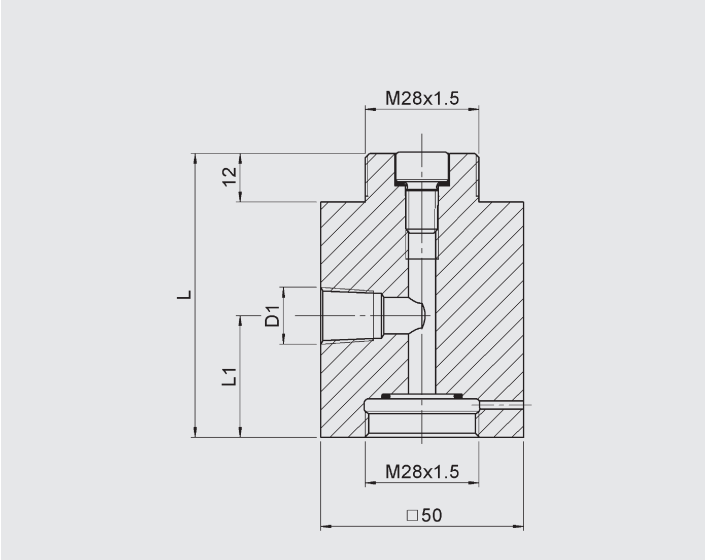
To protect standard and low pressure bladder accumulators, the adapter shown below must be ordered with the burst disc:



L [mm]	L1 [mm]	D1	Carbon steel	Stainless steel
90.5	40	1/4" NPT	366694	–
81.5	30	1/4" NPT	–	3117711
90.5	40	ISO 228 G 1/4"	364802	–
81.5	30	ISO 228 G 1/4"	–	3521154

2.4.2 Adapter for piston and diaphragm accumulators

To protect piston and diaphragm accumulators, the adapter shown below must be ordered with the burst disc:



L [mm]	L1 [mm]	D1	Carbon steel	Stainless steel
70	30	1/4" NPT	3344645	–
		1/4" NPT	–	4329253
		ISO 228 G 1/4"	4286781	–
		ISO 228 G 1/4"	–	3564669

3. TEMPERATURE FUSE

HYDAC offers two different kinds of temperature fuse. In addition to the temperature fuse in carbon steel and stainless steel, which is suitable for bladder accumulators, HYDAC offers a type GMP6 temperaturefuse, which is approved according to the European Pressure Equipment Directive (PED). It is made of stainless steel and has a CE marking.

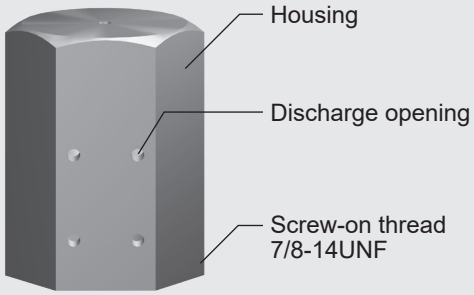
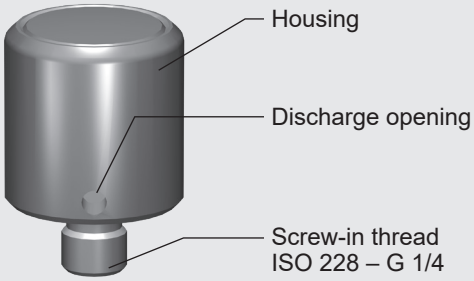
3.1. FUNCTION

Temperature fuses are "devices with a safety function" and are used to release the gas pressure by discharging the nitrogen completely when an increase in temperature reaches unacceptable levels (e.g. in the case of fire).

Installation instructions

Simple to retrofit by replacing the sealing cap with the temperature fuse. When mounting the GMP6 temperature fuse, the operating instructions must be observed, see section 1.2.

3.2. DESIGN

Temperature fuse	GMP6 temperature fuse
	

3.3. STANDARD ITEMS AND TECHNICAL DATA

Type	Temperature fuse		GMP6 temperature fuse	
Standard types	**363501** [1]	Temperature fuse 7/8-14UNF	3517438	GMP6-10-CE1637...
	3094166 [1]	Temperature fuse 7/8-14UNF with eye bolt (for crane hook)	3521196	GMP6-10-CE1637... with adapter for bladder accumulators
			3584817	GMP6-10-CE1637... with adapter for piston and diaphragm accumulators
Permitted operating pressure	≤ 450 bar		50 ... 420 bar	
Temperature range	-10 °C ... +80 °C		-40 °C ... +120 °C [2]	
Melting temperature	Between +160 °C and +170 °C		Between +160 °C and +170 °C	
CE marking	Not available		Available	

[1] Preferred models

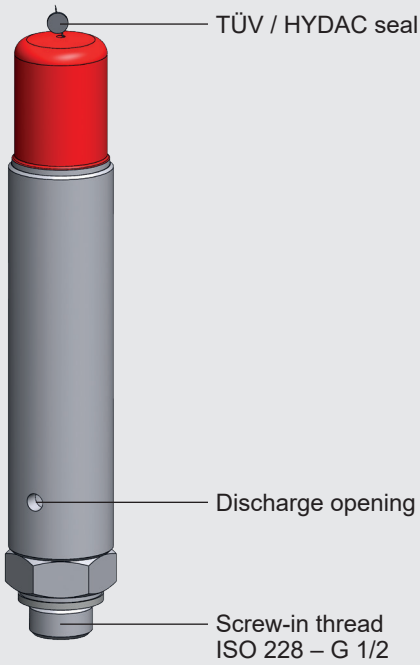
[2] With adapter restricted temperature range -10 °C ... +80 °C

4. GAS SAFETY VALVE

4.1. FUNCTION

The gas safety valve protects the hydraulic accumulator by reducing the pressure in a controlled way **if pressure exceeds the permitted level unexpectedly** (regular triggering of the GSV6 can lead to leakage at the valve). It is pre-set on the pressure side and lead-sealed by the authorised representative. It is also supplied with a declaration of conformity and a type approval.

4.2. DESIGN



4.3. MODEL CODE

(also order example)

GSV6 – 1 0 – CE1637.ENISO4126-1.6.G. 195. 330

Gas safety valve

Series
1 = standard with 2 discharge openings, nominal size 6 mm
2 = 1 discharge opening ISO 228 – G 1/2

Temperature range
0 = -20 °C ... +80 °C
5 = -40 °C ... +80 °C (low temperature)

Component code

Outlet mass flow Q_m [kg/h]
(see table, section 4.4.2)

Response pressure p [bar]
(see table, section 4.4.2)

4.4. STANDARD ITEMS

4.4.1 Technical data

Dimensioning
European Pressure Equipment Directive (PED), EN ISO4126-1, EN 764-7, others on request

Module category
IV to European Pressure Equipment Directive (PED)
Module B + D (EU-type examination)
Module G (unit verification) on request

Nominal size
6 mm

Outlet mass flow
See section 4.4.2

Material
Stainless steel, closing element with flexible seat seal

Medium
Nitrogen (N_2)

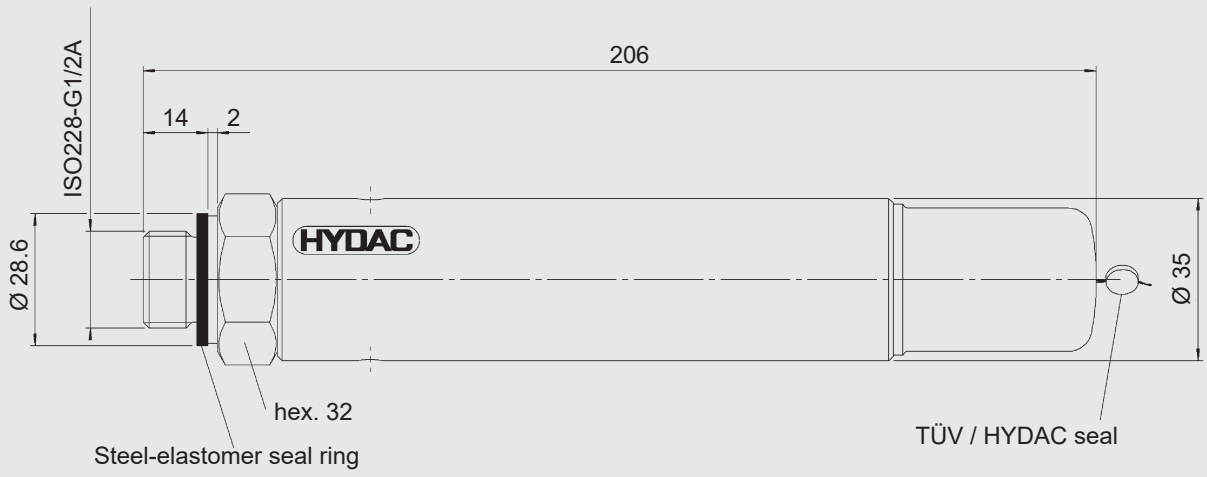
Operating pressure range
30 ... 370 bar

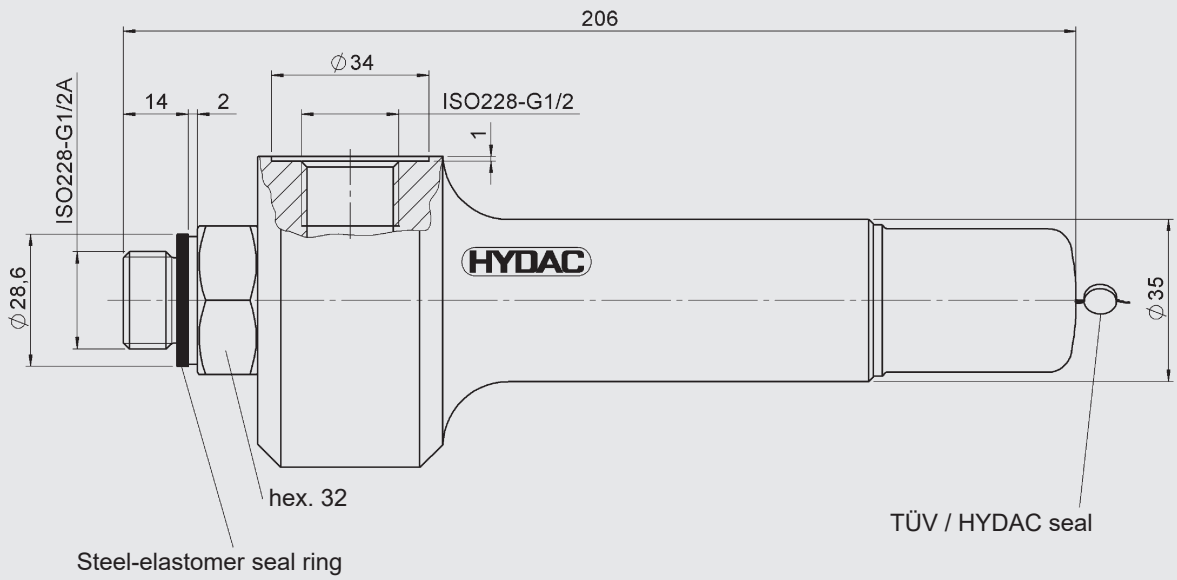
Temperature range
-20 °C ... +80 °C, others on request

Weight
1.1 kg

Installing the GSV gas safety valve
The self-centring steel-elastomer seal ring means that this valve can be installed simply and securely in any position.
See section 1.2.

4.4.2 Tables and drawings





Selection of the response pressure (p) of the gas safety valve is based on the maximum operating pressure of the hydraulic accumulator, according to the application.

Q_m [kg/h]	p [bar]	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

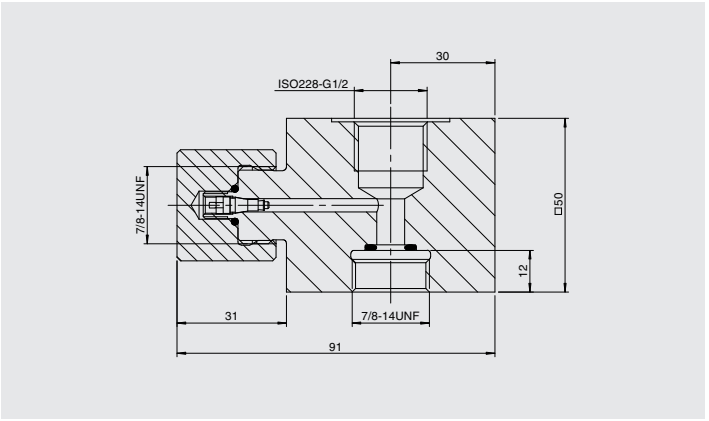
[1] Others on request

> 350 bar = additional price required for EC unit verification, please ask

4.5. ACCESSORIES

4.5.1 Adapter for bladder accumulators

To protect standard or low pressure bladder accumulators, the adapter shown below must be ordered with the GSV6 gas safety valve:

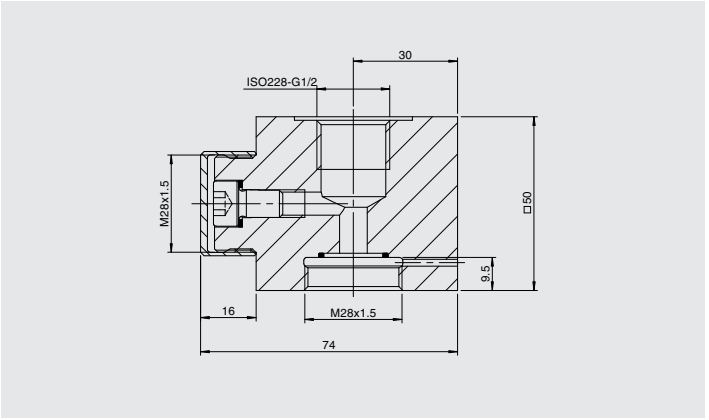


Designation	Part no.
Adapter assembly for bladder accumulators	2103381

Others on request

4.5.2 Adapter for piston and diaphragm accumulators

To protect piston and diaphragm accumulators, the adapter shown below must be ordered with the GSV6 gas safety valve:



Designation	Part no.
Adapter assembly for piston and diaphragm accumulators	3423339

Others on request

5. GAS SAFETY BLOCK

5.1. FUNCTION

The GSB450 is an adapter block which is mounted on a hydraulic accumulator on the gas side and which can be fitted with various pressure devices, charging equipment, safety valves and other safety components.

Charging and testing

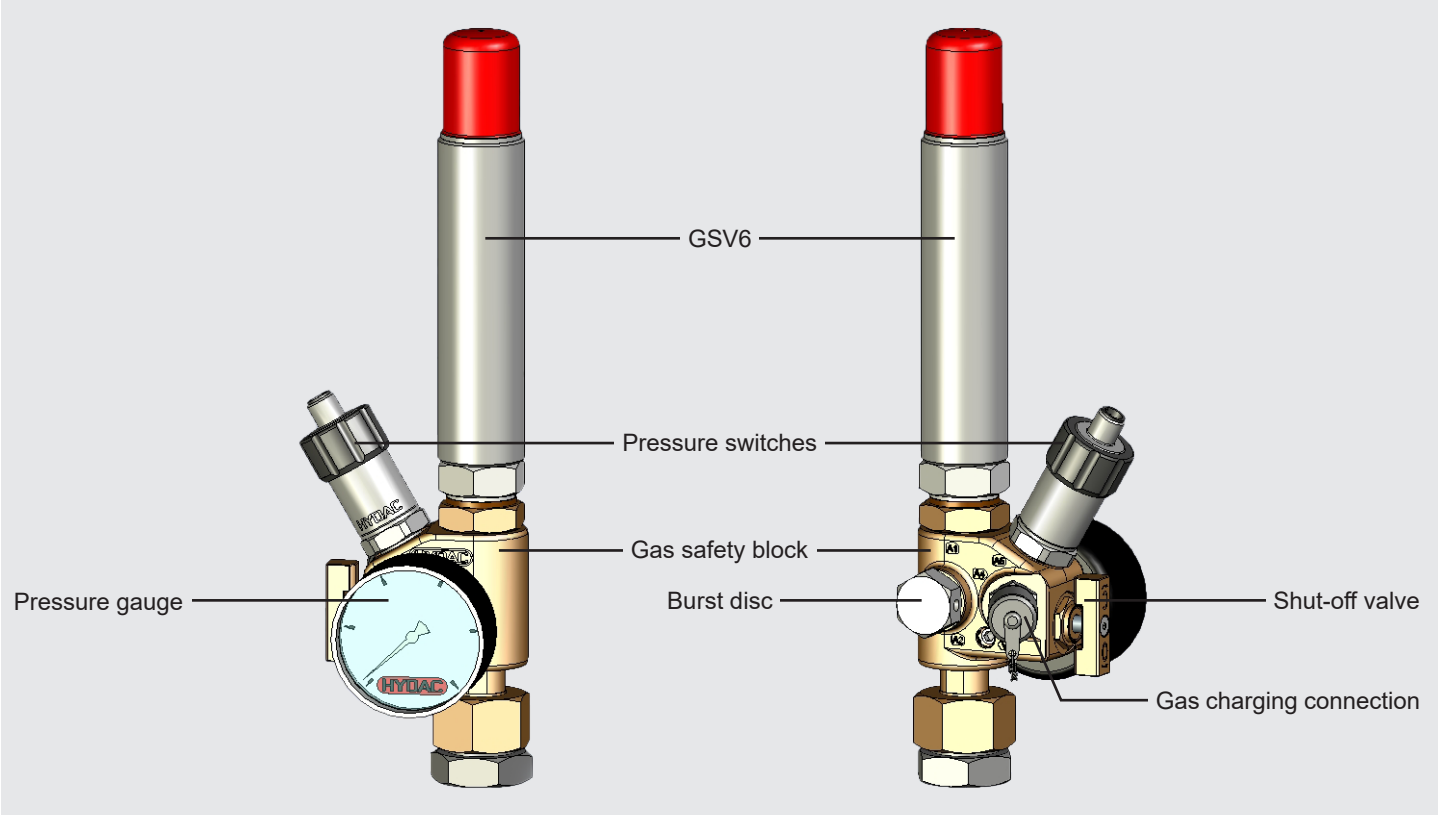
The procedure for charging and testing is described in the operating instructions. The shut-off valve (V1) must always be closed following the charging and testing procedure. The pressure side at the release valve (V2) must then be depressurised to protect the connected fittings and components from a permanent pressure load.

Permanent monitoring

To permanently monitor the accumulator pre-charge pressure, a pressure switch/pressure transmitter can be screwed into connection A2.

For other configurations, please enquire with us.

5.2. DESIGN



The gas safety block GSB450 consists of a brass block (other materials on request) with an integrated vent valve and shut-off valve and connections for:

- Pressure gauge
- Gas safety valve (GSV6)
- Gas charging valve (e.g. Minimess)
- Pressure transmitter or pressure switch
- Burst disc or temperature fuse

The gas safety valve connection is designed as a check valve. Therefore, the valve can be changed even if the system is pressurised.

The version shown in the diagram is an example. Information on the standard design of the GSB450 is provided in section 5.3.

5.3. VERSION

The GSB450 is delivered with the following as standard:

- Shut-off valve
- Release valve
- Pressure gauge (0 - 400 bar, Ø 63 mm)
- Gas charging connection, code 1 (Minimess threaded coupling, series 1620, M16x2)

Options are listed in section 5.7., others on request.

5.4. ADVANTAGES

- Compact design
- Flexible connection options
- Variable indication options: bar, MPa or psi, analogue or digital (optional)
- The direction that the pressure indicator is facing can be individually adjusted
- Accumulator can be charged with nitrogen, directly via Minimess valve
- Pre-charge pressure can be checked without FPU-1

5.5. MODEL CODE

(also order example)

GSB450 – 1 – 1 – 5 – 1 – 1 – 350

Series

Material
1 = standard (brass and add-on parts in carbon steel)
2 = stainless steel (brass and add-on parts in stainless steel)
3 = stainless steel (on request)

Accumulator connection
1 = connection for SK/SBO
2 = connection for SB 7/8-14UNF
3 = connection for SB 5/8-18UNF
8 = connection for threaded pipe fitting to ISO 8434-1 (OD 16, heavy duty)
9 = special connection (on request)

Pressure gauge display
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 (e.g. different pressure units or with glycerine filling)

Gas charging connection
0 = none
1 = Minimess valve M16x2 (NBR seal)
2 = Minimess valve M16x1.5 (FKM seal)
3 = Minimess valve M16x1.5 (gas-tight, stainless steel 1.4104) for permanent monitoring (see section 5.6.2)
9 = special connection

Safety devices
0 = none
1 = gas safety valve GSV6
2 = burst disc
3 = temperature fuse GMP6

Pressure range of the safety equipment

5.6. STANDARD ITEMS

5.6.1 Technical data

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

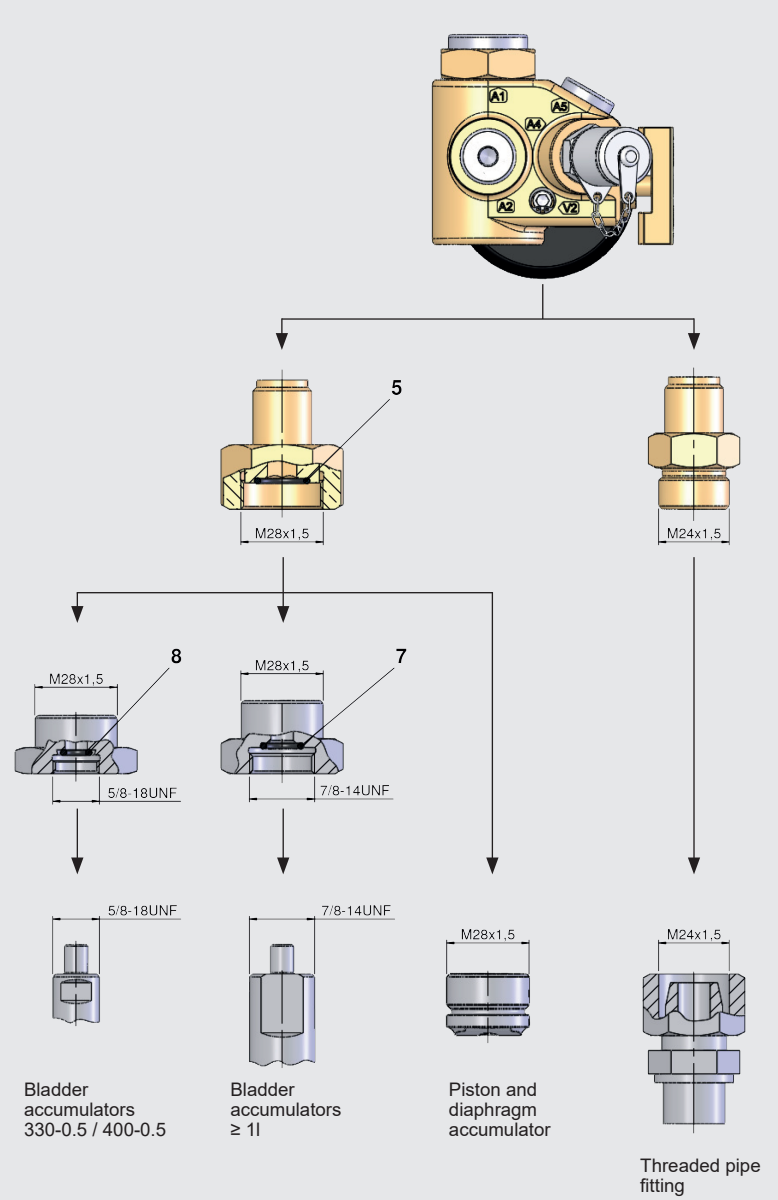
For bladder accumulators, the appropriate adapter is supplied. All other connections are sealed with locking screws.

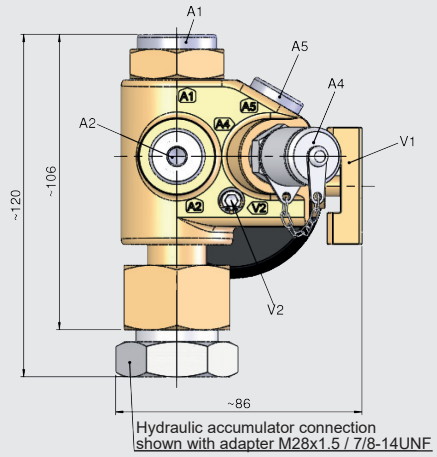
Piston and diaphragm accumulators:
M28x1.5

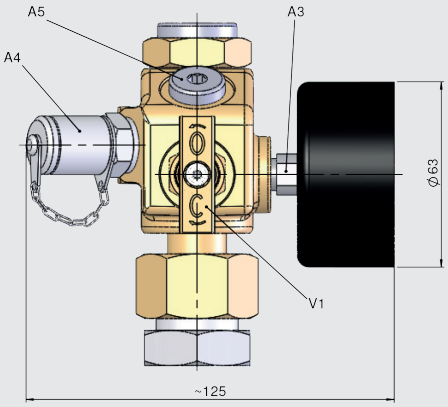
For piston and diaphragm accumulators the connection is a lock nut with M28x1.5 thread as standard.

Weight

- Standard design for SB
  1.6 kg
- Standard design for SBO and SK
  1.5 kg







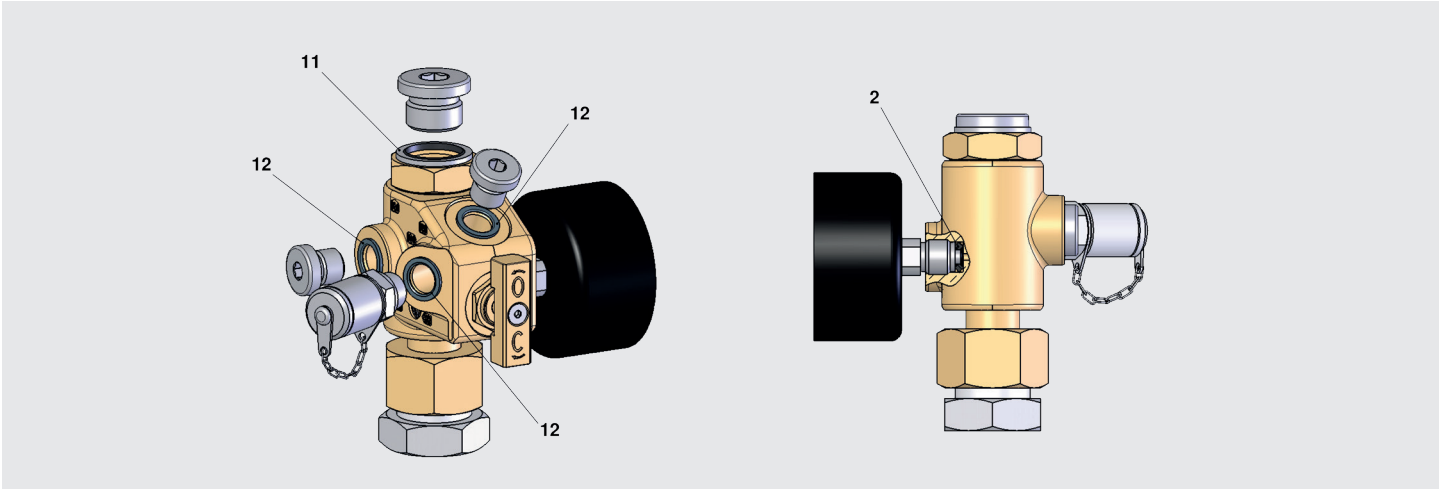
Designation	Part no.
GSB450-1-1-1-1-0	3534710
GSB450-1-1-2-1-0	3534711
GSB450-1-1-3-1-0	3534712
GSB450-1-1-4-1-0	3528946
GSB450-1-1-5-1-0	3426882
GSB450-1-2-1-1-0	3534713
GSB450-1-2-2-1-0	3534714
GSB450-1-2-3-1-0	3484861
GSB450-1-2-4-1-0	3433824
GSB450-1-2-5-1-0	3426905

Installation instructions

The gas safety block can be mounted simply by swapping the sealing cap and the GSB450. To mount the GSB450, the operating instructions must be observed, see section 1.2.

5.6.3 Spare parts

The following spare parts for the GSB450 relate to the standard version: carbon steel / NBR



Description		Quantity	Item	Part no.
Seal kit GSB450 consisting of:		1	–	4024196
Rhombic seal 1/4"		1	2	–
O-ring 15x2		1	5	–
Seal ring		1	6	–
O-ring 11x2		1	7	–
O-ring 9x2		1	8	–
O-ring 5.7x1.9		1	10	–
Seal ring		1	11	–
Seal ring		3	12	–
Pressure gauge	0 - 10 bar	1	3	635139
	0 - 25 bar			635140
	0 - 100 bar			635141
	0 - 250 bar			635142
	0 - 400 bar			635143

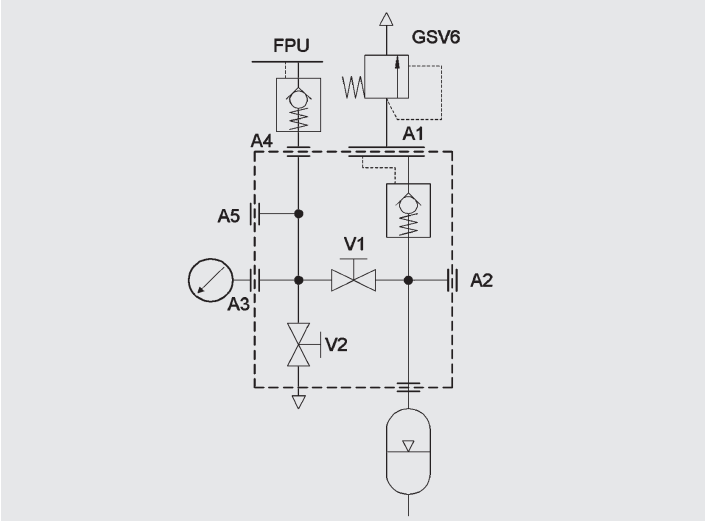
5.7. ACCESSORIES

5.7.1 Block connections and configurations

Ports	Size	Standard configuration	Optional configuration (examples)
A1	ISO 228 - G1/2	Blanking plug	GSV6 gas safety valve
A2	ISO 228 - G1/4	Blanking plug	– Burst disc – Temperature fuse
A3		Pressure gauge 0 – 400 bar	– For other measuring ranges, see section 5.5. – Special pressure gauge (please specify)
A4		Minimess valve M16x2	Minimess valve M16x1.5 (various versions possible, see section 5.5.)
A5		Blanking plug	Pressure transmitter e.g. HYDAC HDA, EDS

Valves

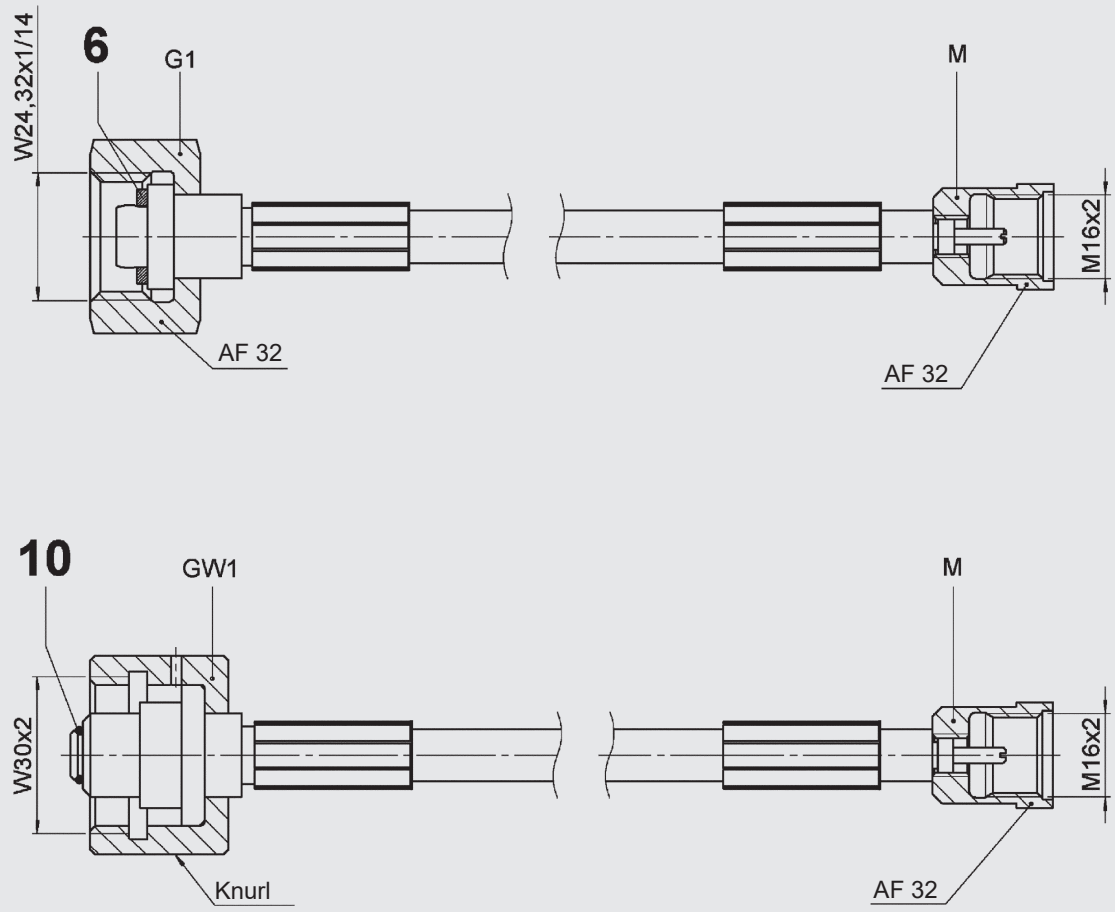
Type	Description
V1	Shut-off valve
V2	Release valve (int. hex. AF 4)



5.7.2 Charging hoses

HYDAC charging hoses comply with DIN EN ISO 4413 and DIN EN 853 to 857.

Charging hoses are designed for the particular maximum permitted operating pressure marked on them and 10,000 charging processes.



Gas connection of nitrogen bottles	Minimess connection	p_{max} [bar]	Length [m]	Part no.
W30x2	M16x2	300	2.5	3434454
			4	3434457
W24.32x1/14	M16x2	200	2.5	3434424
			4	3434451
			10	3526858

Suitable adapters for foreign nitrogen bottles can be found in the following catalogue section:

- FPU charging and testing unit
  No. 3.501

6. NOTE

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

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Mounting elements for hydraulic accumulators

1. DESCRIPTION

1.1. FUNCTION

HYDAC mounting elements enable simple and secure mounting of all hydraulic accumulators. In addition to the standard product range described below, mounting technology for specific customer requirements and applications is available on request. For further information and notes, see:

- HYDAC Accessories product catalogue
  No. 61.000

Quick and easy - Accu-MOUNT
You can use our tool to find the matching accumulator mount, see:
www.hydac.com/Service/Onlinetools

1.2. APPLICATION

The optimum mounting type strongly depends on the use, type and size of the accumulator. Clamps, consoles and accumulator mounting sets are all possible options. As they are safety equipment, our mounting elements must only be attached and installed by trained staff.

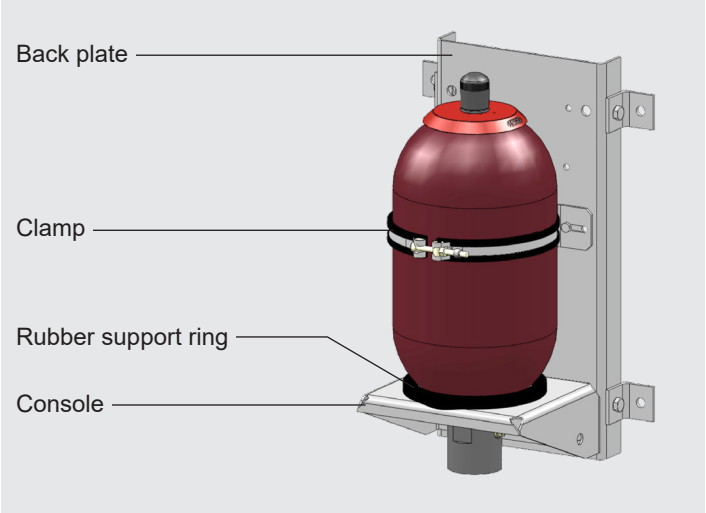
The clamp quantities for bladder and piston accumulators given in the following overviews are HYDAC recommendations that take static use and vertical mounting into account including the corresponding mounting element (e.g. HYDAC consoles).

More information on HYDAC hydraulic accumulators is available in the following catalogue sections:

- Bladder accumulators Low pressure
  No. 3.202
- Bladder accumulators Standard design
  No. 3.201
- Piston accumulators Standard design
  No. 3.301
- Piston accumulators SK280
  No. 3.303
- Diaphragm accumulators
  No. 3.100
- Hydraulic accumulators with back-up nitrogen bottles
  No. 3.553

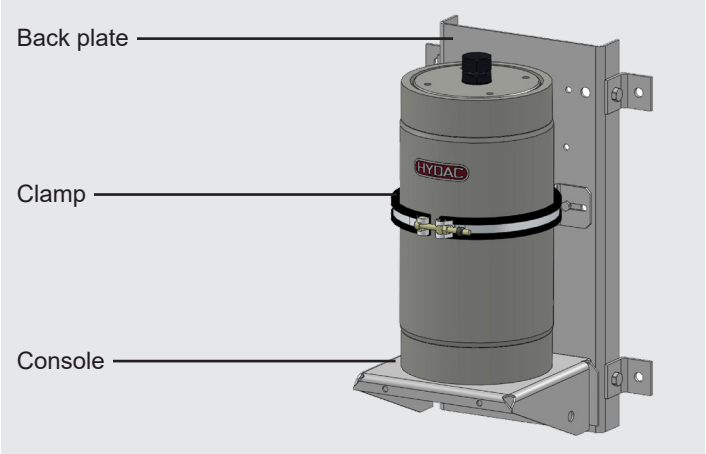
Bladder accumulators

Clamps, consoles and accumulator mounting sets can be used for optimum mounting of the bladder accumulator. The bladder accumulator console is equipped with a rubber support ring.



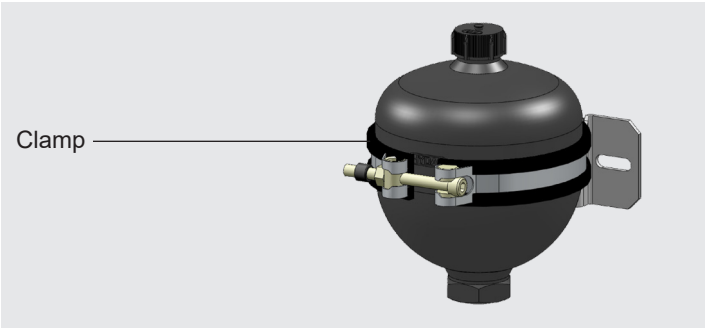
Piston accumulators

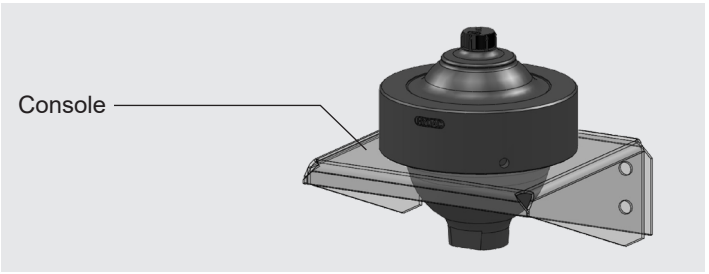
Clamps, consoles and accumulator mounting sets can also be used for piston accumulators. In this case, the console is not equipped with a rubber support ring.
Please request the accumulator mounting set for piston accumulators separately, as the design may vary considerably depending on the accumulator's nominal volume.



Diaphragm accumulators

Weld type diaphragm accumulators are fastened with an accumulator clamp and screw type diaphragm accumulators are fastened with a console. Accumulator mounting sets are not used for diaphragm accumulators.





Materials

The following materials are available as standard:

Clamp	
Fastening, base	zinc-plated
Band clamp	stainless steel
Insert	PE/PP/NBR see section 3.1.
Console	zinc-plated
Rubber support ring [1)]	NBR
Accumulator mounting set	
Clamp	see above
Console	see above
Back plate	zinc-plated

Other materials (e.g. stainless steel) are available on request.

[1)] Only for bladder accumulators

2. STANDARD ITEMS

2.1. BLADDER ACCUMULATORS AND GAS PRESSURE VESSELS

The following selection table shows the recommended mounting type for each series and volume. The number of clamps can vary depending on the requirements and on the length of the hydraulic accumulator and is a HYDAC recommendation (see section 1.2.).

Designation	Part no.	Nominal volume [l]																													
		SB330(H)								SB400				SB550 / SB690		SB690			SB500 / SB600		SB40(H)					SB35HB		SN360		SN600	
		1	2.5	4+6+10 slim	10-20	32+50	60+80	100+130	160+200	0.5	4	10-20	32+50	1	2.5+5	10	20	32+50	10+20	32+50	2.5+5	10+20	32+50	70-130	190+220	20	32+50	50	75(C)	50+75	
Clamp																															
HyRac 106-114/115 H3 ST	444905																				2										
HyRac 110-118/124 H10 ST	445042	1	2																												
HyRac 121-129/133 H8 ST	444906													1	2																
HyRac 167-175/178 H5 ST	445043			1 [1]							1																				
HyRac 216-224/226 H5 ST	445047																					1	2			1	2				
HyRac 223-230/231 H3 ST	445048				1	2																						2			
HyRac 225-234/234 H3 ST	445049											1	2																3	3 [1]	
HSS 242	362712																		1	2											
HRVMS 3 R 248-259/256 ST	3489871																2														
HRVMS 3 R 268-279/276 ST	3559057																												2 [2]		
HRGKSM 0 R 96-100/100 ST	444953									1																					
HRGKSM 3 R 242-253/250 ST	3302566															2															
HRGKSM 4 R 352-363/360 ST	444795						2	3																2							
HRRBS 14 L 267 PP ST ZN	431645																	2													
HRRBS 17 B1L 406 PP ST M ZN B145 H525	3434519								4 [3]																3						
Console																															
KBK 167/G	2107989			1											1																
KBK 222/G	2100651				1	1						1	1						1	1		1	1			1	1	1		1	
KBK 360/G	2107990						1	1	1							1	1	1											1		
KHF 210/G	3111594																									1	1				
Accumulator mounting set																															
SEB 2.5	290787		1																												
SEB 4	238403			1							1																				
SEB 6	2115851			1																											
SEB 10 slim	4189835			1																											
SEB 10	238407				1							1																			
SEB 13-20	240598				1							1																			
SEB 32	238409					1							1																		
SEB 50	240599					1							1																		
SEBL 60-80 [4]	3605561						1																								
SEBL 100-130 [4]	372132							1																							
SEBL 160 [4]	4482591								1																						
SEBL 200 [4]	4500010								1																						
SEH 2.5	2105194														1																
SEH 5	2105195														1																
SEH 10	378952																		1												
SEH 20	298181																		1												
SEH 32	298182																			1											
SEH 50	298183																			1											
SEM 2.5	3007402																				1										
SEM 5	3007423																				1										
SEM 10	3007424																					1									
SEM 20	3007425																					1									
SEM 32	3007426																						1								
SEM 50	3007427																						1								
SEHB 20	3007431																									1					
SEHB 32	3007432																										1				
SEHB 50	3007433																										1				

[1] 2 clamps for SB330-10 litres slimline version or SN600-50 litres

[2] C = compact version

[3] 3 clamps for SB330(H)-160 litres

[4] With back plate possible

Others on request

2.2. PISTON ACCUMULATORS

The following table shows the recommended mounting type for each piston accumulator type. The clamp is selected on the basis of the accumulator's external diameter. The number of clamps can vary depending on the requirements and on the length of the hydraulic accumulator and is a HYDAC recommendation (see section 1.2.).
To prevent deformation of the cylinder, clamps should preferably be mounted near the end caps.

		Piston diameter [mm]																
		50	60		80		100		125		150		180		200	250		> 250
		Accumulator external diameter [mm]																
Designation	**Part no.**	60	75	80	95	100	120	125	150	160	175	180	210	220	235	286	300	> 300
Clamps SK280																		
HRGKSM 0 R 58-61/62 ST	3018442	●																On request
HRGKSM 0 R 73-76/76 ST	444912		●															
HRGKSM 0 R 92-95/96 ST	444995				●													
HRGKSM 1 R 119-127/124 ST	444505						●											
HRGKSM 1 R 146-154/151 ST	444321								●									
HRGKSM 2 R 172-180/178 ST	444402										●							
Clamps SK210/350																		
HRGKSM 0 R 77-80/80 ST	3018445			●														On request
HRGKSM 0 R 96-100/100 ST	444953					●												
HyRac 121-129/133 H8 ST	444906							●										
HyRac 160-167/169 H5 ST	444910									●								
HyRac 176-185/187 H5 ST	445044											●						
HyRac 209-217/223 H10 ST	445046												●					
HyRac 216-224/226 H5 ST	445047													●				
On request	–														●			
HSS 286	237395															●		
HSS 310	237389																●	
Consoles																		
KBK 126	290530							1										On request
KBK 167	238526										1	1						
KBK 219	238042												1	1				
KBK 310	238043															1	1	
On request	–														1			

● = the recommended number of clamps is available on request or from our online tool Accu-MOUNT

2.3. DIAPHRAGM ACCUMULATORS

Weld type

Clamps	Part no.	Accumulator type
HRGKSM 0 R 62-65/65 ST	444911	SBO250-0.075E
HRGKSM 0 R 73-76/76 ST	444912	SBO210-0.16E
HRGKSM 0 R 77-80/80 ST	3018445	SBO160-0.16E
		SBO300-0.16E
HRGKSM 0 R 92-95/96 ST	444995	SBO210-0.32E
		SBO300-0.32E
HyRac 100-105/106 H3 ST	444904	SBO160-0.5E
		SBO210-0.5E
HyRac 106-114/115 H3 ST	444905	SBO100-0.7E
HyRac 110-118/124 H10 ST	445042	SBO140-0.75E
		SBO330-0.6E
HyRac 121-129/133 H8 ST	444906	SBO210-0.75E
		SBO250-0.75E
		SBO250-1E
		SBO330-0.75E
		SBO330-1E
		SBO350-0.6E
HyRac 133-142/142 H3 ST	444907	SBO200-1E
HyRac 143-151/151 H3 ST	444908	SBO140-1.4E
		SBO210-1.4E
HyRac 152-159/160 H3 ST	444909	SBO250-1.4E
		SBO250-2E
		SBO330-1.4E
HyRac 160-167/169 H5 ST	444910	SBO100-2E
HyRac 167-175/178 H5 ST	445043	SBO210-2E
		SBO210-2.8E
		SBO250-2.8E
		SBO250-3.5
		SBO330-2E
		SBO330-2.8E
		SBO330-3.5E

Screw type

Consoles	Part no.	Accumulator type
KMS 210	358989	SBO400-1.3A6
KMS 220	359922	SBO100-2A6
		SBO250-2A6
KMS 280	359925	SBO400-2.8A6
KMS 310	359927	SBO400-4A6

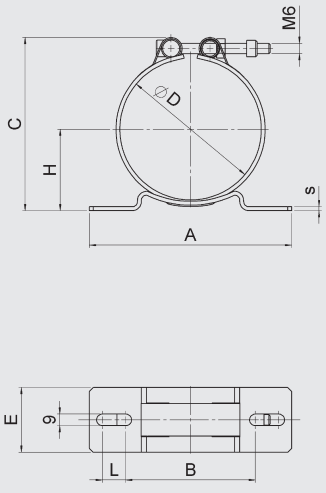
2.4. SILENCERS

		Series			
		SD330	SD280K		
Clamps	**Part no.**	4.7	0.4	2.4	4.4
HyRac 167-175/178 H5 ST	445043	●			
HRGKSM 0 R 58-61/62 ST	3018442		●		
HRGKSM 1 R 119-127/124 ST	444505			●	
HRGKSM 1 R 146-154/151 ST	444321				●

3. TECHNICAL SPECIFICATIONS

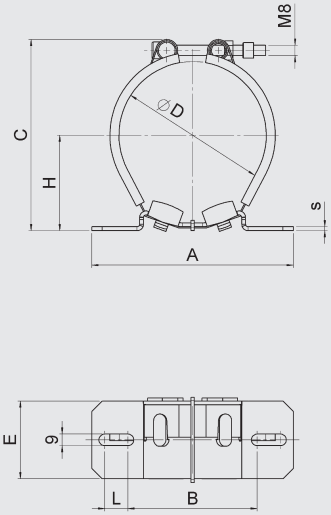
3.1. CLAMPS

HRGKSM



Fastening, base zinc-plated
Band clamp stainless steel
Insert PE

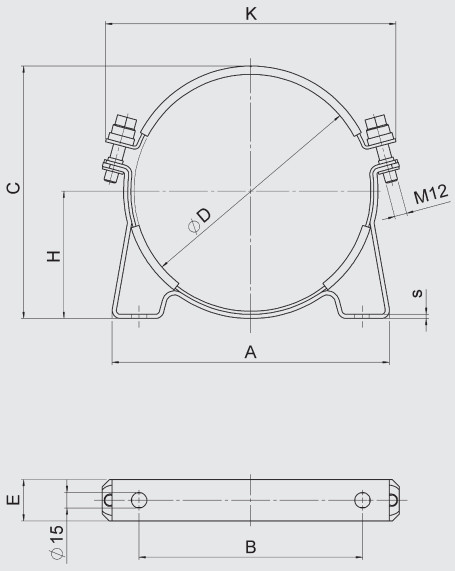
HyRac



Fastening, base zinc-plated
Band clamp stainless steel
Insert PE, NBR

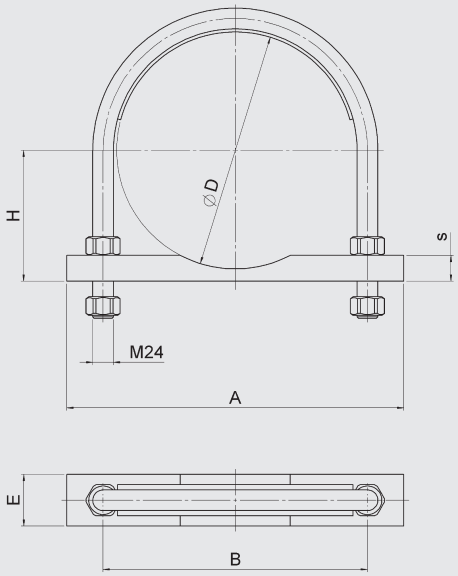
Designation	Part no.	A [mm]	B [mm]	C max. [mm]	ØD (from - to) [mm]	H (from - to) [mm]	E [mm]	L [mm]	s [mm]	K max. [mm]	Weight [kg]
HRGKSM 0 R 58-61/62 ST	3018442	120	85	83	58 - 61	37.3 - 38.8	40	8	3	–	0.16
HRGKSM 0 R 62-65/65 ST	444911			85	62 - 65	38 - 39.5					0.2
HRGKSM 0 R 73-76/76 ST	444912			96	73 - 76	43.5 - 45					0.22
HRGKSM 0 R 77-80/80 ST	3018445			100	77 - 80	45.5 - 47					0.22
HRGKSM 0 R 92-95/96 ST	444995			115	92 - 95	52.5 - 54					0.24
HRGKSM 0 R 96-100/100 ST	444953			120	96 - 100	54.5 - 56.5					0.24
HRGKSM 1 R 119-127/124 ST	444505	156	100	154	119 - 127	66.8 - 70.8	50	18			0.36
HRGKSM 1 R 146-154/151 ST	444321			181	146 - 154	80.5 - 84.5					0.39
HRGKSM 2 R 172-180/178 ST	444402	236	152	209	172 - 180	94.6 - 98.6	60	32			0.53
HRGKSM 3 R 242-253/250 ST	3302566	300	222	280	242 - 253	133.5 - 139		28	4		0.99
HRGKSM 4 R 352-363/360 ST	444795	400	322	398	352 - 363	187.7 - 193.2					1.49
HyRac 100-105/106 H3 ST	444904	156	100	131	100 - 105	58.8 - 61.3	60	18	3	–	0.46
HyRac 106-114/115 H3 ST	444905			143	106 - 114	62.5 - 66					0.41
HyRac 110-118/124 H10 ST	445042			148	110 - 118	72 - 76					0.42
HyRac 121-129/133 H8 ST	444906			165	121 - 129	76 - 82					0.43
HyRac 133-142/142 H3 ST	444907			170	133 - 142	76.5 - 81					0.44
HyRac 143-151/151 H3 ST	444908			179	143 - 151	82 - 86					0.45
HyRac 152-159/160 H3 ST	444909			191	152 - 158	87 - 91					0.5
HyRac 160-167/169 H5 ST	444910	236	152	197	160 - 167	89 - 93	60	32	4	–	0.7
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 209-217/223 H10 ST	445046			255	209 - 217	122.5 - 126.5					0.77
HyRac 216-224/226 H5 ST	445047			247	216 - 224	123.7 - 127.7					0.77
HyRac 223-230/231 H3 ST	445048			257	223 - 230	120.5 - 123.5					0.78
HyRac 225-234/234 H3 ST	445049			265	225 - 234	123 - 127.5					0.79

HSS



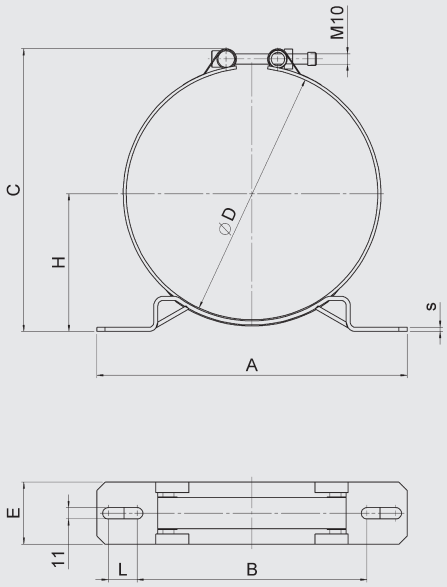
Clamp	zinc-plated
Insert	NBR

HRRBS



Clamp	zinc-plated
Insert	PP

HRVMS



Clamp	zinc-plated
Clamping band	stainless steel
Insert	PE

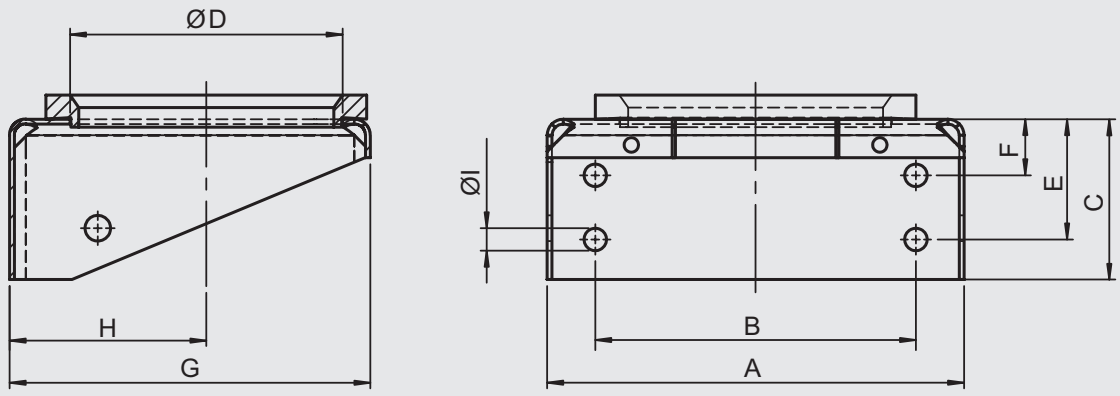
Designation	Part no.	A [mm]	B [mm]	C max. [mm]	ØD (from - to) [mm]	H (from - to) [mm]	E [mm]	L [mm]	s [mm]	K max. [mm]	Weight [kg]
HSS 222/229	235224 [1]	270	216	244	226	123	40	–	4	295	1.7
HSS 242	362712	268	216	265	242	136				305	1.7
HSS 286	237395	332	280	314	286	163				355	2.1
HSS 310	237389	332	280	333	310	170				380	2.1
HRRBS 14 L 267 PP ST ZN	431645	370	302	–	267 - 273	145.5 - 148.5	50	–	25	–	2.66
HRRBS 17 B1L 406 PP ST M ZN B145 H525	3434519	540	440	–	406.4 - 419	218.2 - 224.5	60	–	30	–	6.15
HRVMS 3 R 248-259/256 ST	3489871	300	222	292	248 - 259	135.5 - 141	60	28	4	–	1.05
HRVMS 3 R 268-279/276 ST	3559057			311	268 - 279	144.4 - 149.5					1.1

[1] Alternative to part no. 445048 and 445049

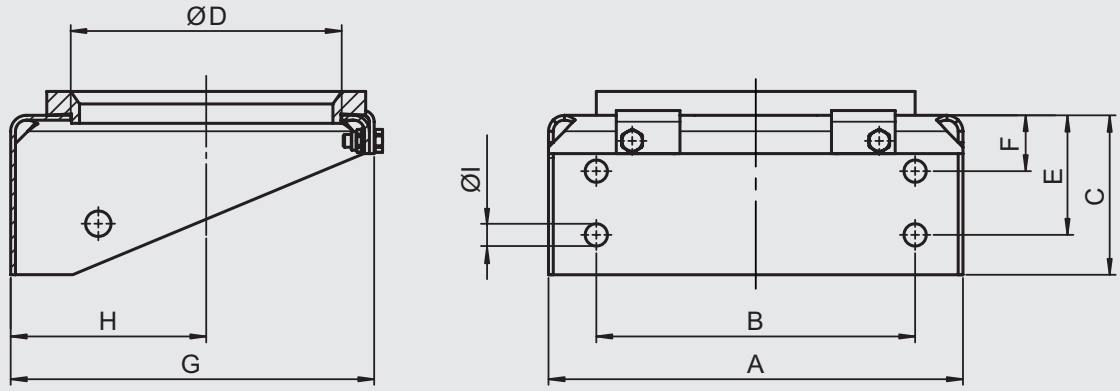
3.2. CONSOLES

3.2.1 Consoles for bladder accumulators and gas pressure vessels

KBK



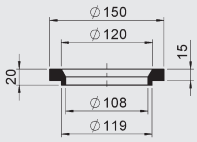
KHF



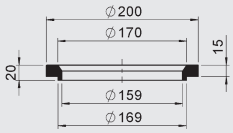
Designation	Part no.	A [mm]	B [mm]	C [mm]	ØD [mm]	E [mm]	F [mm]	G [mm]	H [mm]	ØI [mm]	Weight [kg]
KBK 167/G	2107989	260	200	100	120	75	35	225	92	14	2.5
KBK 222/G	2100651	260	200	100	170	75	35	225	123		2.4
KBK 360/G	2107990	390	270	240	211	180	60	390	195	22	20.1
KHF 210/G [1]	3111594	260	200	100	170	75	35	230	123	14	2

Rubber support ring

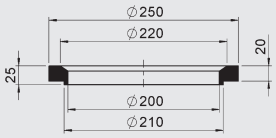
G 167



G 222



G 360

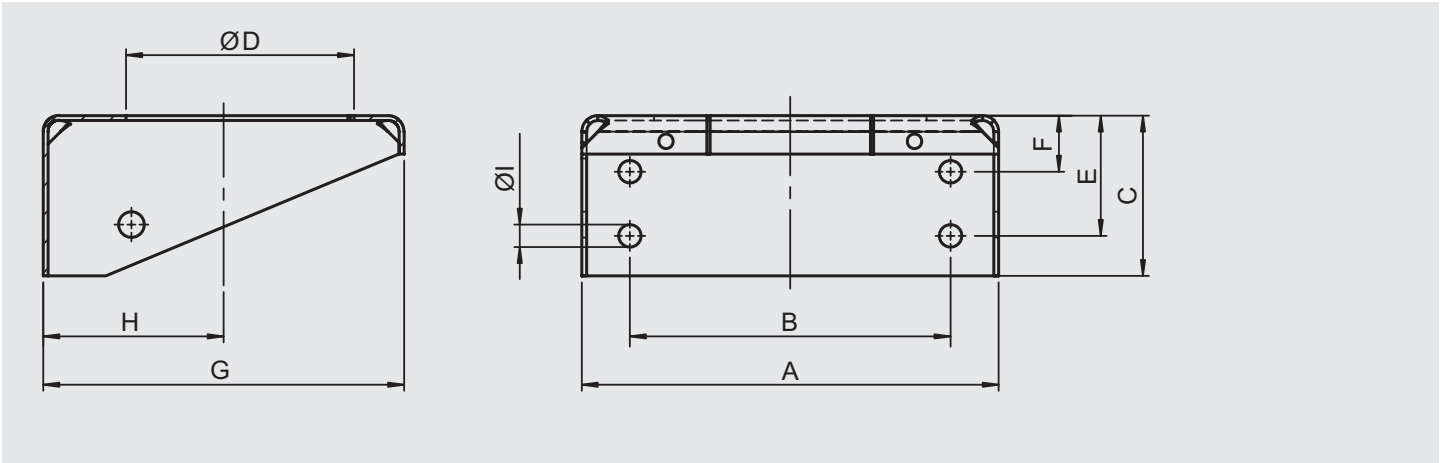


Spare parts

Designation	Part no.
KBK 167	238526
G 167	236997
KBK 222	3002160
G 222 [2]	236996
KBK 360	357959
G 360	355966
KHF 210	239965

[1] See also section 3.3., SEHB
[2] Also for KHF 210

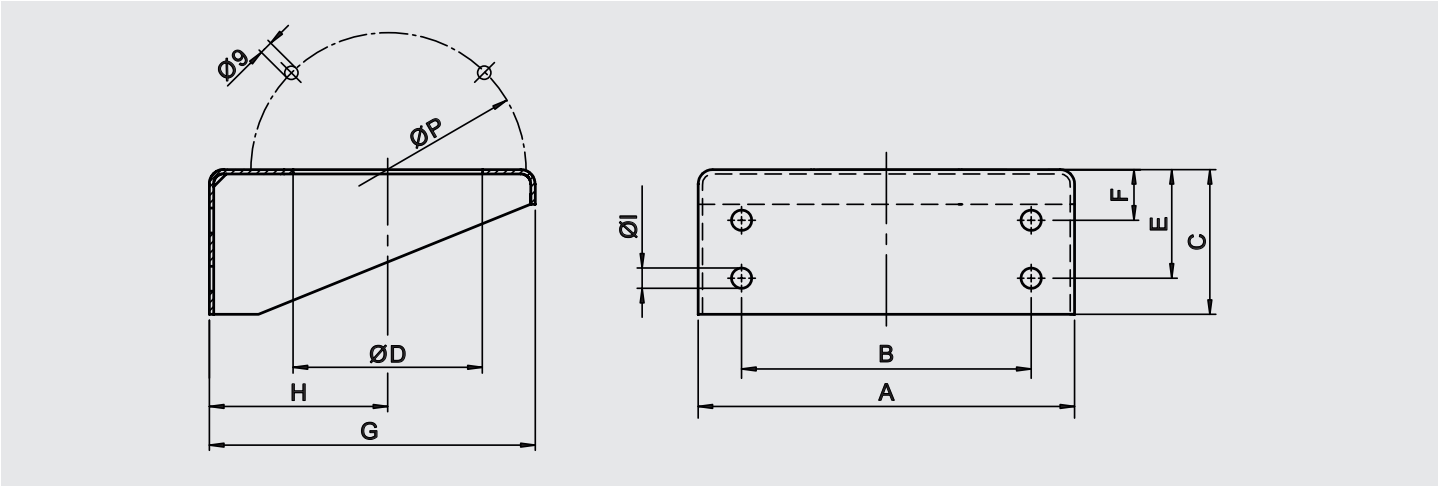
3.2.2 KBK consoles for piston accumulators



Designation	Part no.	A [mm]	B [mm]	C [mm]	ØD [mm]	E [mm]	F [mm]	G [mm]	H [mm]	ØI [mm]	Weight [kg]
KBK 126	290530	175	100	60	65	36	–	150	77	14	1.1
KBK 167	238526	260	200	100	120	65	25	225	92		2.4
KBK 219	238042	270	180	100	135	80	40	250	123		6.5
KBK 310	238043	330	220	200	190	140	60	340	170	22	18.3

3.2.3 KMS consoles for screw type diaphragm accumulators

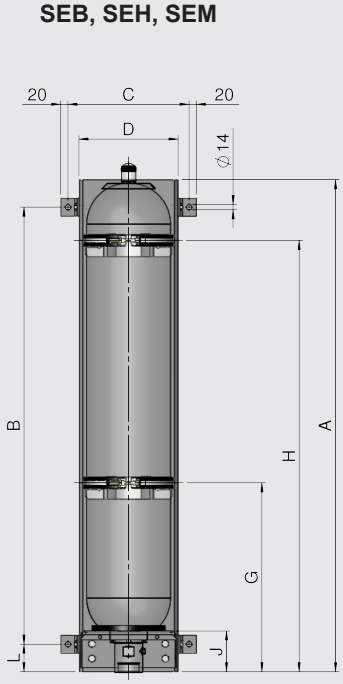
The screw type diaphragm accumulators have M8 threaded bores in the lock nut for fixing to the KMS console.

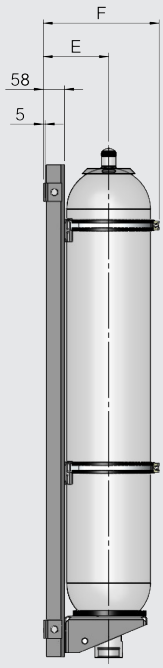


Designation	Part no.	A [mm]	B [mm]	C [mm]	ØD [mm]	ØP [mm]	E [mm]	F [mm]	G [mm]	H [mm]	ØI [mm]	Weight [kg]
KMS 210	358989	260	200	100	170	180	75	35	225	123	14	2.4
KMS 220	359922				170	188						
KMS 280	359925	330	220	200	215	230	140	60	340	170	22	18.3
KMS 310	359927				245	265						

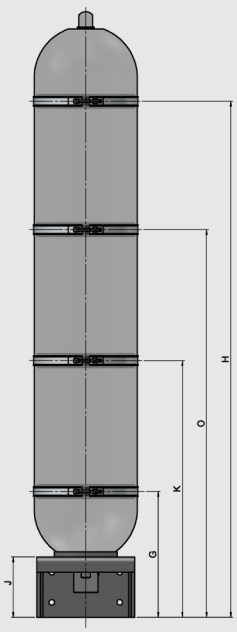
3.3. ACCUMULATOR MOUNTING SET FOR BLADDER ACCUMULATORS

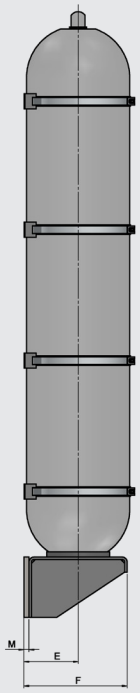
SEB, SEH, SEM





SEBL





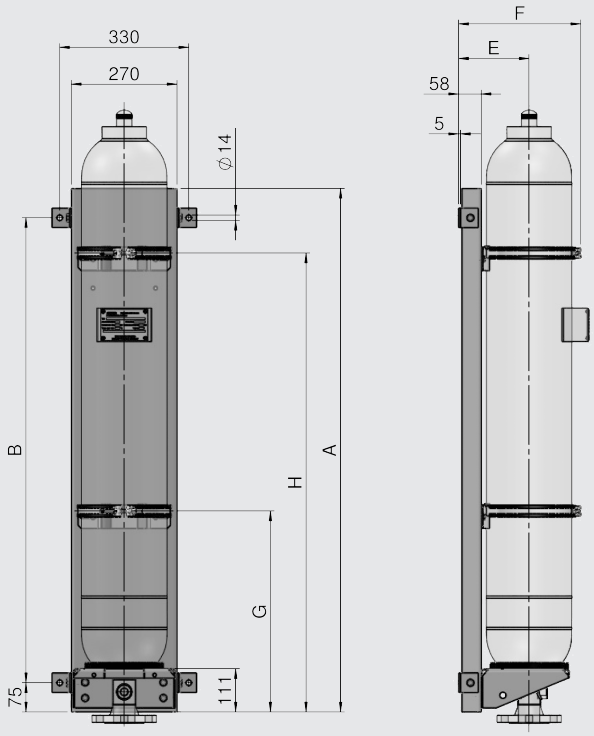
Designation	Part no.	Vol. [l]	A [mm]	B [mm]	C [mm]	D [mm]	E max. [mm]	F max. [mm]	G [mm]	H [mm]	K [mm]	O [mm]	M [mm]	L [mm]	J [mm]
SEB/SEBL for SB330/440															
SEB 2.5	290787	2.5	460	310	198	138	134	209	220	410				75	–
SEB 4	238403	4	410	320					–	270				45	95
SEB 6	2115851	6	570	420			154	285		415					
SEB 10 slim	4189835	10	1340	1190					500	1160					
SEB 10	238407		580							330					
SEB 13-20	240598	13	570	420	330	270			–		–			75	111
		20					185	318		500			–		
SEB 32	238409	32	1340	1190						1160		–			
SEB 50	240599	50													
SEBL 60-80 [1]	3605561	60								930					
		80								1200					
SEBL 100-130 [1]	372132	100	–	–	–	–	195	390	500	1450	950			–	240
		130								1750	1100				
SEBL 160 [1]	4482591	160								1750	1125				
SEBL 200 [1]	4500010	200					215	410	500	2050	1020	1540	20		
SEH for SB500/550/600															
SEH 2.5	2105194	2.5	460	310	198	138	136	215	220	410					
SEH 5	2105195	5	750	600						650					–
SEH 10	378952	10	570	420					–	330					
SEH 20	298181	20			330	270	197	326		500	–	–	–	75	
SEH 32	298182	32	1340	1190						1160					111
SEH 50	298183	50							500						
SEM for SB40															
SEM 2.5	3007402	2.5	460	310	198	138	123	194	220	410					
SEM 5	3007423	5	750	600						650					–
SEM 10	3007424	10	570	420					–	330					
SEM 20	3007425	20			330	270	179	307		500	–	–	–	75	
SEM 32	3007426	32	1340	1190						1160					111
SEM 50	3007427	50							500						

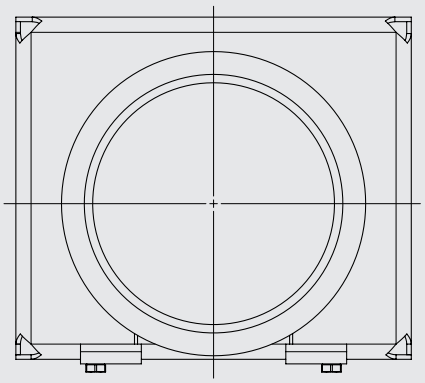
[1] SEBL with back plate possible on request

The SEB accumulator mounting set is also available with an SAF and SB330 as a compact unit (ACCUSET SB330).
See catalogue section:

- ACCUSET SB
  No. 3.503

SEHB





Notice: The console (KHF 210/G) included in the SEHB accumulator mounting sets is opened at the front for easier mounting of the bladder accumulator.

Designation	Part no.	Vol. [l]	A [mm]	B [mm]	C [mm]	ØD [mm]	E max. [mm]	F max. [mm]	G [mm]	H [mm]	L [mm]	J [mm]
SEHB accumulator mounting set for SB35HB												
SEHB 20	3007431	20	570	420	–	–	184	312	–	500	75	111
SEHB 32	3007432	32	1340	1190					500	1160		
SEHB 50	3007433	50										

4. NOTE

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

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ACCUSET-SB

1. DESCRIPTION

1.1. FUNCTION

In addition to completely piped accumulator stations, HYDAC supplies accumulator units with mounting elements, various additional devices on the gas side (e.g. adapters, safety devices, pressure gauges) and additional devices on the fluid side (e.g. adapters, monitoring devices).

This space-saving combination simplifies the connection of the hydraulic accumulator to the hydraulic system, reduces maintenance time and considerably reduces the time and effort required for installation. Depending on the application, HYDAC accumulator units can be designed with bladder accumulators, piston accumulators or diaphragm accumulators.

The ACCUSET-SB is a standardised HYDAC bladder accumulator unit and is described in more detail in the following sections. The most important characteristics and functions are as follows:

- Simple and secure hydraulic accumulator mounting at the installation site
- Connection of the hydraulic accumulator to a hydraulic system via a safety and shut-off block
- Protects the hydraulic accumulator from excessive pressure
- Hydraulic accumulator discharge to the tank via a pressure release valve
- Separation of the hydraulic accumulator from the system
- Two additional hydraulic connections on the shut-off block for accessories (e.g. pressure gauge).

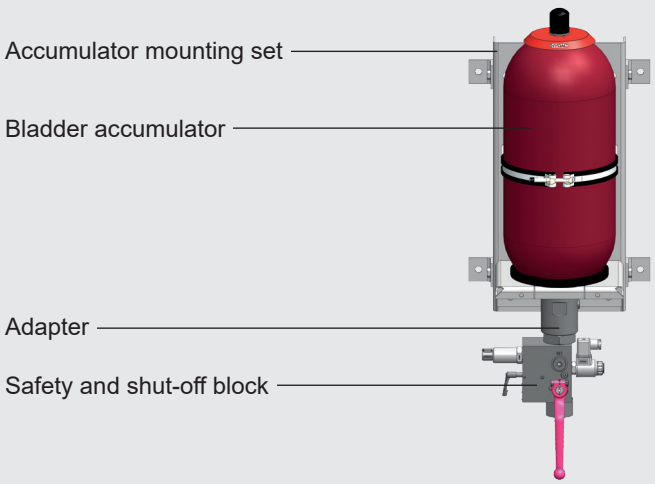
More information on HYDAC hydraulic accumulators and accessories is available in the following brochure sections:

- Bladder accumulators Standard design No. 3.201

- Accumulator stations No. 3.653

- Mounting element for hydraulic accumulators No. 3.502

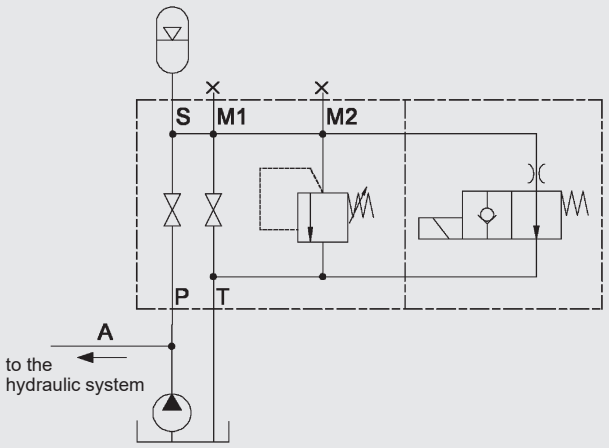
1.2. DESIGN



The ACCUSET is made up of a forged bladder accumulator, a safety and shut-off block, the connecting adapter and a corresponding accumulator mounting set. The parts are designed for optimum compatibility and form a compact, ready-to-install device. For more technical details, see brochure section:

- Bladder accumulators Standard design
  No. 3.201
- SAF/DSV safety and shut-off block
  No. 3.551
- Mounting elements for hydraulic accumulators
  No. 3.502

Circuit diagram



2. FURTHER INFORMATION

- Operating instructions for bladder accumulators
  No. 3.201.BA
- Operating instructions SAF safety and shut-off block
  No. 3.551.BA

The operating instructions must be observed!
All work with HYDAC bladder accumulators or safety and shut-off blocks must only be carried out by suitably trained staff. Incorrect installation or handling can lead to serious accidents.

- Installation and repair instructions bladder accumulators
  No. 3.201.M

For repairs to be performed on hydraulic accumulators, we provide corresponding assembly and repair instructions.

Further information such as accumulator sizing, safety information and extracts from the acceptance specifications can be found in our overview brochure section:

- HYDAC Accumulator Technology
  No. 3.000

This document and others are available from our Download Center at www.hydac.com.

3. MODEL CODE

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

ACCUSET-SB330 – 10 A 1 / 1 1 2 U – 10 Y 1 – 330

Series

Nominal volume [l]

Fluid port
A = standard connection

Gas valve
1 = standard version

Material of fluid port/block
1 = carbon steel

Shell material
1 = carbon steel

Accumulator bladder/seal material
2 = NBR / NBR

Certification code
U = European Pressure Equipment Directive (PED)

Series SAF block
10 = SAF10

Type – poppet valve
M = manual discharge
Y = solenoid-operated and manual discharge (normally open)

Voltage type – poppet valve
1 = 24 V DC (for Y version)

Permitted operating pressure/response pressure of the pressure release valve [bar]

4. STANDARD ITEMS

The ACCUSET-SB330 is the standard HYDAC ACCUSET.

The corresponding part numbers are listed in the tables in section 4.2. (MC = 112) and refer to ACCUSETs with bladder accumulators from the series SB330 in acc. with PED (CC = U).

Designs that differ from the standard types described below can be requested from HYDAC.

4.1. TECHNICAL DATA

4.1.1 Permitted operating temperature

The standard ACCUSET-SB330 can be operated in the following temperature range:
-10 °C to +80 °C

4.1.2 Permitted operating pressure

The permitted operating pressure of the standard ACCUSET-SB330 is 330 bar.

4.1.3 Nominal volume

The nominal volume of the standard ACCUSET-SB330 is given in section 4.2.

4.1.4 Effective gas volume

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

4.1.5 Effective volume

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

4.1.6 Maximum flow rate of the operating fluid

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

4.1.7 Limits for gas pre-charge pressure

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

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

The specified values are maximum values and must not be considered as referring to a permanent load. The sustainable pressure ratio is affected by geometry, temperature, medium, flow rate and gas losses resulting from physical characteristics.

For more information, see brochure section:

- HYDAC Accumulator Technology
  No. 3.000

4.1.8 Pressure limit

The DB12 is set to 330 bar, pressure setting with TÜV.

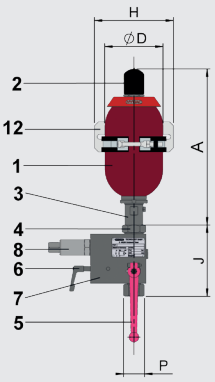
4.1.9 Release valve

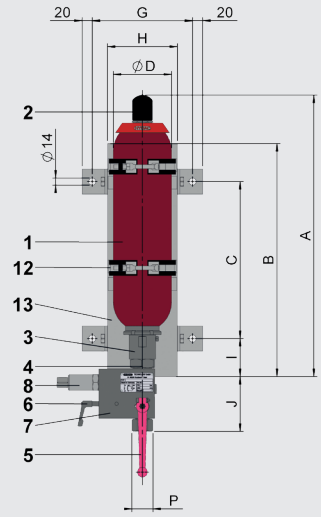
Operating voltage 24 V DC.

4.1.10 Fluid port P

See table in section 4.2.

4.2. DIMENSIONS AND SPARE PARTS





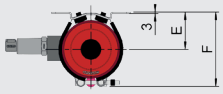


Fig. 1

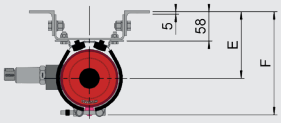
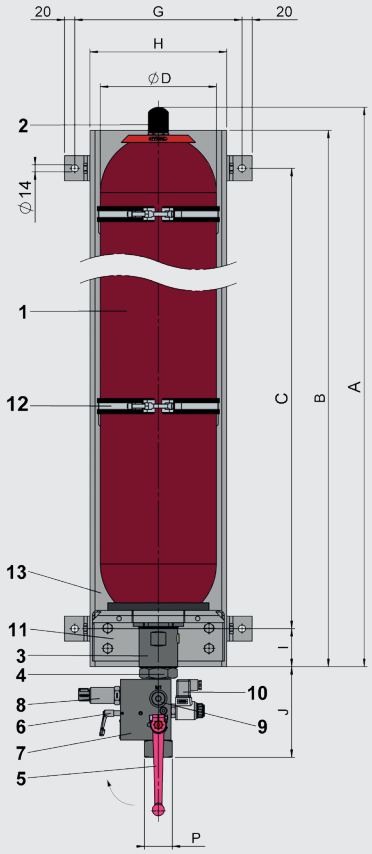


Fig. 2



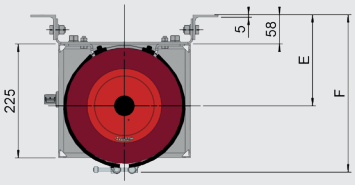


Fig. 3

Nominal volume [l]	SAF type	Part no.	Eff. gas volume [l]	A max. [mm]	B [mm]	C [mm]	ØD max. [mm]	E [mm]	F [mm]	G [mm]	H [mm]	I [mm]	Fig.
1	SAF10, M	3033471 [1]	1	302	–	–	118	74	147	–	156	–	1
	SAF10, Y	3033472 [1]											
2.5	SAF10, M	3033473 [2]	2.4	571	460	310	118	133	214	198	138	75	2
	SAF10, Y	3033474 [2]											
4	SAF10, M	3033475	3.7	440	415	320	173	152	253	330	270	50	
	SAF10, Y	3033476											
6	SAF10, M	3033477	5.7	560	570	420	173	152	253	330	270	75	3
	SAF10, Y	3033478											
10	SAF10, M	3033479	9.3	568	570	420	229	180	317	330	270	75	
	SAF10, Y	3033480											
13	SAF10, M	3033481	12	686	570	420	229	180	317	330	270	75	
	SAF10, Y	3033482											
	SAF20, M	3033483											
	SAF20, Y	3033484											
20	SAF20, M	3033485	18.4	896	570	420	229	180	317	330	270	75	
	SAF20, Y	3033486											
24	SAF20, M	3033487	23.6	1062	570	420	229	180	317	330	270	75	
	SAF20, Y	3033488											
32	SAF20, M	3033489	33.9	1411	1340	1190	229	180	317	330	270	75	
	SAF20, Y	3033490											
	SAF32, M	3033491											
	SAF32, Y	3033492											
50	SAF20, M	3033493	47.5	1931	1340	1190	229	180	317	330	270	75	
	SAF20, Y	3033494											
	SAF32, M	3033495											
	SAF32, Y	3033496											

[1] Without back plate and console, with one HyRac clamp 110-118/124 H10 ST

[2] Without console, with back plate and two HyRac clamps 110-118/124 H10 ST

SAF series	Nominal volume SB330 [l]	P ISO 228	Pressure gauge connection	J [mm]
SAF10	1	G 1/2	2 x G 1/4	142
	2.5			104
	4			113
	6			102
	≥ 10			147
SAF20	2.5	G 1	G 1/4, G 1/2	135
	4			142
	6			132
	≥ 10			178
SAF32	≥ 10	G 1 1/2		203

Designation	Item
Accumulator shell	1
Gas valve	2
Oil valve	3
Adapter S	4
Switching handle	5
Pressure release spindle	6
SAF safety block	7
Release valve	8
Pressure gauge connection	9
Release valve	10
Console	11
HyRac clamp	12
Back plate	13

5. NOTE

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

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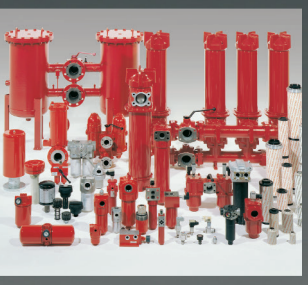
Accumulators 30.000



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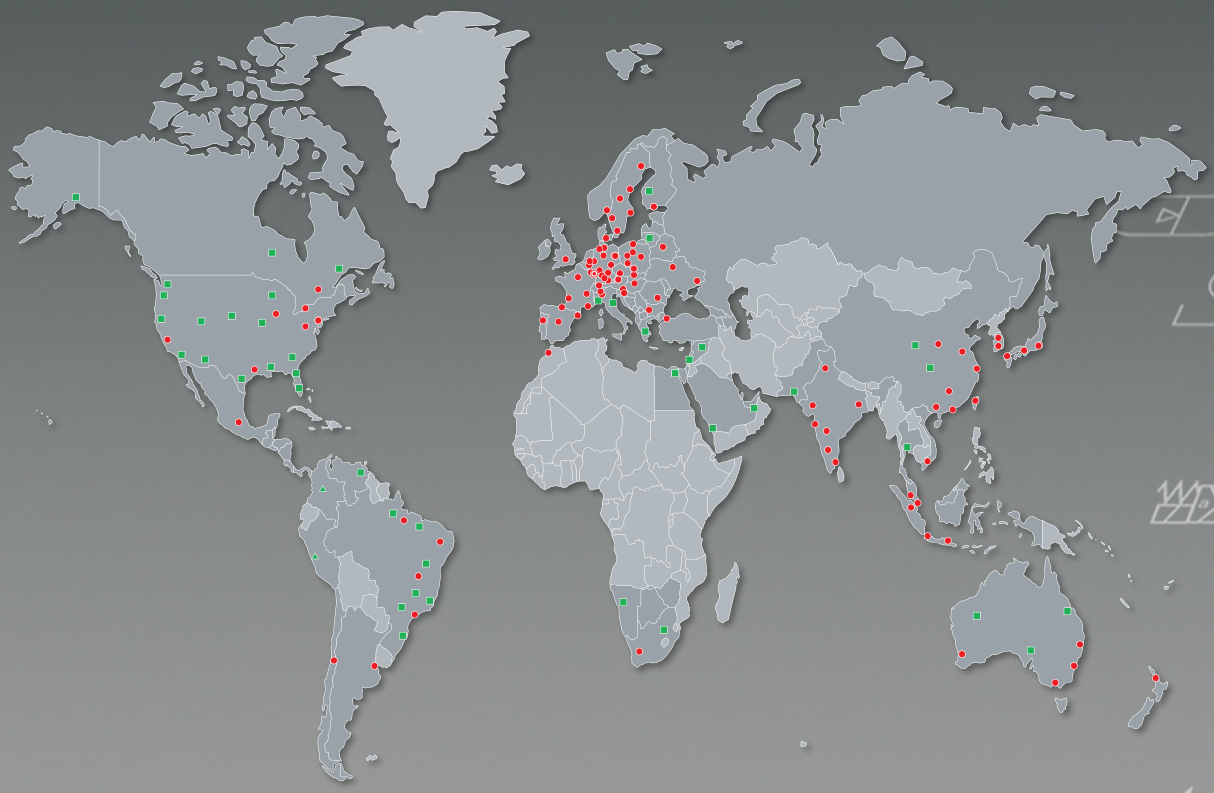

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