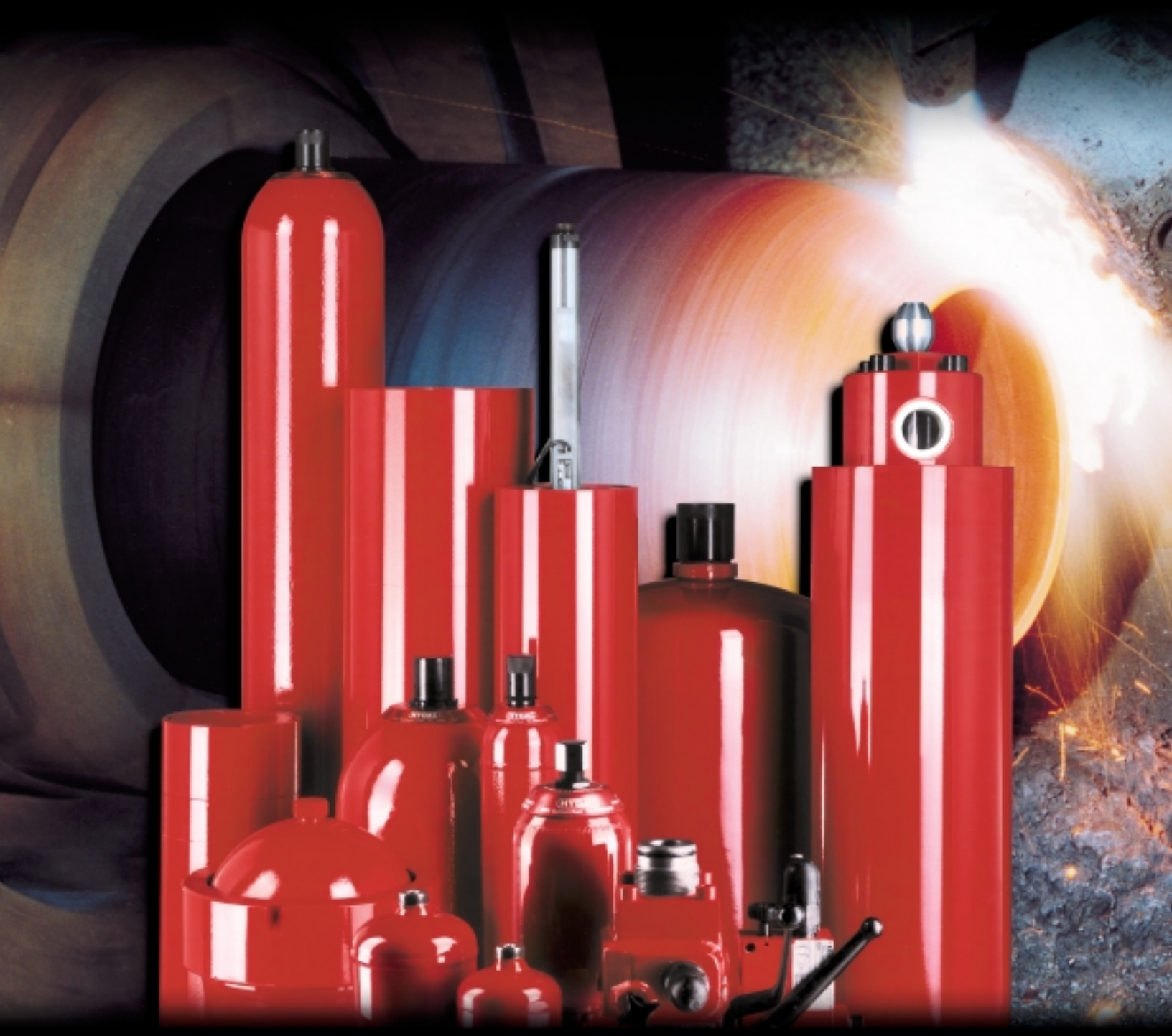
HYDAC INTERNATIONAL

Accumulators

Bladder, Piston, Diaphragm



www.hydacusa.com

About HYDAC

HYDAC stands for worldwide presence and accessibility to the customer. HYDAC has over 1000 distributors worldwide and more than 30 wholly owned branches. HYDAC accumulators – a name synonymous with advanced technology, design, manufacturing and application engineering for more than 36 years, is considered a leader throughout the hydraulic industry, worldwide.

HYDAC Products

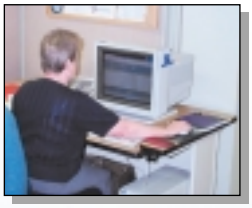
HYDAC is the only worldwide manufacturer producing all types of hydraulic accumulators – bladder, piston, and diaphragm accumulators and hydraulic dampeners. Not only does **HYDAC** supply the most comprehensive hydraulic accumulator range, but also the best technical solution to every application. HYDAC accumulators are supplied with pressure vessel certifications to the laws governing the appropriate country of installation.

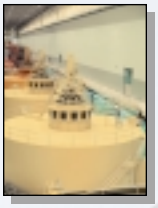
HYDAC Quality

HYDAC stands for quality and customer service. **HYDAC** achieves the highest quality accumulators and related parts through continuous research and development in our laboratories for testing of physical, chemical, and mechanical properties. To ensure that **HYDAC** accumulators and related products are as innovative as possible with optimum performance and safety, a Finite Element Analysis is implemented during the Computer Aided Design process.

HYDAC Customer Service

Our internal staff and worldwide distribution network take care of the important matter of customer service. **HYDAC** values high standards, professional ethics, and mutual respect in all transactions with customers, vendors, and employees. We invest in our relationships by providing expertise, quality, dependability, and accessibility to foster growth and a sense of partnership. Our customer service representatives are committed to serving the customers' needs.



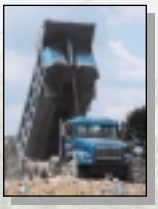


Energy and Environmental Technology

HYDAC accumulators have played a key role in providing innovative solutions resulting in lowering operational costs and increasing hydraulic system performance in hydroelectric, wind, and waste power plants. **HYDAC** has vast expertise in applying accumulator technology within the power generation industry.

Offshore Shipbuilding and Marine Technology

Maritime technology places special demands on material functionality and reliability. **HYDAC** accumulators meet these demands due to our high quality and test standards. **HYDAC** accumulators have been applied under the toughest conditions from drilling rigs to deep sea applications.

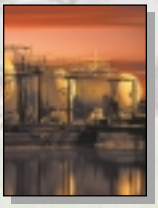


Mobile Market

The aim of our engineers has always been to reduce volume and weight, resulting in increased product performance. **HYDAC** provides compact high performance accumulators for the Mobile Market, **HYDAC** accumulators can be found on all types of construction, forestry, and agricultural equipment.

Industrial Engineering

Since we began, **HYDAC** has been involved in many industrial applications. Our knowledge and expertise of many industries provides a comprehensive range of versatile hydraulic accumulators. **HYDAC** offers many solutions for machine tools, plastic injection molding machines, test equipment, presses, and metal forming machines. Other industrial applications include: steel and heavy industry, power transmission, and paper mills.



Process Technology

Worldwide **HYDAC** accumulators can be found in paper mills, steel mills and manufacturing plants, foundries, power plants, and in the chemical, petrochemical and plastics industries. For more than 36 years **HYDAC** has been supplying accumulators to companies who require the most advanced process technology.

Introduction

Bladder Accumulators

Diaphragm Accumulators

Piston Accumulators

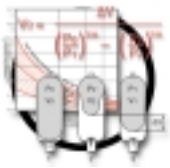
Nitrogen Bottles

Dampeners, Silencers, Shock Absorbers

Accessories

Application Examples

Sizing Accumulators



Spare Parts, Seal Kits, & Tools

All information is subject to change without notice.

Introduction

HYDAC (derived from **HYD**raulic **AC**cumulators) has been a name synonymous with advanced technology, design, manufacturing and application engineering for more than 36 years. **HYDAC** is the only manufacturer of all three types of accumulators – Bladder, Piston, & Diaphragm.

Functions

As an essential element in modern hydraulics, accumulators perform many useful functions, such as:

- reducing pump capacity and electrical energy
- providing auxiliary hydraulic power in case of an emergency
- limiting pressure fluctuations during temperature changes in a closed hydraulic loop
- compensating for leakage
- minimizing pump pulsations
- absorbing shocks

Benefits

- increasing system performance and efficiency
- lowering operating and maintenance costs
- providing fail-safe conditions
- avoiding pump, pipe and system failures to achieve


Machining Department - Sulzbach, Germany


Laboratory test stand


Assembly of bladder accumulators


Assembly of piston accumulators

Certification

United States

HYDAC Technology GmbH in D-66280 Sulzbach/Saar is authorized (effective August 21, 1985) by the "National Board of Boiler and Pressure Vessel Inspectors", in conformity with the appropriate specification of the American Society of Mechanical Engineers (ASME), to use the Code Symbol as a stamp and for registration purposes.

European Union Member States (listed in bold below)

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

China (Self quality for China)

HYDAC Technology GmbH is recognized as an importer of bladder, diaphragm and piston accumulators since 30.03.1998.

Japan (KHK certificate)

For the Japanese market, **HYDAC** Technology GmbH is approved as a "self inspecting manufacturer". Therefore **HYDAC** is authorized to manufacture, test and import accumulators from outside Japan.

For details on other country certifications, please contact HYDAC

Complete Country Code Listing

Algeria	U[3]
Argentina	U[3]
Australia	F[1]
Austria	U
Bahamas	E
Barbados	U[3]
Belgium	U
Bermuda	U[3]
Bolivia	U[3]
Brazil	U[3]
Canada	S1[2]
Chile	U[3]
Costa Rica	E[3]
Czech Republic	U
Denmark	U
Ecuador	U[3]
Egypt	U
Finland	U
France	U
Germany	U
Greece	U

Hong Kong	A9
Hungary	U[3]
Iceland	U[3]
India	U[3]
Indonesia	U[3]
Iran	U
Iraq	U[3]
Ireland	U
Israel	U[3]
Italy	U
Japan	P
Jordan	U[3]
Korea	U
Kuwait	U[3]
Lebanon	U[3]
Libya	U[3]
Luxembourg	U
Malaysia	U[3]
Mexico	U[3]
New Zealand	T
Netherlands	U
Nigeria	U[3]

Norway	U[3]
Pakistan	U[3]
Peru	U[3]
Philippines	U[3]
Poland	A4
Portugal	U
Puerto Rico	E[3]
Romania	U
Russia (CIS)	A6
Saudi Arabia	U[3]
Singapore	U
Slovakia	A8
South Africa	U[3]
Spain	U
Sudan	U[3]
Sweden	U
Switzerland	U
Syria	U
Taiwan	U[3]
Thailand	U[3]
Tunisia	U[3]
Turkey	U
United Kingdom	U
USA	S
Yugoslavia	U

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

Types of Accumulators

Bladder Accumulators

The standard bladder accumulator consists of a “closed” rubber bladder inside a forged steel shell. A mechanically actuated valve closes when the fluid has been expelled, blocking off the fluid port, thereby enclosing the bladder within the shell. Where high discharge rates are required, a high flow model is available.

Applications with corrosive environments may require shells furnished with an internal and/or external coating or manufactured from stainless steel (see below).

The top repairable accumulator permits service and maintenance of the bladder without removing the accumulator from the hydraulic system.

When the pressure level of a system permits, a low pressure accumulator may be used. It is similar to a standard bladder accumulator, except that the poppet valve is replaced by a perforated plate covering the fluid port, and the shell may be of welded construction.

For applications requiring light weight a Kevlar wrapped accumulator shell is available. The wrapping supports the thinner metal shell to permit a substantial weight reduction.

Bottom Repairable
Pressure: 3000 to 6000 psi
Nominal Vol: 1 Qt. to 15 Gal.

Low Pressure
Pressure: 275 to 500 psi
Nominal Vol: 2.5 to 120 Gal.

Kevlar Wrapped (lightweight)

High Flow (to 2200 gpm)

Top Repairable

High Pressure (to 14,500 psi)

Diaphragm Accumulators

A diaphragm accumulator performs the same function as a bladder accumulator, however, it operates like a membrane. A poppet is molded into the bottom of the diaphragm to prevent its extrusion through the fluid port.

Diaphragm accumulators are frequently used where small volumes are required, light weight is important, a higher pressure ratio is required (up to 10:1) and low cost is a prime factor.

Applications with corrosive environments may require shells furnished with an internal and/or external coating or manufactured from stainless steel (see below).

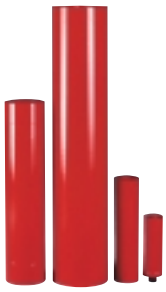
Welded

Threaded (repairable)

Automotive

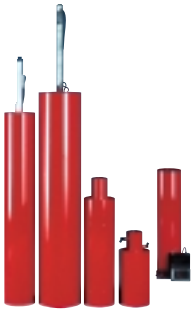
Piston Accumulators

A piston accumulator consists of a fluid section and a gas section with the piston acting as a gas-proof screen. The gas section is precharged with dry nitrogen gas. Auxiliary gas bottles are frequently used with piston accumulators to provide the required gas volume.



Basic

Extending Piston Rod



electric proximity switches

Stainless Steel Accumulators

Stainless steel piston and diaphragm type accumulators are available in various sizes and pressure ranges. They offer special corrosion resistance, that is required for chemical and off-shore industries, petro-chemical and nuclear power plants and for food applications.

Piston

Diaphragm

Dampeners

Pulsations and shocks in hydraulic lines can result in costly damage to the piping and other system components. Reciprocating piston pumps by design create pressure pulsations, vibrations, and noise in the system. **HYDAC** suction stabilizers, pulsation dampeners and silencers, when applied to piston pumps, will reduce pulsations and noise. Furthermore, pressure pulsations can make control in servo systems nearly impossible without installing a pulsation dampener. **HYDAC** shock absorbers can be applied to greatly reduce shock wave energy. These waves can be harmful to all components in your hydraulic system. Shock waves can be created by closing a valve in a high flow line, such as one found in a petroleum terminal.

Accessories

A full range of accessories for the installation, service and maintenance of all accumulators completes the program. In addition to the items shown, special valve blocks and adapters are available for your particular requirements.

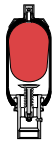
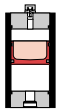
For more information on these accessories, see page 27

Type Selection Considerations:

- **System Pressure**
- **System Temperature**
- **Volume / Usable Volume**
- **Flow Rate**
- **Pressure Ratio**
- **Installation Space and Position**
- **Chemical Compatibility**

Use the comparison chart below as a quick reference guide.

Comparison of Standard Accumulators

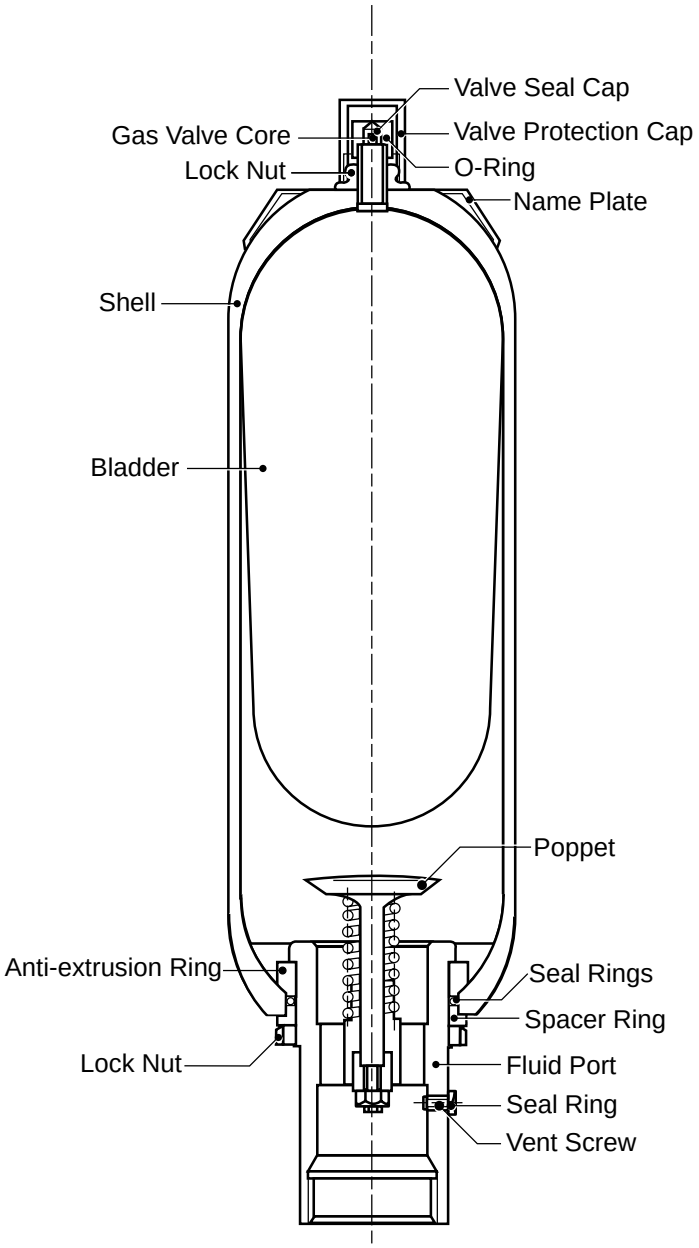
Type	Nominal Volume	MAWP (psi)	Pressure Ratio	Flow Rate	Mounting Position	Weight	Cost	Design Consideration
Diaphragm 	5 to 230 in^3	3000, 5000 (up to 10,000)	8:1 typically (up to 10:1)	up to 60 gpm	any	lowest	lowest	• small volume and flow • low weight • compact design • good for shock applications *(good response characteristics)*
Bladder 	1 qt. to 15 gal	3000, 5000 (up to 10,000)	4:1	up to 480 gpm	prefer vertical	middle	middle	• best general purpose • wide range of standard sizes • good for shock applications *(good response characteristics)*
Piston 	1 qt. to 100 gal	3000, 5000 (up to 10,000)	∞:1	up to 2000 gpm	prefer vertical	highest	middle to highest	• best for large stored volumes • best for high flow rates • not recommended for shock applications • best for use with backup nitrogen bottles

Description

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

Construction

HYDAC bladder accumulators consist of a welded or forged pressure vessel (shell), a bladder and ports for gas and fluid inlet. The gas and fluid sides are separated by the bladder.



Bladder Materials

Not all fluids are compatible with every elastomer at all temperatures. Therefore, **HYDAC** offers the following choice of elastomers:

- **NBR** (Standard Nitrile)
- **LT-NBR** (Low Temperature Nitrile)
- **ECO** (Epichlorohydrin)
- **IIR** (Butyl)
- **FPM** (Fluorelastomer)
- others (available upon request)

To determine which material is appropriate...
ALWAYS REFER TO FLUID MANUFACTURER'S RECOMMENDATION

Corrosion Protection

For use with certain aggressive or corrosive fluids, or in a corrosive environment, **HYDAC** offers protective coatings and corrosive resistant materials (i.e. stainless steel) for the accumulator parts that come in contact with the fluid, or are exposed to the hostile environment.

Mounting Position

HYDAC bladder accumulators can be installed vertically, at any angle, or horizontally depending upon the application. When installing vertically or at an angle, the fluid port must be at the bottom. On certain applications listed below, specific positions are preferable:

- **Energy Storage:** vertical
- **Pulsation Damping:** any position from vertical to horizontal
- **Maintaining Constant Pressure:** any position from vertical to horizontal
- **Volume Compensation:** any position from vertical to horizontal

System Mounting

HYDAC bladder accumulators are designed to be screwed directly onto the system. We also recommend the use of our mounting components, which are detailed on page 33, to minimize risk of failure due to system vibrations.

Applications

Some common applications of bladder accumulators are:

- Agricultural Machinery & Equipment
- Forestry Equipment
- Oil Field & Offshore
- Machine Tools
- Mining Machinery & Equipment
- Mobile & Construction Equipment
- Off- Road Equipment

For specific examples of applications using bladder accumulators, please see page 45.

Model Code

SB 330 - 20 A 1 / 112 S – 210 C

Series
- **SB 330** = 3000 psi
- **SB 600** = 5000 psi

Design
- ***(omit)*** = Standard *(bottom repairable)*
- **H** = High Flow
- **TR** = Top Repairable
- **HT** = High Flow / Top Repairable

Size *(see dimension tables on following pages for most common sizes)*
- **1** = 1 quart
- **4** = 1 gallon
- **6** = 1.5 gallons
- **10** = 2.5 gallons
- **20** = 5 gallons
- **32** = 10 gallons
- **42** = 11 gallons
- **54** = 15 gallons

Line Connection
- **A** = Threaded
- **F** = Flanged

Gas Port
- **1** = Standard model, HYDAC gas valve version 4 (8V1 - ISO 4570)

Material Code
Depending on Application
- **112** = Standard for oil service *(mineral oil)*

Fluid Port
- **0** = Synthetic coated carbon steel *(internal & external for water service)*
- **1** = Carbon steel
- **2** = Stainless steel (high strength)
- **3** = Stainless steel (corrosion resistance)
- **4** = Chemically plated carbon steel *(internal & external for water service)*
- **6** = Low temperature carbon steel (<-40°F)

Shell
- **0** = Synthetic coated carbon steel *(internal & external for water service)*
- **1** = Carbon steel
- **2** = Chemically plated carbon steel *(internal & external for water service)*
- **6** = Low temperature carbon steel (<-40°F)

Bladder Compound
- **2** = NBR (Buna N)
- **3** = ECO (Hydrin)
- **4** = IIR (Butyl)
- **5** = LT-NBR (low temp. Buna)
- **6** = FPM (Fluoro-elastomer)
- **7** = Others (available on request)

Compound	Oper. Temp Range	Typical Fluids
NBR	5° to 180°F 32° to 180°F	mineral oils water & water-glycols
ECO	-20° to 250°F	mineral oils
IIR	-40° to 200°F	phosphate esters & brake fluids
LT-NBR	-50° to 180°F	mineral oils
FPM	5° to 300°F	chlorinated hydrocarbons

Country of Installation
- **S** = USA

(for other countries see page 2 for proper code designation)

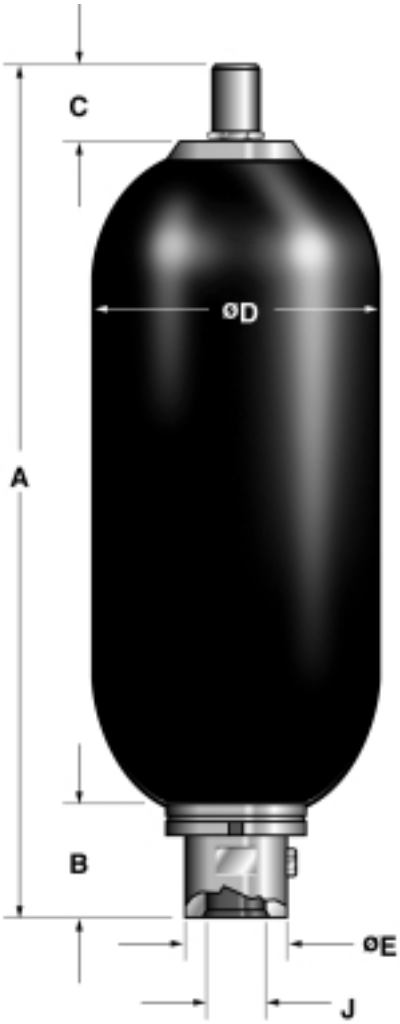
Maximum Working Pressure
- **210** = 3000 psi
- **345** = 5000 psi

Fluid Port Connection
Threaded
- **A** = BSPP (ISO 228)
- **B** = Metric (DIN 13)
- **C** = SAE (ANSI B1.1)
- **D** = NPT (ANSI B1.2)

Flanged
- **E** = SAE 2” - 3000 psi (Code 61)
- **F** = SAE 1 1/2” - 6000 psi (Code 62)

*Model Codes containing red selections are non-standard items – Contact **HYDAC** for information and availability*
Not all combinations are available

Standard Bladder Accumulators - Bottom Repairable

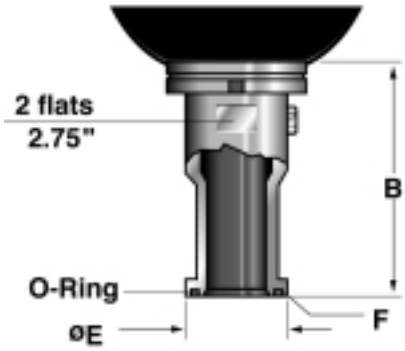


SB 330... (3000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in³	Weight lbs./(kg)	A in./(mm)	B(1 in./(mm)	C in./(mm)	ØD in./(mm)	ØE in./(mm)	Thread J SAE	Thread J NPTF	Q(2 gpm
1	1/4	66	10 (4.5)	12.0 (303)	2.0 (51)	2.3 (58)	4.6 (117)	1.4 (36)	1 1/16-12 UN	3/4”	60
4	1	226	30 (14)	16.3 (415)	2.6 (66)	2.3 (58)	6.6 (168)	2.1 (53)	1 5/8-12 UN	1 1/4”	160
6	1 1/2	340	33 (15)	20.5 (521)	2.6 (66)	2.3 (58)	6.6 (168)	2.1 (53)	1 5/8-12 UN	1 1/4”	160
10	2 1/2	566	86 (39)	22.0 (559)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 7/8-12 UN	2”	240
20	5	1125	140 (63)	34.5 (876)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 7/8-12 UN	2”	240
32	10	2080	226 (102)	54.7 (1390)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 7/8-12 UN	2”	240
42	11	2320	270 (123)	60.2 (1530)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 7/8-12 UN	2”	240
54	15	3205	330 (150)	78.3 (1990)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 7/8-12 UN	2”	240

SB 600... (5000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in³	Weight lbs./(kg)	A in./(mm)	B(1 in./(mm)	C in./(mm)	ØD in./(mm)	ØE in./(mm)	Thread J SAE	Q(2 gpm
1	1/4	66	17 (7.7)	13.2 (335)	2.4 (62)	2.3 (58)	4.8 (122)	2.1 (53)	1 5/8-12 UN	160
4	1	226	33 (15)	16.3 (415)	2.5 (64)	2.3 (58)	6.8 (173)	2.1 (53)	1 5/8-12 UN	160
10	2 1/2	566	114 (52)	22.4 (568)	3.1 (80)	2.8 (70)	9.1 (232)	3.0 (76)	1 7/8-12 UN	240
20	5	1125	162 (73)	35.0 (888)	3.1 (80)	2.8 (70)	9.1 (232)	3.0 (76)	1 7/8-12 UN	240
32	10	2080	250 (113)	55.2 (1402)	3.1 (80)	2.8 (70)	9.1 (232)	3.0 (76)	1 7/8-12 UN	240
54	15	3180	370 (168)	78.8 (2002)	3.1 (80)	2.8 (70)	9.1 (232)	3.0 (76)	1 7/8-12 UN	240

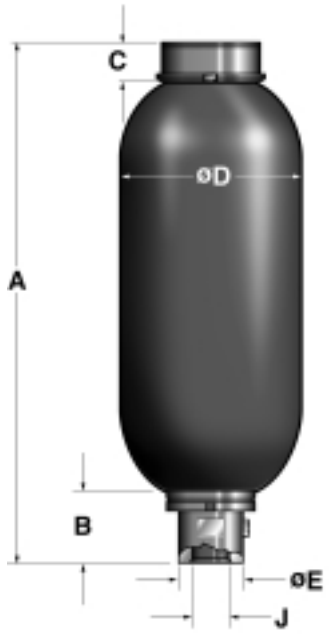


Split Flange Connection (sizes 10 - 54)

Series	B in./(mm)	øE in./(mm)	Split Flange Connection F	Q(2 gpm
SB 330 **SB 330 T**(3	4.1 (104)	2.8 (71.4)	SAE 2” – 3000 psi Code 61	240
SB 600 **SB 600 T**(3	5.5 (140)	2.5 (63.5)	SAE 1 1/2” – 6000 psi Code 62	240

1) Applies to SAE thread type only. For Split Flange, see separate chart and illustration.
2) Maximum discharge flow rate recommended for vertically mounted accumulators.
3) sizes 20 to 54 only.

Top Repairable and High Flow Bladder Accumulators



SB 330 TR... (Top Repairable, 3000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in³	Weight lbs./(kg)	A in./(mm)	B(1 in./(mm)	C in./(mm)	ØD in./(mm)	ØE in./(mm)	Thread J SAE	Thread J NPTF	Q(2 gpm
10	2 1/2	566	94 (43)	21.3 (540)	3.1 (80)	1.6 (40)	9.1 (231)	3.0 (76)	1 7/8-12 UN	2”	240
20	5	1125	140 (63)	34.8 (883)	3.1 (80)	1.6 (40)	9.1 (231)	3.0 (76)	1 7/8-12 UN	2”	240
32	10	2080	226 (102)	55.0 (1397)	3.1 (80)	1.6 (40)	9.1 (231)	3.0 (76)	1 7/8-12 UN	2”	240
54	15	3205	330 (150)	78.6 (1997)	3.1 (80)	1.6 (40)	9.1 (231)	3.0 (76)	1 7/8-12 UN	2”	240

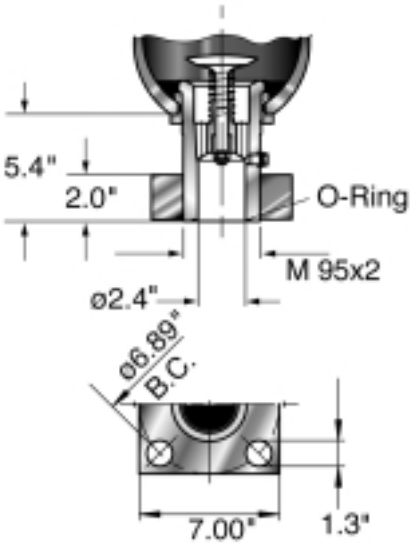
SB 600 TR... (Top Repairable, 5000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in³	Weight lbs./(kg)	A in./(mm)	B(1 in./(mm)	C in./(mm)	ØD in./(mm)	ØE in./(mm)	Thread J SAE	Q(2 gpm
20	5	1125	172 (78)	33.5 (851)	3.1 (80)	1.6 (40)	9.1 (232)	3.0 (76)	1 7/8-12 UN	240
32	10	2080	260 (118)	53.7 (1364)	3.1 (80)	1.6 (40)	9.1 (232)	3.0 (76)	1 7/8-12 UN	240
54	15	3205	380 (172)	77.3 (1964)	3.1 (80)	1.6 (40)	9.1 (232)	3.0 (76)	1 7/8-12 UN	240

SB 330 HT... (Top Repairable, High Flow, 3000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in³	Weight lbs./(kg)	A in./(mm)	B(1 in./(mm)	C in./(mm)	ØD in./(mm)	ØE in./(mm)	Thread J SAE	Q(2 gpm
20	5	1125	161 (73)	36.0 (914)	5.3 (135)	1.6 (40)	9.1 (232)	3.8 (97)	2 1/2-12 UN	480
32	10	2080	247 (112)	57.2 (1409)	5.3 (135)	1.6 (40)	9.1 (232)	3.8 (97)	2 1/2-12 UN	480
54	15	3205	352 (160)	79.8 (2027)	5.3 (135)	1.6 (40)	9.1 (232)	3.8 (97)	2 1/2-12 UN	480

High Flow Flange Connection (optional)



1) Applies to SAE thread type only. For Split Flange, see chart and illustration below.
2) Maximum discharge flow rate recommended for vertically mounted accumulators.

Description

HYDAC diaphragm accumulators utilize the compressibility of a gas (nitrogen) in storing hydraulic energy. The gas is required because fluids are practically incompressible and thus, can not store energy by themselves. The diaphragm is utilized to separate the gas and the fluid sides of the accumulator.

The diaphragm accumulator functions by drawing in fluid from the hydraulic circuit when the pressure increases and thus, compresses the gas. It returns this energy to the circuit as the pressure decreases by the expansion of the gas.

A poppet is incorporated into the diaphragm to prevent its extrusion through the fluid port.

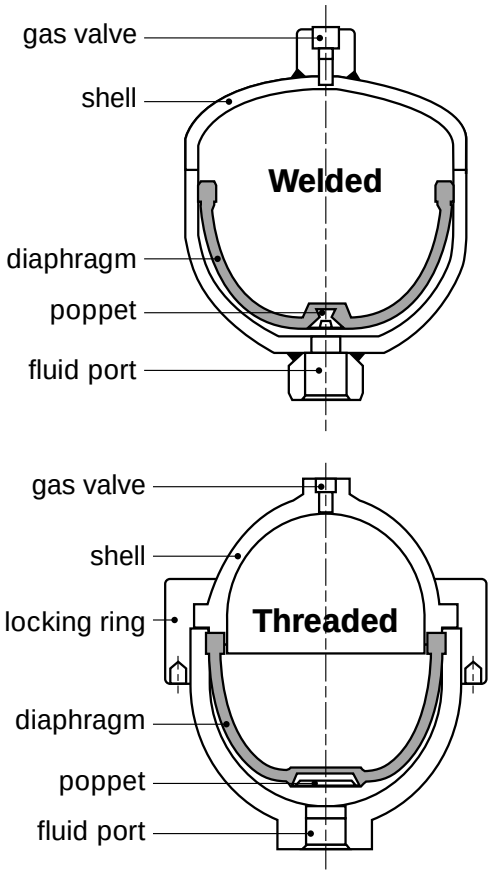
HYDAC manufactures two types of diaphragm accumulators:

- welded (non-repairable)
- threaded (repairable)

These have been successfully applied to both industrial and mobile applications for energy storage, maintaining pressure, leakage compensation, and vehicle hydraulic systems (e.g. brake and suspension).

Construction

Both types of diaphragm accumulators have the same basic construction. The difference is in the shell. The welded version has a shell that is electron-beam welded, and therefore cannot be repaired. The threaded type has a shell made up of two halves (top and bottom) which are held together by a threaded locking ring.



Diaphragm Materials

Not all fluids are compatible with every elastomer at all temperatures. Therefore, **HYDAC** offers the following choice of elastomers:

- **NBR** (Standard Nitrile)
- **LT-NBR** (Low Temperature Nitrile)
- **ECO** (Epichlorohydrin)
- **IIR** (Butyl)
- **FPM** (Fluorelastomer)
- others (available upon request)

To determine which material is appropriate...
ALWAYS REFER TO FLUID MANUFACTURER'S RECOMMENDATION

Corrosion Protection

For use with certain aggressive or corrosive fluids, or in a corrosive environment, **HYDAC** offers protective coatings and corrosive resistant materials (i.e. stainless steel) for the accumulator parts that come in contact with the fluid, or are exposed to the hostile environment.

Mounting Position

Diaphragm accumulators by design may be mounted in any position. In systems where contamination is a problem, we recommend a vertical mount with fluid port oriented downward.

System Mounting

HYDAC diaphragm accumulators are designed to be screwed directly onto the system. We also recommend the use of our mounting components, which are detailed on page 33, to minimize risk of failure due to system vibrations.

Applications

Some common applications of diaphragm accumulators are:

- Agricultural Machinery & Equipment
- Forestry Equipment
- Machine Tools
- Mining Machinery & Equipment
- Mobile & Construction Equipment
- Off- Road Equipment

For specific examples of applications using diaphragm accumulators, please see page 45.

Model Code

SBO 210 - 1 E4 / 112 S – 210 CK 010

Series
SBO *XXX* = Diaphragm Accumulator (XXX = series designation)
(see tables on following pages for most common series and size selections)

Size *(in Liters, see tables on dimension pages to follow)*
0.075 = 0.075 Liters
...see tables on following pages for complete list of sizes, and which versions they are available in
3.5 = 3.5 Liters

Shell Construction and Gas Port Design
E1 = Welded Construction, rechargeable, HYDAC Gas Valve Version 1 *(M 28 x 1.5)*
E2 = Welded Construction, factory precharged and sealed, *(not rechargeable)*
E4 = Welded Construction, rechargeable, HYDAC Gas Valve Version 4 *(8VI-ISO 4570)*
A6 = Threaded Construction, rechargeable, HYDAC Gas Valve Version 1 *(M 28 x 1.5)*

Material Code
Depending on Application
112 = Standard for oil service *(mineral oil)*

Fluid Port
1 = Carbon steel
3 = Stainless steel
4 = Chemically plated carbon steel *(ONLY WETTED SURFACES for water service)*
6 = Low temperature carbon steel (< -20°F)

Shell
0 = Synthetic coated carbon steel *(internal & external for water service)*
1 = Carbon steel
2 = Chemically plated carbon steel *(internal & external for water service)*
4 = Stainless steel *(please note: MAWP decreases for most stainless models - see tables)*
6 = Low temperature carbon steel (< -20°F)

Diaphragm Compound
2 = NBR (Buna N)
3 = ECO (Hydrin)
4 = IIR (Butyl)
5 = LT-NBR (low temperature Buna)
6 = FPM (fluoro-elastomer)
7 = Others (available on request)

Compound	Oper. Temp Range	Typical Fluids
NBR	5° to 180°F 32° to 180°F	mineral oils water & water-glycols
ECO...113...	-20° to 250°F	mineral oils
ECO...663...	-40° to 200°F	mineral oils (with low temperature CS shell)
IIR	-20° to 200°F	phosphate esters & brake fluids
LT-NBR	-40° to 180°F	mineral oils (with low temperature CS shell)
FPM	5° to 300°F	chlorinated hydrocarbons

Country of Installation
S = USA
(for other countries see page 2 for proper code designation)

Maximum Working Pressure in bar *(see tables on dimension pages to follow)*
100 = 1500 psi
140 = 2000 psi
200 = 3000 psi
210 = 3000 psi
250 = 3600 psi
330 = 4700 psi
400 = 5800 psi
450 = 6500 psi
500 = 7200 psi
750 = 10000 psi

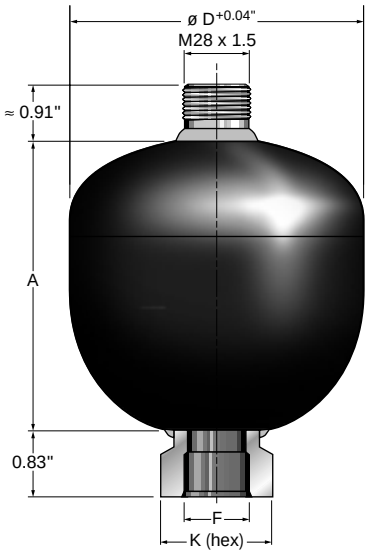
Fluid Port Connection
CK = Standard SAE connection
(other fluid ports available upon request — consult factory)

Gas Precharge Pressure (P_0) in bar *(always required for E2 model gas valve)*
= 3 digits

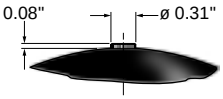
*Model Codes containing red selections are non-standard items – Contact **HYDAC** for information and availability*
Not all combinations are available

Welded Diaphragm Accumulators - non-repairable

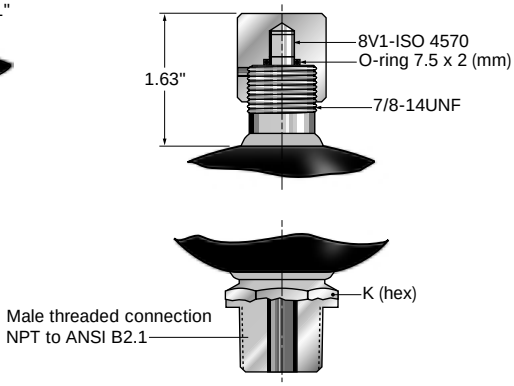
Version E1



Version E2



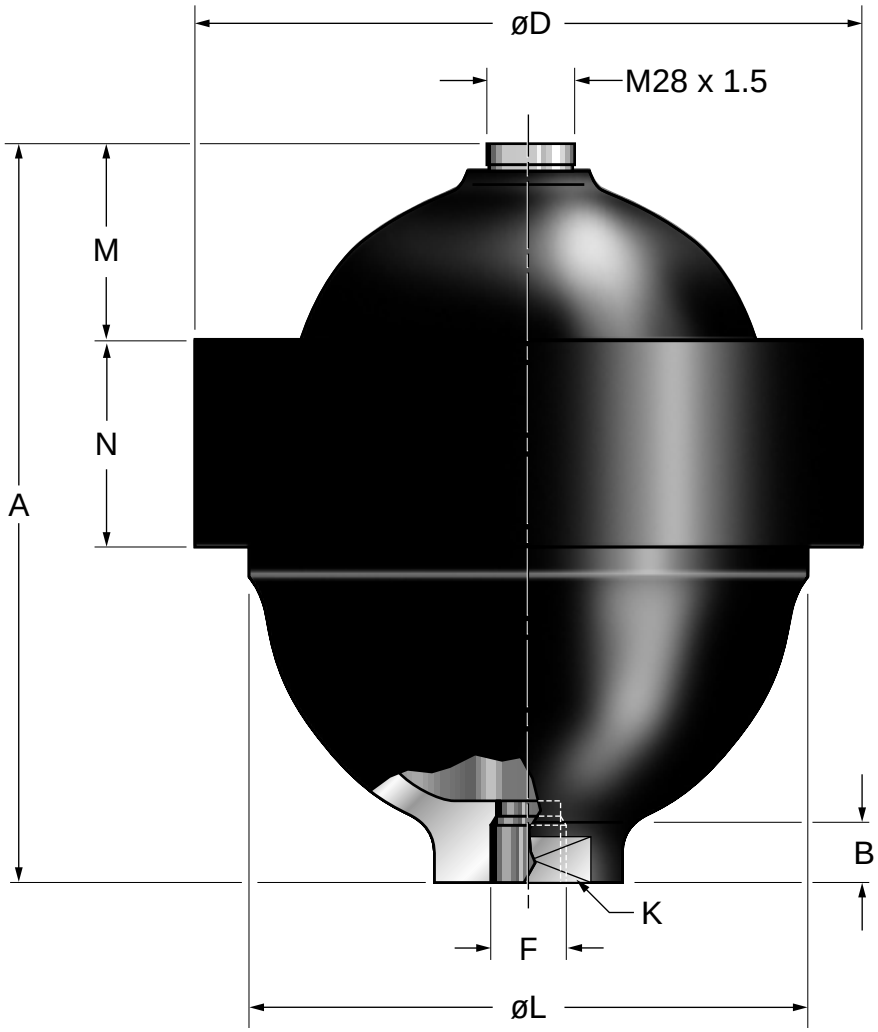
Version E4



Series	Max. p_2:p_0	Size (liters)	Effective Gas Vol in³	MAWP psi/(bar)	Weight lbs./(kg)	A in./(mm)	øD[2] in./(mm)	Thread F SAE	Thread F NPTF[3]	K (hex) in./(mm)	Q gpm
SBO 250	8 : 1	0.075	5	3600 (250)	1.5 (0.7)	2.68 (68)	2.52 (64)	9/16-18 UNF	3/8”	1.18 (30)	10
SBO 210	8 : 1	0.16	10	2600/(180)[1] 3000/(210)	1.8 (0.8)	3.15 (80)	2.91 (74)	9/16-18 UNF	3/8”	1.18 (30)	10
SBO 210	8 : 1	0.32	20	2400/(160)[1] 3000/(210)	2.9 (1.3)	3.66 (93)	3.66 (93)	3/4-16 UNF	1/2”	1.42 (36)	25
SBO 210	8 : 1	0.5	30	3000 (210)	3.7 (1.7)	4.35 (124)	4.13 (105)	3/4-16 UNF	1/2”	1.42 (36)	25
SBO 330	8 : 1	0.6	36	4700 (330)	7.3 (3.3)	5.04 (128)	4.53 (115)	3/4-16 UNF	1/2”	1.42 (36)	25
SBO 210	8 : 1	0.75	45	2000/(140)[1] 3000/(210)	6.2 (2.8)	4.88 (124)	4.76 (121)	3/4-16 UNF	1/2”	1.42 (36)	25
SBO 330	8 : 1	0.75	45	4700 (330)	8.9 (4.0)	4.78 (122)	4.96 (126)	3/4-16 UNF	1/2”	1.42 (36)	25
SBO 200	8 : 1	1	60	3000 (210)	7.9 (3.6)	5.39 (137)	5.35 (136)	3/4-16 UNF	1/2”	1.42 (36)	25
SBO 140	8 : 1	1.4	85	2000 (140)	8.6 (3.9)	5.91 (150)	5.71 (145)	3/4-16 UNF	1/2”	1.42 (36)	25
SBO 210	8 : 1	1.4	85	3000 (210)	11.9 (5.4)	6.14 (156)	5.91 (150)	3/4-16 UNF	1/2”	1.42 (36)	25
SBO 330	8 : 1	1.4	85	4700 (330)	16.6 (7.5)	6.33 (160)	6.1 (155)	3/4-16 UNF	1/2”	1.42 (36)	25
SBO 100	8 : 1	2	120	1500/(100)[1] 1500/(100)	8.8 (4.0)	6.57 (167)	6.30 (160)	1 1/16-12 UNF	3/4”	1.81 (46)	40
SBO 210	8 : 1	2	120	3000 (210)	14.6 (6.6)	6.81 (173)	6.57 (167)	1 1/16-12 UNF	3/4”	1.81 (46)	40
SBO 330	8 : 1	2	120	4700 (330)	17.7 (8.0)	7.12 (180)	6.77 (172)	1 1/16-12 UNF	3/4”	1.81 (46)	40
SBO 210	4 : 1	2.8	170	3000 (210)	18.0 (8.2)	8.94 (227)	6.57 (167)	1 1/16-12 UNF	3/4”	1.81 (46)	40
SBO 250	4 : 1	3.5	230	3000 (210)	24.6 (11.2)	11.14 (283)	6.69 (170)	1 1/16-12 UNF	3/4”	1.81 (46)	40
SBO 330	4 : 1	3.5	230	4700 (330)	30.6 (13.8)	10.78 (274)	6.77 (172)	1 1/16-12 UNF	3/4”	1.81 (46)	40

1) Stainless steel version for chemical, water, and oil service
2) Diameter at electron beam weld may be up to +0.150” larger
3) May be supplied with adapter

Threaded Diaphragm Accumulators - repairable



Series	Max. $p_2:p_0$	Size liters	Effective Gas Vol in³	MAWP psi/(bar)	Wt. lbs./(kg)	A in./(mm)	B in./(mm)	Ø D[2] in./(mm)	Thread F SAE	K in./(mm)	Ø L in./(mm)	M in./(mm)	N in./(mm)	Q gpm
SBO 500	10 : 1	0.1	6	7200 (500)	4.2 (1.9)	4.33 (110)	1.18 (30)	3.74 (95)	3/4-16	1.26 (68)	2.68 (68)	0.87 (22)	1.38 (35)	25
SBO 500	10 : 1	0.25	15	5000/(350)[1] 7200/(500)	8.6 (3.9)	5.04 (128)	0.79 (20)	4.53 (115)	3/4-16	1.42 (36)	3.62 (92)	0.71 (18)	2.17 (55)	25
SBO 750	10 : 1	0.25	15	8700/(600)[1] 10000/(750)	19.8 (9.0)	5.35 (136)	0.43 (11)	6.02 (153)	3/4-16	1.42 (36)	4.49 (114)	0.59 (15)	2.48 (63)	25
SBO 450	10 : 1	0.6	36	3600/(250)[1] 4700/(330)	12.6 (5.7)	6.69 (170)	0.75 (19)	5.51 (140)	3/4-16	1.61 (41)	4.53 (115)	1.77 (45)	2.24 (57)	25
SBO 210	10 : 1	1.3	80	3000 (210)	18.7 (8.5)	7.48 (190)	0.31 (8)	6.69 (170)	3/4-16	1.26 (32)	5.71 (145)	2.24 (57)	2.17 (55)	25
SBO 400	10 : 1	1.3	80	5800 (400)	24.7 (11.2)	7.75 (197)	1.10 (28)	7.91 (201)	3/4-16	1.97 (50)	6.30 (160)	1.97 (50)	2.56 (65)	25
SBO 250	10 : 1	2	120	2600/(180)[1] 3600/(250)	25.1 (11.4)	8.93 (227)	0.67 (17)	7.91 (201)	1 1/16-12	1.61 (41)	6.61 (168)	2.44 (62)	2.52 (64)	40

1) Stainless steel version for chemical, water, and oil service

Description

Fluids are practically incompressible and cannot therefore store pressure energy. The compressibility of a gas (nitrogen) is utilized in hydro-pneumatic accumulators for storing fluids. **HYDAC** piston accumulators are designed on this principle, using nitrogen as the compressible medium.

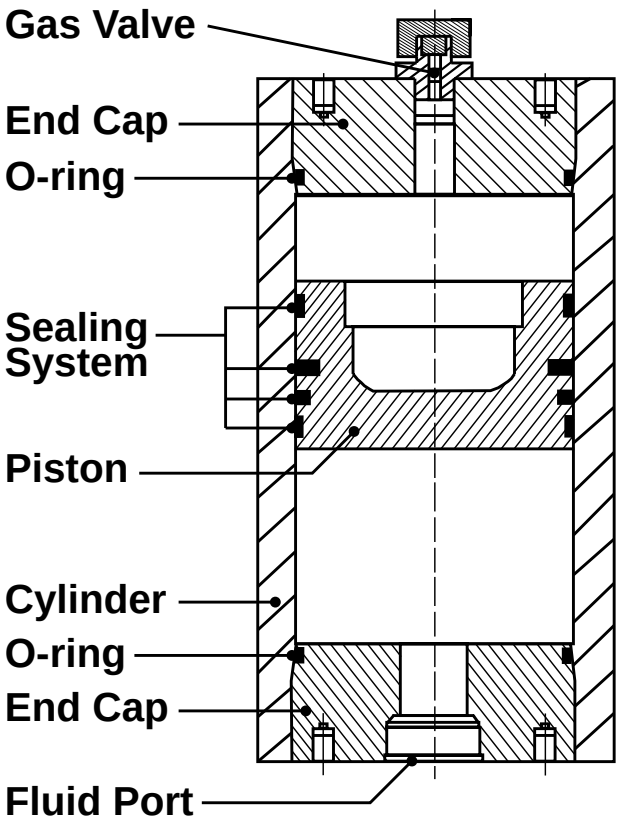
A piston accumulator consists of a fluid section and a gas section with the piston acting as a gas proof screen. The gas section is precharged with dry nitrogen gas.

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

Construction

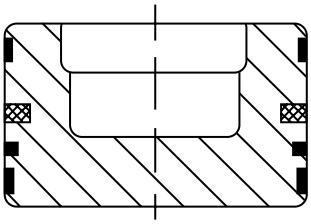
HYDAC piston accumulators consist of:

- A cylinder with a finely finished internal surface
- An end cap on the gas side and fluid side, sealed with o-rings
- A light weight metal piston
- A variety of sealing systems are available depending on the application



Piston Types

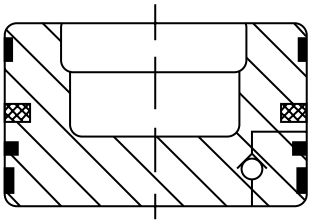
TYPE 2



Application:
Low-friction design for higher piston speeds, slow movements without stick-slip effect and high number of actuations (millions). Actual cycles achieved will vary with operating parameters.

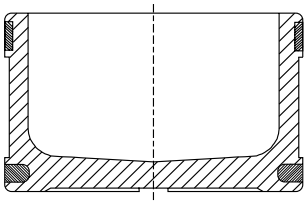
Notes: Filtration ≤ 10 µm absolute. (ISO 18/16/13)
Max. continuous velocity = 12 fps

TYPE 2 with Check Valve



Application:
The addition of a check valve drastically reduces the oil pumping to the gas side of the piston.

TYPE 3



Application:
General duty, cycle requirements 100,000's - Actual cycles achieved will vary with operating parameters.

Notes: Filtration ≤ 10 µm absolute. (ISO 18/16/13)
Max. continuous velocity = 3 fps

Sealing Systems

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

- Number of actuations or cycles
- Piston speed
- Temperature fluctuation
- Operating fluid
- Cleanliness of fluid
- Maintenance requirements

Seal Materials

The following sealing elastomers are available, depending on the operating conditions:

- **NBR** (acrylic nitrile butadiene rubber)
- **FPM** (fluoro-elastomer)
- **PUR** (polyurethane)

Suitable materials are also available for low temperature applications.

Corrosion Protection

For use with certain aggressive or corrosive fluids, or in a corrosive environment, **HYDAC** offers protective coatings and corrosive resistant materials (i.e. stainless steel) for the accumulator parts that come in contact with the fluid, or are exposed to the hostile environment.

System Mounting

HYDAC piston accumulators may operate in any position. Vertical installation is preferable with the gas side up. We recommend the use of our mounting components, which are detailed on page 33, to minimize risk of failure due to system vibrations.

Advantages of HYDAC Piston Accumulators

- Complete size range from 1 qt. to 100 gallons nominal volume
- High ratios possible between precharge pressure and maximum working pressure
- High flow rates - up to 4700 gpm from one accumulator
- Power savings.
- Gas-proof and leak-free.
- No sudden discharge of gas when seal is worn.
- Space efficient.
- Piston location monitoring available.

Advantages of Using the Low-friction Sealing System (type 2):

- Minimum friction.
- Suitable for low pressure differentials.
- No start-up friction, no stick-slip.
- Low noise, no vibration.
- High piston speeds up to 12 fps continuous
- Improved accumulator efficiency.
- High life expectancy
- Low maintenance requirements.

Effects of Seal Friction

The permissible piston velocity depends on the sealing friction. Higher piston velocities are possible where there is less sealing friction.

HYDAC piston accumulators with low friction piston seals allow continuous operating velocities of up to 12 fps with short excursions to 15 fps (see type 2 piston).

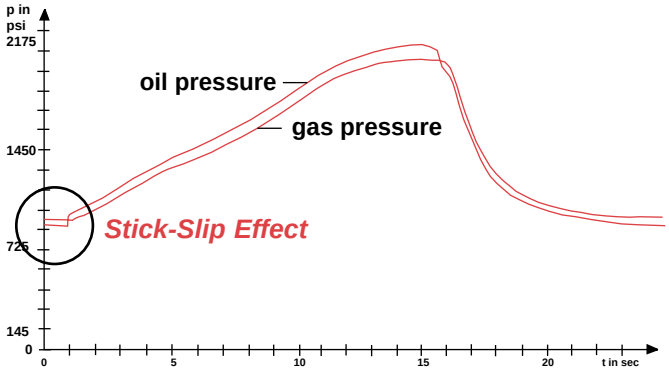
Small pressure differentials between gas and oil side improve the effectiveness of **HYDAC** piston accumulators. To emphasize the friction effect on the pressure curve during an accumulation cycle, measurements with various sealing systems are illustrated.

The measurement graphs below are a true representation of the gas and oil pressure of piston accumulators with different sealing systems. The comparison of these two measurements clearly shows the difference in the pressure differential between gas and oil side:

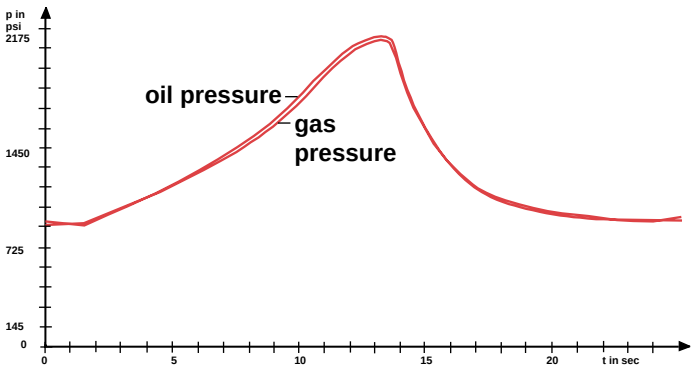
Graph 1: Δp max. $\approx$ 125 psi

Graph 2: Δp max. $\approx$ 14.5 psi

The effect of the sealing friction on the working pressure is particularly striking in traditional piston designs. Abrupt piston movements (the stick-slip effect) are caused by the seal friction as shown in Graph 1. The low sealing friction of **HYDAC** type 2 pistons drastically reduces the stick-slip effect therefore maximizing piston responsiveness.



Graph 1: Traditional piston designs



Graph 2: Piston Type 2 (low friction model)

Model Code

SK 350 - 20 / 2112 S - 210 F C F - V E - 18 _ - _

Series
SK 350 = 3000 psi
SK 600 = 5000 psi

Size *(in Liters, see tables on dimension pages to follow)*
4 = 4 Liters
...see tables on following pages for complete list of sizes, and which versions they are available in
300 = 300 Liters

Material and Piston Type

Piston Type *(see page 13)*
2 = Low Friction Model
3 = General Duty

Piston Material
1 = Aluminum
2 = Carbon steel *(machined)*
3 = Stainless steel
4 = Carbon steel with surface protection *(machined)*
5 = Steel *(cold impact formed)*

Cylinder and End Cap Material
1 = Carbon steel *(machined)*
2 = Carbon steel with surface protection *(machined)*
3 = Stainless steel
6 = Low temperature carbon steel *(< -20°F)*

Seal Material *(including piston seals)*
2 = NBR
6 = FPM *(fluoro-elastomer)*
8 = PUR *(Polyurethane)*

Compound	Oper. Temp Range	Typical Fluids
NBR	5° to 180°F	mineral oil,
NBR	32° to 180°F	mineral oil, water & water-glycols
PUR	14° to 180°F	mineral oil
FPM	5 to 300°F	chlorinated hydrocarbons

Country of Installation
S = USA
(for other countries see page 2 for proper code designation)

Maximum Working Pressure in bar *(based upon first choice - SERIES)*
210 = 3000 psi (SK 350)
345 = 5000 psi (SK 600)

Fluid Port Connection

Type of Connection *(refer to tables on the following page)*
A = Threaded, Female
F = Flanged

Standard / Specification of Type of Connection *(refer to tables on the following page)*
A, B, C, D

Size of Connection *(refer to tables on the following page)*
A, B, C, D, E, ...

Gas Side Connection

Type of Connection *(refer to tables on the following page)*
A = Threaded, Female
F = Flanged
V = Gas Valve

Standard/Specification of Type of Connection *(OMIT if V was chosen directly above, refer to tables on the following page)*
***(omit)*, A, B, C, D**

Size of Connection *(refer to tables on the following page)*
A, B, C, D, E, ...

Piston Diameter

06 = 60mm		**15** = 150mm	
08 = 80mm		**18** = 180mm	
10 = 100mm		**25** = 250mm	
12 = 125mm		**35** = 355mm	

Supplementary Equipment

A	= Electrical Limit Switch (35mm stroke)	**M**	= Magnetic flapper indication
B	= Electrical Limit Switch (200mm stroke)	**S**	= Cable tension measurement system
C	= Electrical Limit Switch (500mm stroke)	**U**	= Ultrasonic measurement system
K	= Protruding Piston Rod	**E...**	= Special switch[1] (fixed and adjustable)

Safety Devices

1 = Burst Disc (indicate nominal pressure)
2 = Gas safety valve
3 = Thermal fuse cap *(see page 38)*

*Model Codes containing red selections are non-standard items – Contact **HYDAC** for information and availability*
Not all combinations are available

1) Consult **HYDAC** for assistance with specifying switch details

Model Code Support Tables for Gas & Fluid Connections

Female Threaded Connections: (1 **code = A**(1 [ ](2 [ ](3

		A	B	C	D	E	F	G	H	J	K	L	M
A	BSPP (ISO 228)	G1/8	G1/4	G3/8	G1/2	G3/4	G1	G1 1/4	G1 1/2	G2	G2 1/2	G3	N/A
B	DIN 13 or ISO 965/1 (Metric)	M10x1	M12x1.5	M14x1.5	M16x1.5	M18x1.5	M22x1.5	M27x2	M33x2	M42x2	M48x2	M60x2	N/A
C	ANSI B1.1 (UN..-2B) Seal SAE J 514	5/16-24UNF	3/8-24UNF	7/16-20UNF	1/2-20UNF	9/16-18UNF	3/4-16UNF	7/8-14UNF	1 1/16-12UN	1 3/16-12UN	1 5/16-12UN	1 5/8 12UN	1 7/8 12UN
D	ANSI B1.20.3	1/16-27	1/8-27	1/4-18	3/8-18	1/2-14	3/4-14	1-11 1/2	1 1/4-11 1/2	1 1/2-11 1/2	2-11 1/2	2 1/2-8	N/A

1) use “A” as the first character of the connection code for all Female Threaded Connections.
2) Enter the letter of the ROW as the second character of the connection code.
3) Enter the letter of the COLUMN as the third character of the connection code.

Flange Connections: (4 **code = F**(4 [ ](5 [ ](6

		A	B	C	D	E	F	G	H	J	K	L	M
C	SAE Code 61 (3000 psi)	1/2”	3/4”	1”	1 1/4”	1 1/2”	2”	2 1/2”	3”	3 1/2”	4”	5”	N/A
D	SAE Code 62 (6000 psi)	1/2”	3/4”	1”	1 1/4”	1 1/2”	2”	N/A	N/A	N/A	N/A	N/A	N/A

4) use “F” as the first character of the connection code for all Flange Connections.
5) Enter the letter of the ROW as the second character of the connection code.
6) Enter the letter of the COLUMN as the third character of the connection code.

Gas Valve Connections: (7 **code = V**(7 *(omit)* (8 [ ](9

A	G 3/4 male with M28x1.5/M8 (standard HYDAC gas valve version 1)
E	G 3/4 male with 7/8-14 UNF-VG8 (standard HYDAC gas valve version 4)

7) use “V” as the first character of the connection code for all Gas Valve Connections.
8) OMIT the second character of the connection code.
9) Enter the letter of the ROW as the third character of the connection code.

Other Connections & Custom Solutions are Available:

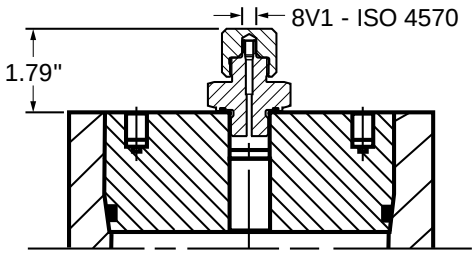
HYDAC has the capabilities to produce accumulators with many other types of connections. The options listed above are simply the most common, and most readily available. Other connection options include:

- Male threads
- Protruding flanges
- ANSI flanges
- DIN flanges
- Autoclave
- High Pressure Block FLANGE (Rexroth, AVIT, HAVIT) PN320

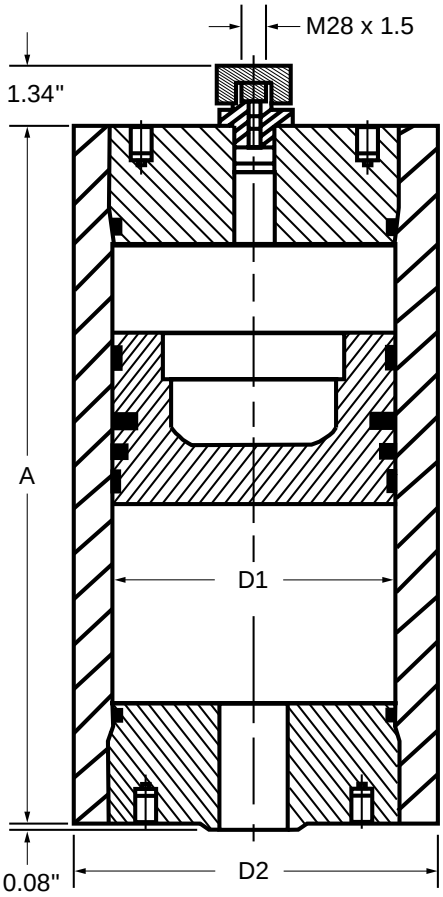
Custom solutions that incorporate valve/manifold assemblies are also available — for more information on special connections and custom solutions, consult factory.

Dimensions: PISTON ACCUMULATOR - Type 2

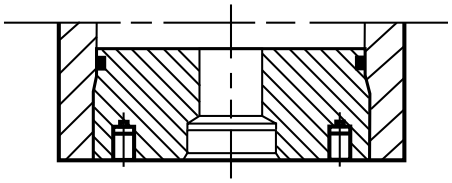
Gas Valve Version 4 (code designation VE)
Uses Charging Unit FPS



Gas Valve Version 1 (code designation VA)
Uses Charging Unit FPK



Flange Connection (code designation F_ _)
(specified by model code)



Threaded Connection (code designation A_ _)
(specified by model code)

SK 350 (maximum working pressure 5000 psi)

Size Liters	Effective Gas Volume Gallons	Weight lbs.	(kg)	A in.	(mm)	ØD1 in. (mm)	ØD2 in. (mm)
0.2	0.05	15	(7)	8.6	(218)	2.36 (60)	3.15 (80)
0.5	0.125	20	(9)	12.8	(325)		
1	0.25	26	(12)	19.8	(502)		
0.5	0.125	24	(11)	9.8	(250)	3.15 (80)	3.94 (100)
1	0.25	29	(13)	13.8	(350)		
2	0.5	40	(18)	21.7	(550)		
2.5	0.625	62	(28)	20.9	(532)	3.94 (100)	4.96 (126)
5	1.25	88	(40)	33.5	(850)		
7.5	1.875	115	(52)	46.1	(1170)		
2	0.5	82	(37)	13.6	(345)	4.92 (125)	6.30 (160)
5	1.25	115	(52)	23.2	(590)		
15	3.75	225	(102)	55.3	(1405)		
6	1.5	128	(58)	21.5	(545)	5.91 (150)	7.09 (180)
20	5	231	(105)	52.6	(1335)		
40	10	386	(175)	97.2	(2470)		

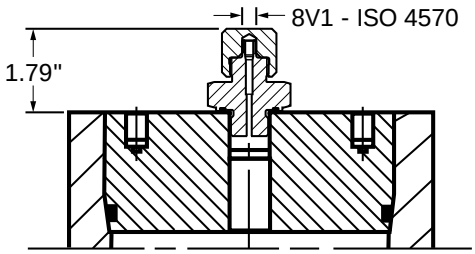
SK 350 (maximum working pressure 3000 psi)

Size Liters	Effective Gas Volume Gallons	Weight lbs.	(kg)	A in.	(mm)	ØD1 in. (mm)	ØD2 in. (mm)
10	2.5	233	(107)	28	(711)	7.09 (180)	8.62 (219)
16	4	283	(128)	37.2	(945)		
20	5	316	(143)	43.4	(1102)		
30	7.5	400	(181)	58.9	(1496)		
40	10	482	(219)	74.4	(1890)		
50	12.5	566	(257)	89.9	(2283)		
40	10	788	(357)	49	(1245)	9.84 (250)	12.21 (310)
50	12.5	882	(400)	57.1	(1450)		
60	15	974	(442)	65	(1651)		
75	20	1114	(505)	77.1	(1958)		
100	25	1347	(611)	97.1	(2466)		
115	30	1488	(675)	109.2	(2774)		
135	35	1676	(760)	125.3	(3183)		
150	40	1816	(824)	137.4	(3490)		
170	45	2004	(909)	152.4	(3871)		
190	50	2194	(994)	168.4	(4277)		
100	25	1859	(843)	61.9	(1572)	13.98 (355)	17.09 (434)
115	30	1986	(901)	67.9	(1725)		
150	40	2287	(1037)	81.8	(2078)		
190	50	2630	(1193)	97.7	(2482)		
250	65	3144	(1426)	121.6	(3089)		
300	80	3572	(1620)	141.5	(3594)		

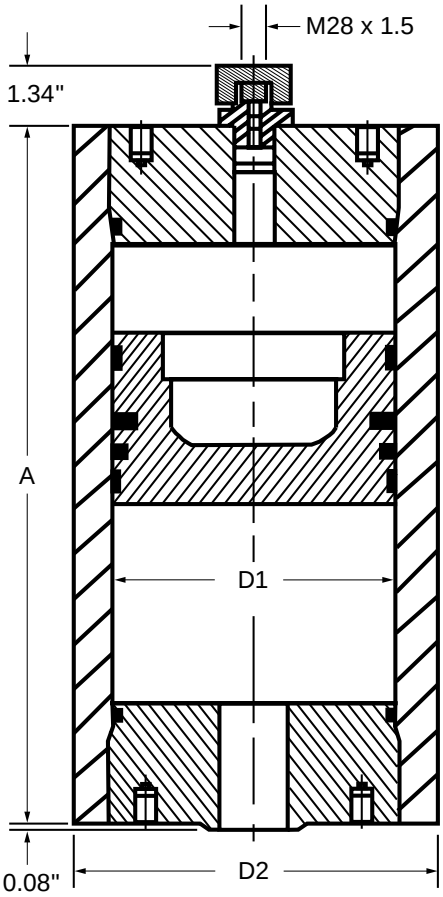
Note: Other Sizes available on request. Intermediate sizes are possible, depending on the length/diameter required. Please consult factory for details on special sizes.

Dimensions: PISTON ACCUMULATOR - Type 2

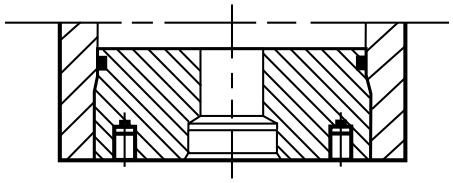
Gas Valve Version 4 (code designation VE)
Uses Charging Unit FPS



Gas Valve Version 1 (code designation VA)
Uses Charging Unit FPK



Flange Connection (code designation F_ _)
(specified by model code)



Threaded Connection (code designation A_ _)
(specified by model code)

SK 600 (maximum working pressure 5000 psi)

Size Liters	Effective Gas Volume Gallons	Weight lbs.	(kg)	A in.	(mm)	ØD1 in. (mm)	ØD2 in. (mm)
10	2.5	302	(137)	28	(711)		
16	4	402	(182)	37.2	(945)		
20	5	447	(203)	43.4	(1102)	7.09	9.61
30	7.5	606	(275)	58.9	(1496)	(180)	(244)
40	10	736	(334)	74.4	(1890)		
50	12.5	884	(401)	89.9	(2283)		
40	10	1110	(503)	49	(1245)		
50	12.5	1254	(569)	57.1	(1450)		
60	15	1396	(633)	65	(1651)		
75	20	1611	(731)	77.1	(1958)		
100	25	1969	(893)	97.1	(2466)	9.84	13.31
115	30	2184	(990)	109.2	(2774)	(250)	(338)
135	35	2472	(1121)	125.3	(3183)		
150	40	2689	(1220)	137.4	(3490)		
170	45	2977	(1350)	153.5	(3899)		
190	50	3265	(1481)	169.5	(4305)		

Description

Nitrogen Bottles are commonly used to increase the effective gas volume while keeping the size and cost of the piston accumulator at a minimum.

Model Code

SN330 B - 57 CC / 010 S - 210 EE

Series
- **SN 330** = Nitrogen Bottle (3000 psi MAWP)
- **SN 600** = Nitrogen Bottle (5000 psi MAWP)

Design Code*
- *(omit)* = Standard Nitrogen Bottle
- **B** = Based on Bladder Accumulator Shell
- **K** = Based on Piston Accumulator Shell
- **M** = Based on Diaphragm Accumulator Shell

Size*
- **54** = 54 Liters (5000 psi MAWP)
- **57** = 57 Liters (3000 psi MAWP)
- **100** = 100 Liters (3000 psi MAWP)

Connection Type

Connection 1 *(see table 1 on following page)*
- **A** = BSP (ISO 228)
- **B** = Metric (DIN 13 According to ISO 965/1)
- **C** = SAE (ANSI B1.1) *(standard)*
- **D** = NPT (ANSI B2.1)
- **F** = Flange

Connection 2 *(see table 1 on following page)*
- **A** = BSP (ISO 228)
- **B** = Metric (DIN 13 According to ISO 965/1)
- **C** = SAE (ANSI B1.1) *(standard)*
- **D** = NPT (ANSI B2.1)
- **F** = Flange

Material Code

Ports
- **0** = No Components *(standard)*
- **1** = Carbon steel
- **3** = Stainless steel (316)
- **4** = Carbon steel (coated)

Shell
- **1** = Carbon steel *(standard)*
- **2** = Carbon steel (coated)
- **4** = Stainless steel (316)

Seal Material
- **0** = No Elastomer *(standard)*
- **2** = NBR (Buna N)
- **4** = IIR (Butyl)
- **6** = FPM (Fluoro-elastomer)

Country of Installation
- **S** = USA

(for other countries see page 2 for proper code designation)

Maximum Working Pressure in bar ***(based upon third choice - SIZE)***
- **210** = 3000 psi (sizes 57 & 100)
- **345** = 5000 psi (size 54)

Connection Size *(see table 1 on following page)*

Connection 1

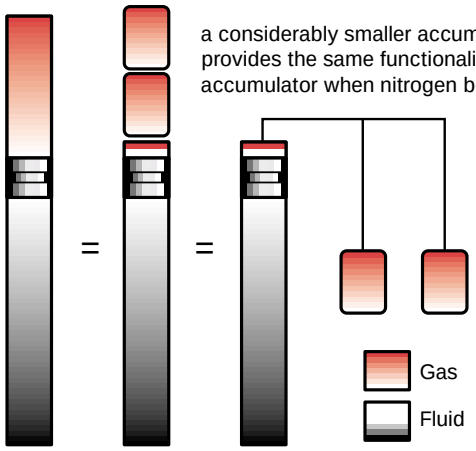
Connection 2

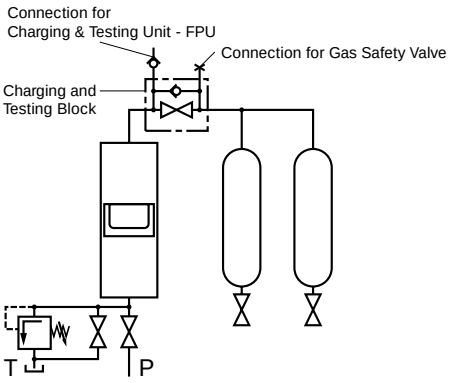
*Model Codes containing red selections are non-standard items – Contact **HYDAC** for information and availability*

Not all combinations are available

** Size offering listed is for standard nitrogen bottles. For Design Codes other than standard nitrogen bottles, refer to the model code of the accumulator type for sizes available.*

Typical Application





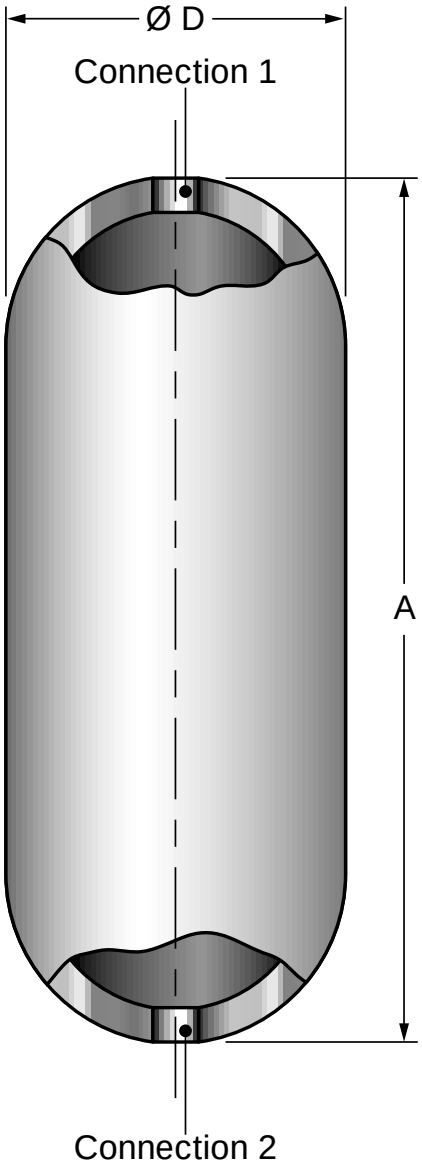


TABLE 1: Connections

Size	Connection Type				
	A BSP (ISO228)	B Metric (DIN 13 Acc.ISO 965/1)	C SAE (ANSI B1.1)	D NPT (ANSI B2.1)	F SAE Flange
A	G 1/4”	M 12 x 1.5	7/16”-20 UNF	1/4”	1/2” 3000 psi Code 61
B	G 3/8”	M 18 x 1.5	9/16”-18UNF	3/8”	3/4”-3000 psi Code 61
C	G 1/2”	M 22 x 0.5	3/4”-16UNF	1/2”	1” 3000 psi Code 61
D	G 3/4”	M 27 x 2	1 1/16”-12UN	3/4”	1 1/4” 3000 psi Code 61
E	G 1”	M 33 x 2	1 5/16”-12UN	1”	1 1/2” 3000 psi Code 61
F	G 1 1/4”	M 42 x 2	1 5/8”-12UN	1 1/4”	2” 3000 psi Code 61
G	G 1 1/2”	M 48 x 2	1 7/8”-12UN	1 1/2”	1/2” 6000 psi Code 62
H	G 2”	M 14 x 1.5	2 1/2”-12UN	2”	3/4” 6000 psi Code 62
I	G 1 3/4”	M 8	—	—	1” 6000 psi Code 62
J	—	—	—	—	1 1/4” 6000 psi Code 62
K	—	—	7/8”-14UNF	5/8”	1 1/2” 6000 psi Code 62
L	—	—	—	—	2” 6000 psi Code 62

TABLE 2: Dimensions

Size [MAWP]	Connections (1 and 2)	Vol. (Gallons)	Weight (lbs.)	A (inches)	D (inches)	Part Number
54 (5000 psi)	1 5/16-12UN	15	353	72”	9”	02050050
57 (3000 psi)	1 5/16-12UN	15	247	72”	9”	02108665
100 (3000 psi)	1 5/16-12UN	25	386	89.4”	10.5”	02050054

For dimensions of nitrogen bottles other than standard shells, please refer to the dimension tables for that particular type (Bladder, Piston, & Diaphragm)

Description

The pressure fluctuations occurring in hydraulic systems can be periodic or single occurrence problems due to:

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

Dampeners have two fluid connections for inline mounting. The volume of flow is directed straight at the bladder or diaphragm by diverting it in the fluid valve. This causes direct contact of the fluid flow with the bladder or diaphragm which, in an almost inertialess operation, balances the flow rate fluctuations via the gas volume. It is particularly effective with higher frequency oscillations. The gas pre-charge pressure is adjusted for the specific systems operating conditions.

Construction

HYDAC pulsation dampeners consist of:

- The welded or forged pressure vessel in carbon steel; for chemically aggressive fluids they are available in coated carbon steel or stainless steel
- The special fluid valve with inline connection, which guides the flow into the vessels (threaded or flange connections available)
- The bladder or diaphragm in various compounds as listed below

Compound Materials

Not all fluids are compatible with every elastomer at all temperatures. Therefore, **HYDAC** offers the following choice of elastomers:

- **NBR** (Standard Nitrile)
- **LT-NBR** (Low Temperature Nitrile)
- **ECO** (Epichlorohydrin)
- **IIR** (Butyl)
- **FPM** (Fluorelastomer)
- others (available upon request)

To determine which material is appropriate...
ALWAYS REFER TO FLUID MANUFACTURER'S RECOMMENDATION

Corrosion Protection

For use with certain aggressive or corrosive fluids, or in a corrosive environment, **HYDAC** offers protective coatings and corrosive resistant materials (i.e. stainless steel) for the accumulator parts that come in contact with the fluid, or are exposed to the hostile environment.

Mounting Position

The mounting position of hydraulic dampeners is dependent on the dampener chosen and the specific application. The preferred position is typically vertical.

System Mounting

Dampeners should be mounted as close as possible to the pulsation source.

Applications

Pulsation dampeners are used to:

- Reduce vibrations caused by pipes, valves, couplings, etc. in order to prevent pipe and valve damage
- Protect measurement instruments and eliminate the impaired performance caused by pulsations
- Reduce system noise
- Increase machine performance
- Allow the connection of multiple pumps to one line
- Increase the allowable rpm and feed pressure of pumps
- Reduce system breakdowns and increase the service life of the system

See illustration on page 25 for a graphic representation of a pressure spike with and without an accumulator being used as a shock absorber.

Model Code

SBXXX P 10 A 1 112 S 210 AI 010

Series

SB *XXX* = Bladder Style (XXX = series designation)
SBO *XXX* = Diaphragm Style (XXX = series designation)
(see tables on following pages for most common series and size selections)

Design

P = Pulsation Dampener
PH = Pulsation Dampener/High Flow
S = Suction Stabilizer

Size *(in Liters, see tables on dimension pages to follow)*

Type of Connection

A = Threaded
E = Threaded *(for SBO welded design only)*
F = Flanged

Gas Port

For series SB
1 = HYDAC gas valve version 4 (BV1-I504570)
For series SBO
1 = HYDAC gas valve version 1 (M28x1.5)
4 = HYDAC gas valve version 4 (BV1-I504570)
6 = HYDAC gas valve version 1(M28x1.5/ for SBO design only)

Material Code

Depending on application
112 = Standard for oil service *(mineral oil)*

Fluid port
1 = Carbon steel
3 = Stainless steel
6 = Low temperature carbon steel (< -20°F)

Shell
0 = Synthetic coated carbon steel *(internal/water service)*
1 = Carbon steel
2 = Chemically plated carbon steel *(internal/water service)*
4 = Stainless steel
6 = Low temperature carbon steel (< -20°F)

Bladder/diaphragm compound
2 = NBR *(Buna N)*
3 = ECO *(hydrin)*
4 = IIR *(Butyl)*
5 = NBR *(Low temperature Buna N)*
6 = FPM (Fluoro-elastomer)
7 = Others

Country of Installation

S = USA
Others upon request (see page 2 for other country codes)

Maximum Work Pressure

210 = 3000 psi
345 = 5000 psi

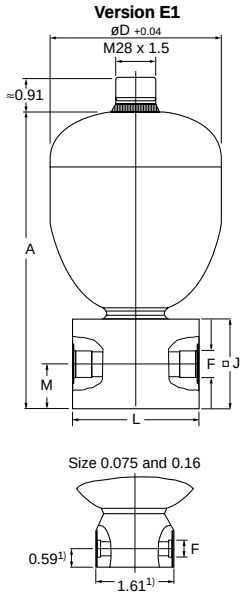
Fluid Port Connection

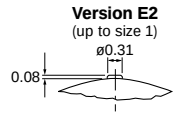
Threaded: **AI** = BSPP (ISO 228)
CI = SAE (ANSI B1.1)
Flanged: **FI** = SAE 1 1/2" - 6000 psi (code 62)

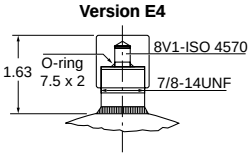
Precharged Pressure (P_0) in bar

*Model Codes containing red selections are non-standard items – Contact **HYDAC** for information and availability*
Not all combinations are available

Dimensions: Welded Diaphragm Type







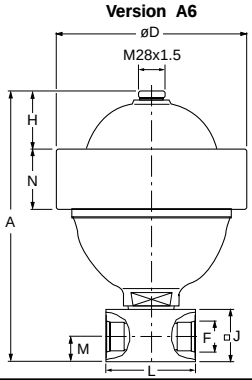
Series	Size	Gas Volume (in³)	Max. working pressure		Weight (lbs)	A (in)	øD[3] (in)	Thread F		□J (in)	L (in)	M (in)	Q[2] (gpm)
			psi	bar				SAE	BSP				
SB0250	0.075	5	3600	250	2.2	4.57	2.52	9/16-18UNF	ISO 228-G1/4	-	-	-	5
SB0210	0.16	10	3000	210	2.5	5.04	2.91	9/16-18UNF	ISO 228-G1/4	-	-	-	5
SB0210	0.32	20	3000	210	5.8	5.96	3.66	3/4-16UNF	ISO 228-G1/2	1.97	3.15	0.99	10
SB0210	0.5	30	3000	210	8.7	6.51	4.13	3/4-16UNF	ISO 228-G1/2	1.97	3.15	0.99	10
SB0330	0.6	36	4700	330	12.3	7.74	4.53	1 5/16-12UNF	ISO228-G 1	2.36	4.13	1.18	40
SB0210	0.75	45	3000	210	11.2	7.58	4.76	1 5/16-12UNF	ISO228-G 1	2.36	4.13	1.18	40
SB0200	1	60	3000	210	12.9	8.02	5.35	1 5/16-12UNF	ISO228-G 1	2.36	4.13	1.18	40
SB0210	2	120	3000	210	19.6	9.47	6.57	1 5/16-12UNF	ISO228-G 1	2.36	4.13	1.18	40

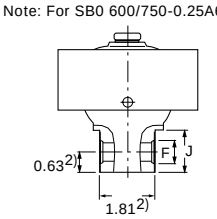
[1] For SAE-Threads only

[2] Pressure loss at Q (viscosity 32 cSt) approx. 50 psi

[3] Diameter at electron-beam weld may be up to + 0.150" larger

Dimensions: Threaded Diaphragm Type





Series	Size	Gas Volume (in²)	Max. working pressure		Weight (lbs)	A (in)	øD (in)	Thread F		H (in)	J (in)	L (in)	M (in)	N (in)	Q[3] (gpm)
			psi	bar				SAE	BSP						
SB0350[1]	0.25	15	5000	350	11.5	6.30	4.53	3/4-16UNF	ISO 228-G1/2	0.70	□1.97	3.15	0.99	2.17	10
SB0500	0.25	15	7200	500	11.5	6.30	4.53	3/4-16UNF	ISO 228-G1/2	0.70	□1.97	3.15	0.99	2.17	10
SB0600[1]	0.25	15	8700	600	22.7	6.77	6.02	3/4-16UNF	ISO 228-G1/2	0.60	□2.17	2.16	0.71	2.48	10
SB0750	0.25	15	10000	750	22.7	6.77	6.02	3/4-16UNF	ISO 228-G1/2	0.60	□2.17	2.16	0.71	2.48	10
SB0250[1]	0.6	36	3600	250	17.6	8.31	5.51	1 5/16-12UNF	ISO228-G 1	1.77	□2.36	4.13	1.18	2.24	40
SB0330	0.6	36	4700	330	17.6	8.31	5.51	1 5/16-12UNF	ISO228-G 1	1.77	□2.36	4.13	1.18	2.24	40
SB0210	1.3	80	3000	210	23.7	10.26	6.69	1 5/16-12UNF	ISO228-G 1	2.45	□2.36	4.13	1.18	2.17	40
SB0400	1.3	80	5800	400	29.7	10.47	7.83	1 5/16-12UNF	ISO228-G 1	1.97	□2.36	4.13	1.18	2.56	40
SB0180[1]	2	120	2600	180	30.1	11.52	7.83	1 5/16-12UNF	ISO228-G 1	2.54	□2.36	4.13	1.18	2.40	40
SB0250	2	120	3600	250	34.0	11.75	6.60	1 5/16-12UNF	ISO228-G 1	2.54	□2.36	4.13	1.18	2.52	40

[1] Only available in stainless steel

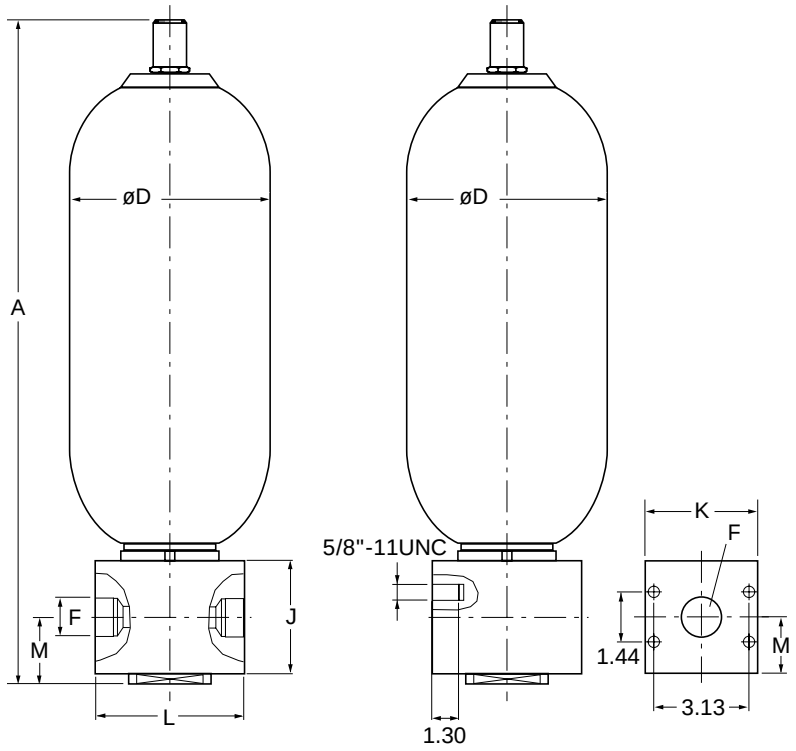
[2] For SAE-Threads only

[3] Pressure loss at Q (viscosity 32 cSt) approx. 50 psi

Dimensions: Bladder Type

Threaded connection
(Size 1/4 and 1 gal.)

Flanged connection
(Size 2 1/2 and 10 gal.)



Series: SB 330 P (max. working pressure 3000 psi)

Size	Vol. (gal)	Gas Volume (in²)	Weight (lbs)	A (in)	øD (in)	Connection F	J (in)	K (in)	L (in)	M (in)	Q[1] (gpm)
1	1/4	66	24	14.4	4.6	ISO 228-G1 1/4	3.15	3.15	4.72	2.24	80
4	1	226	40	18.0	6.6	ISO 228-G1 1/4	3.15	3.15	4.72	2.24	80
10	2 1/2	566	90	24.4	9.0	SAE 1 1/2" - 6000 psi (code 62 SAE)	3.94	4.50	6.69	3.35	140
20	5	1125	154	36.3	9.0	SAE 1 1/2" - 6000 psi (code 62 SAE)	3.94	4.50	6.69	3.35	140
32	10	2080	220	56.9	9.0	SAE 1 1/2" - 6000 psi (code 62 SAE)	3.94	4.50	6.69	3.35	140

[1]Pressure loss at Q (viscosity 32 cSt) approx. 50 psi

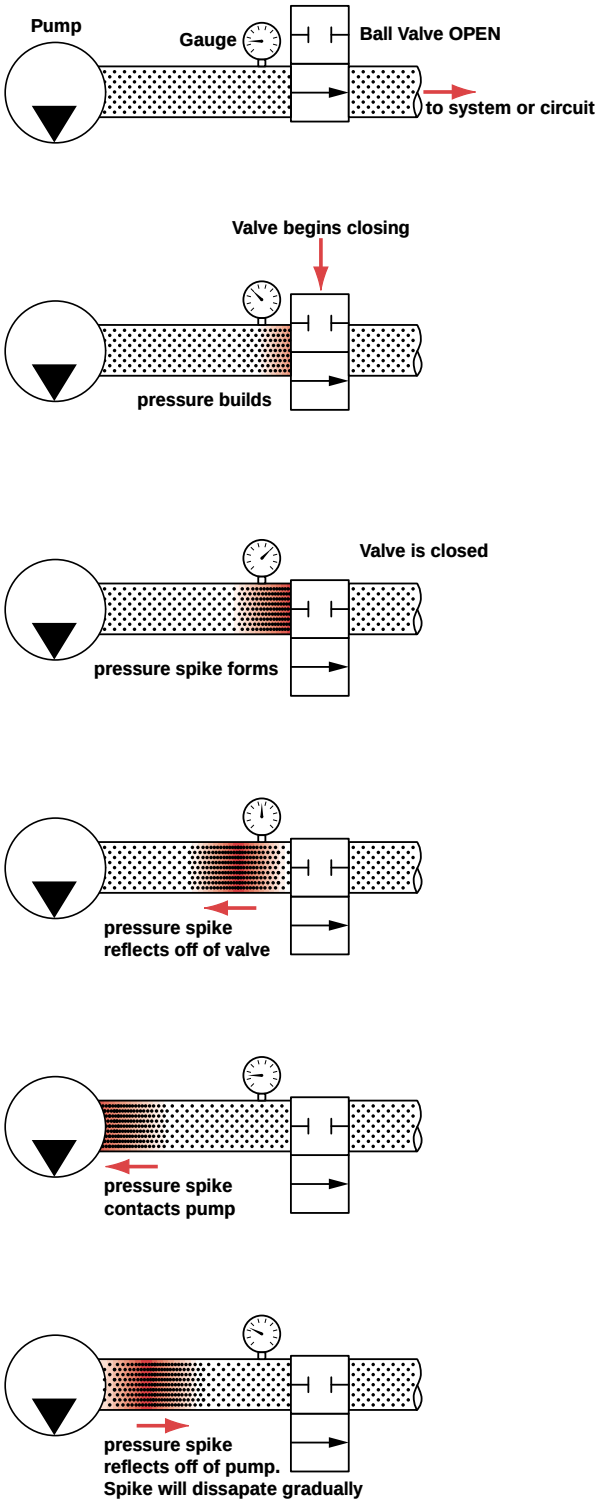
Series: SB 600 P (max. working pressure 5000 psi)

Size	Vol. (gal)	Gas Volume (in²)	Weight (lbs)	A (in)	øD (in)	Connection F	J (in)	K (in)	L (in)	M (in)	Q[1] (gpm)
1	1/4	66	24	14.4	4.6	ISO 228-G1 1/4	3.15	3.15	4.72	2.24	80
4	1	226	49	18.0	6.6	ISO 228-G1 1/4	3.15	3.15	4.72	2.24	80
10	2 1/2	566	102	24.4	9.1	SAE 1 1/2" - 6000 psi (code 62 SAE)	3.94	4.50	6.69	3.35	140
20	5	1125	183	36.3	9.1	SAE 1 1/2" - 6000 psi (code 62 SAE)	3.94	4.50	6.69	3.35	140
32	10	2080	269	56.9	9.1	SAE 1 1/2" - 6000 psi (code 62 SAE)	3.94	4.50	6.69	3.35	140

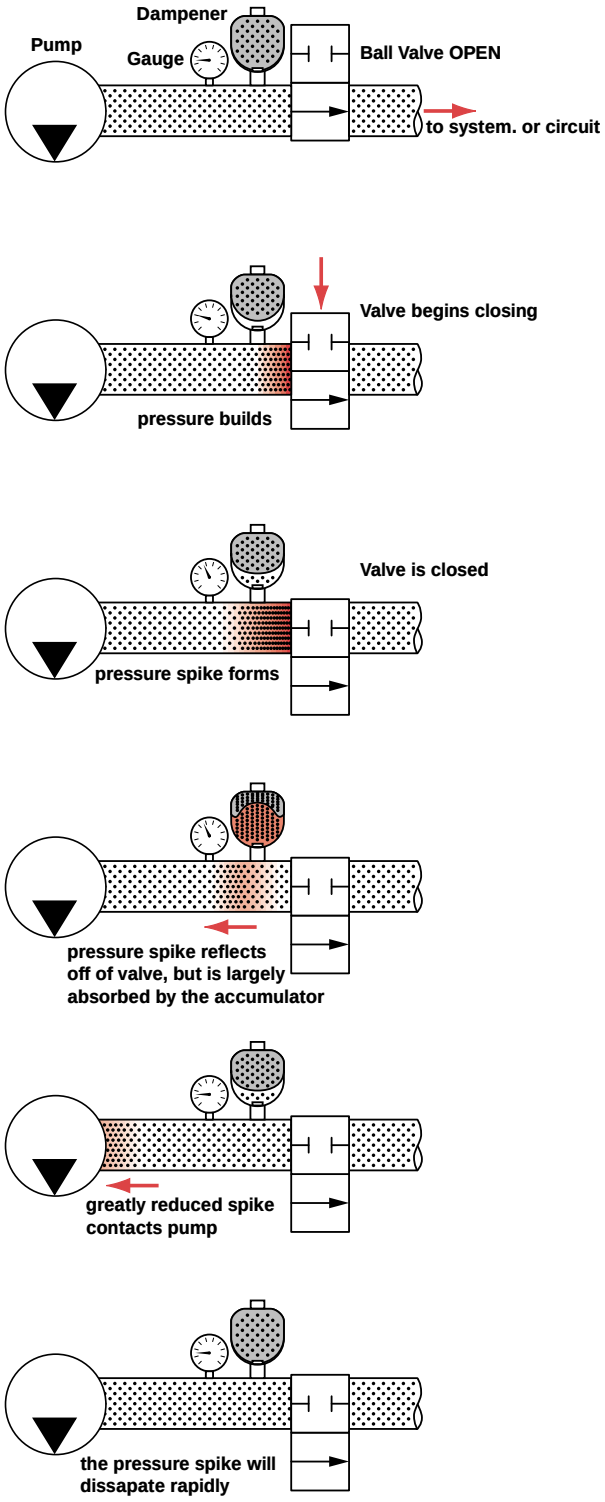
[1]Pressure loss at Q (viscosity 32 cSt) approx. 50 psi

Graphic Example of a Pressure Spike

Without Accumulator



With Accumulator



for assistance in sizing pulsation dampeners, shock absorbers, and suction stabilizers, please contact the HYDAC Accumulator Group at **1-877-GO HYDAC.**

General
All displacement pumps such as axial and radial piston pumps, vane, gear or screw pumps produce volume and pressure fluctuations which show up as vibrations and noises. Noise is not only produced and transmitted by the pump but it is also the result of mechanical vibration and vibration caused by the fluid pulsations, which are amplified when transmitted to larger areas. 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.

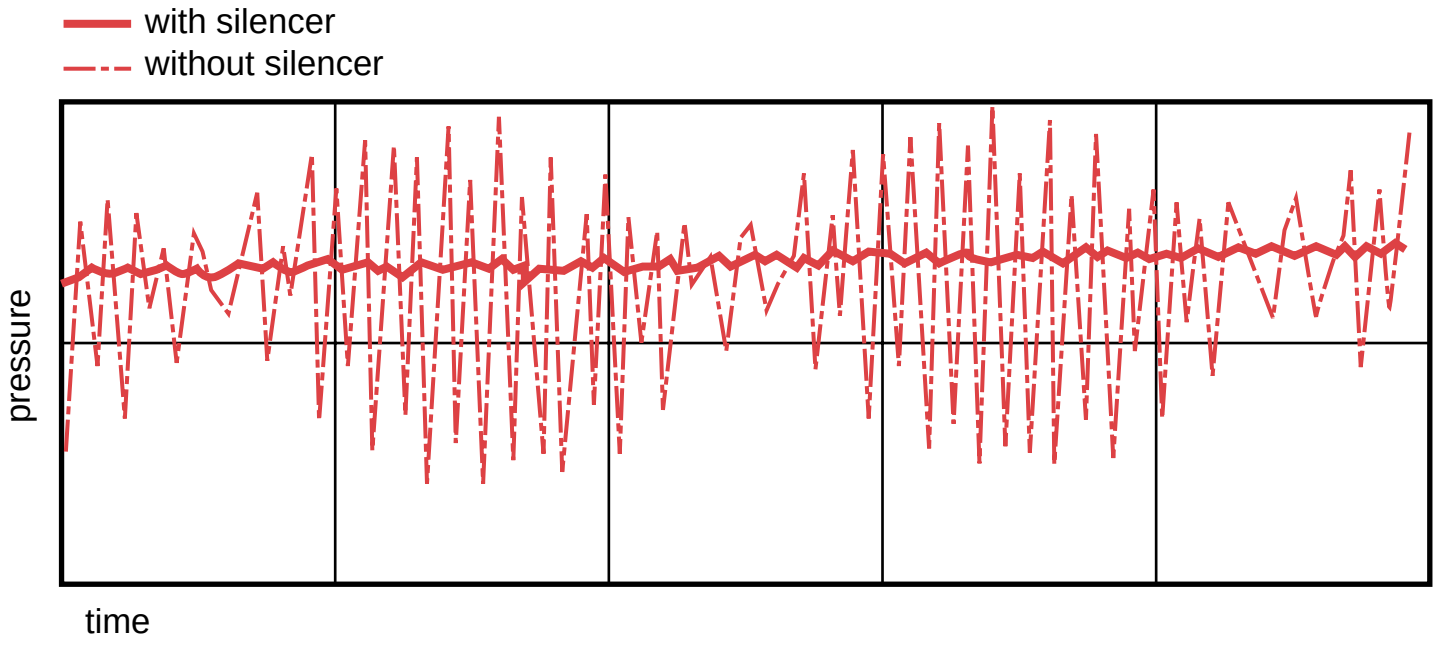
Applications
Vehicles, machines tools, plastics machinery, ships, hydraulic power stations, and other systems with large “surface” are all applications where the noise level can be reduced.

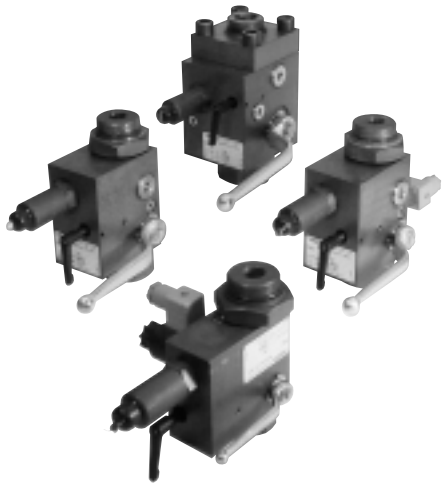
Description
The **HYDAC** Fluid Silencer is based on the principle of an expansion chamber with internal tube. By reflection of the oscillations within the silencer the majority of the oscillations are dampened across a wide frequency spectrum.

Construction
The **HYDAC** Fluid Silencer consists of a welded or forged external housing, an internal tube, and system connections on opposite sides. The silencer has no moving parts and no gas charge and is therefore is absolutely maintenance free. The **HYDAC** Fluid Silencer can be used for minerals oils, phosphate ester, and water glycol. A stainless steel model is available for other fluids.

Mounting
It is recommended that one connection side is joined via a flexible hose in order to reduce the transmission of mechanical vibrations. The mounting position of the dampener is optional, whereby the flow direction has to be taken into account.

For Assistance selecting the proper silencer for your applications, please Contact HYDAC at 1-877-GO HYDAC.





Description

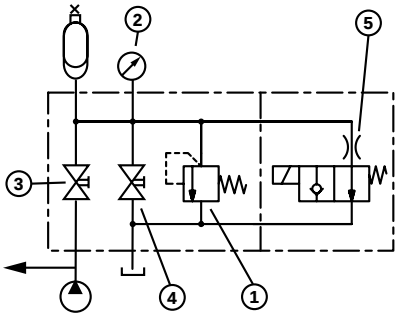
HYDAC safety and shut-off blocks are designed to protect, shut-off, and discharge hydraulic accumulators or user units. The compact design simplifies the hydraulic system connection and offers the following advantages:

- minimum space compared to individual components
- reduced installation time
- various system connections
- system lockout

Safety & Shut-off Block Features:

1 – pressure relief valve
2 – pressure gauge (optional)
3 – main shut-off valve
4 – manual bleed valve
5 – 2-way solenoid operated bleed valve (optional)

Circuit Diagram



Note: When using hydro-pneumatic accumulators for stored hazardous energy, **HYDAC** recommends the use of its Safety and Shut-off Block (SAF) with **solenoid operated** bleed valve.

Technical Specifications

Fluids
Mineral oil, hydraulic oil, water glycol, non-flammable fluids (other fluids upon request)

Temperature (for carbon steel)
5º F to 180º F (-15º C to 80º C)

Maximum Working Pressure
up to 5800 psi (400 bar)

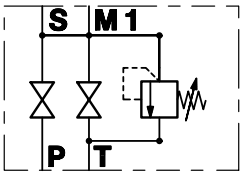
Construction

The Safety and Shut-off Block consists of a valve block, a built-in pressure relief valve, a main shut-off valve, and a manually operated bleed valve. In addition, an optional solenoid operated bleed valve allows automatic release of the accumulator or user unit and therefore of the hydraulic system in an emergency or during shut-down. The necessary return line connection is provided in addition to the gauge connection.

Standard Models

Model with manually operated bleed valve

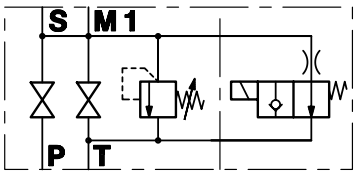
The basic model type “M” contains a manually operated bleed valve for manual pressure release of the accumulator.



Sizes: SAF 10 M
SAF 20 M
SAF 32 M

Model with solenoid operated bleed valve

In addition to the features of the type “M” block, the type “E” model also contains a solenoid operated bleed valve for automatic pressure release of the accumulator.



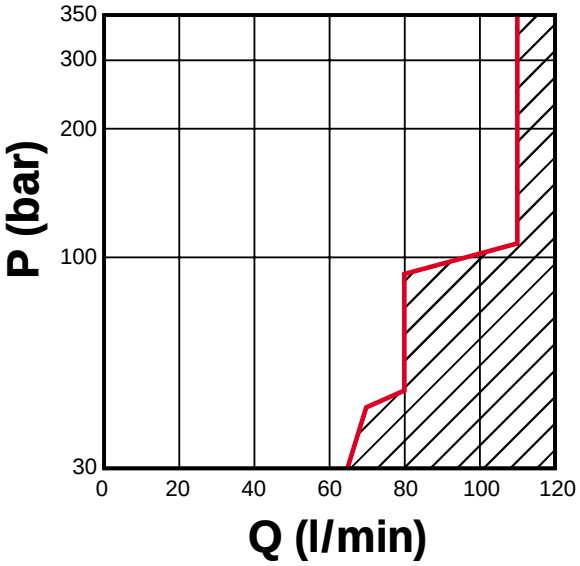
Sizes: SAF 10 E
SAF 20 E
SAF 32 E

Connections

S – Accumulator Connection
P – System Connection
T – Tank Connection
M1 – Gauge Connection

Pressure Relief Valve (DB12)

This valve cannot be set to values in the shaded area



Model Code: SAF Safety & Shut-off Blocks

SAF 20 E 1 6 Y 1 - N 250 C - S 60 L

Designation

Safety and Shut-off Block

Size of main shut-off valve

10 = DN 10
20 = DN 20
32 = DN 32

Model

M = Manual discharge
E = Solenoid operated and manual discharge

Block Material

1 = Carbon Steel

Seal Material

6 = FPM (Fluoro-elastomer)

2-Way Solenoid Operated Bleed Valve

Operating Function

(omit) = if manual discharge was selected
Y = Normally Open (standard) (2SV5E2Y)
Z = Normally Closed (2SV5E2Z)

Solenoid

(omit) = if manual discharge was selected
1 = 24 VDC
2 = 110 VAC – 60 Hz

Pressure Relief Valve (HYDAC DB12)

N 250 = Adjustable up to max pressure of 250 bar (3625 psi)
N 350 = Adjustable up to max pressure of 350 bar (5075 psi)
T XXX = Factory set and lead sealed, CE certified Safety Relief Valve, non-adjustable (xxx is pressure in bar)

Connection Type

Threaded:

A = BSPP (ISO 228)
C = SAE (ANSI B 1.1) (standard)

Flanged (SAF 32 only):

E = SAE 2” – 3000 psi (Code 61)
F = SAE 1-1/2” – 6000 psi (Code 62)

S Adapter (required only for safety and shut-off blocks with threaded connection)

	SAE: (connection type C)			**BSPP:** (connection type A)		
For Sizes 10 & 20	S 60	=	1 1/16”-12UN	S 10	=	G3/4”
	S 62	=	1 5/8”-12UN	S 11	=	G1”
	S 63	=	1 7/8”-12UN	S 12	=	G1 1/4”
	S 64	=	3/4”-16UNF	S 13	=	G2”
For Size 32	S 620	=	1 5/8”-12UN	S 309	=	G2”
	S 630	=	1 7/8”-12UN			

(see section 4 - others upon request)

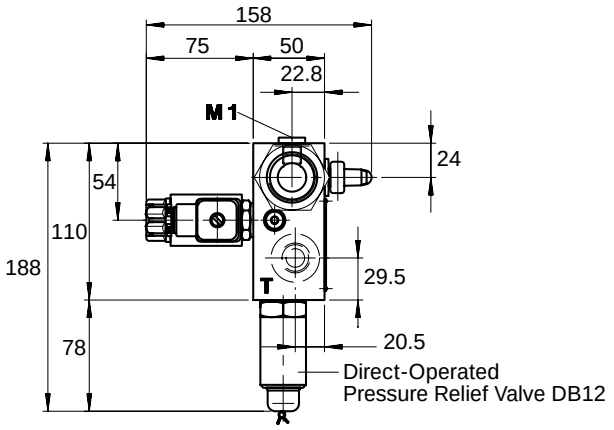
Locking Device (if required)

L

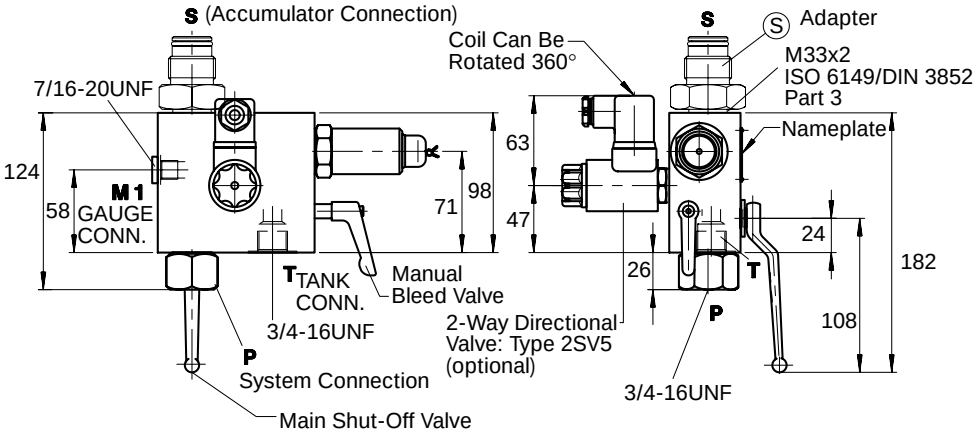
*Model Codes containing red selections are non-standard items – Contact **HYDAC** for information and availability*
Not all combinations are available

Dimensions: SAF 10 M/E...C

Type	Approximate Weight kg	(lbs.)
SAF 10 M	4.2	(9.3)
SAF 10 E	4.6	(10.1)

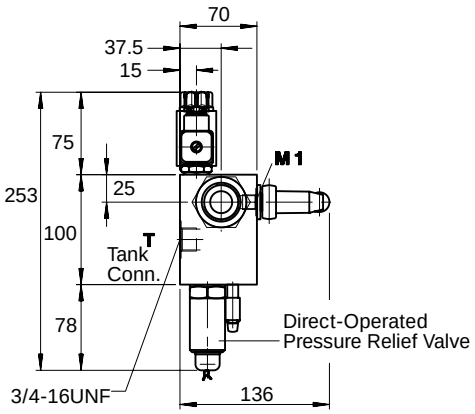


Dimensions in millimeters.
Note: for "M" Type block the 2-way directional valve is replaced with a plug

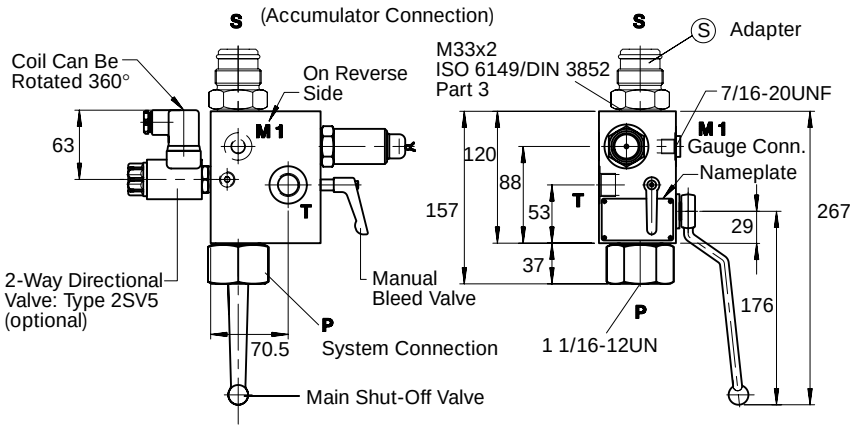


Dimensions: SAF 20 M/E...C

Type	Approximate Weight kg	(lbs.)
SAF 20 M	6.8	(15.0)
SAF 20 E	7.2	(15.8)



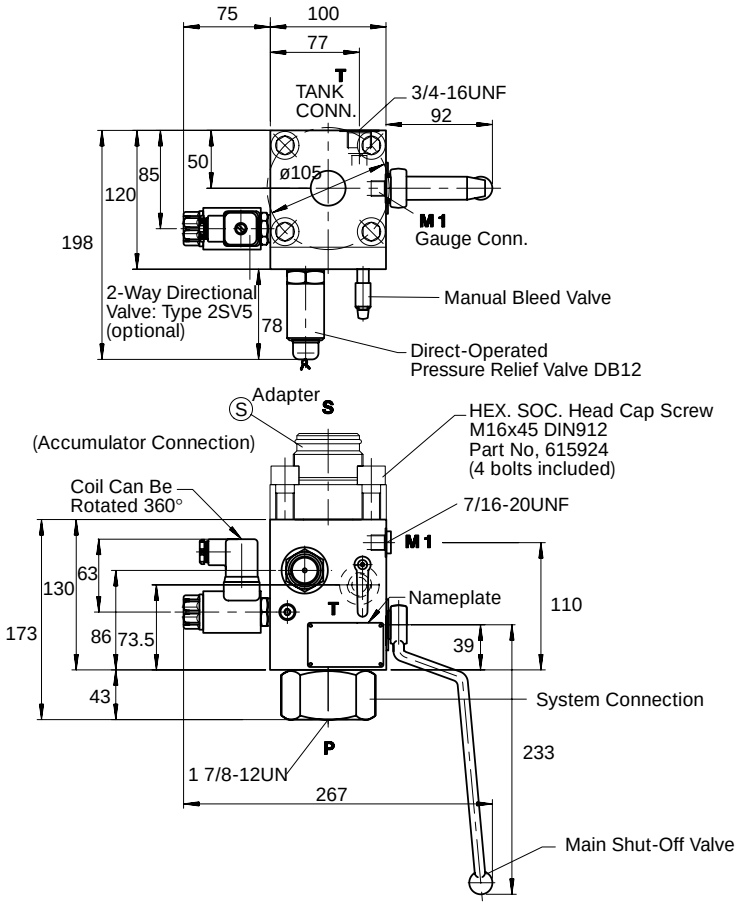
Dimensions in millimeters.
Note: for "M" Type block the 2-way directional valve is replaced with a plug



Dimensions: SAF 32 M/E...C

Type	Approximate Weight kg	(lbs.)
SAF 32 M	12.0	(26.4)
SAF 32 E	12.4	(27.2)

Dimensions in millimeters.
Note: for "M" Type block the 2-way directional valve is replaced with a plug

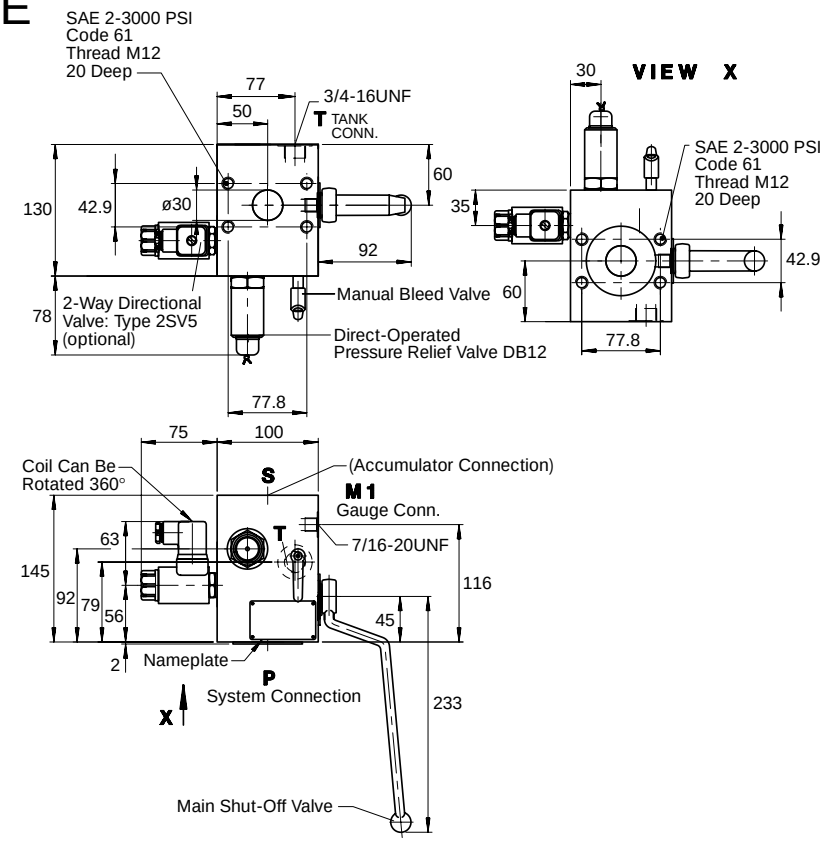


Dimensions: SAF 32 M/E...E

Type	Approximate Weight kg	(lbs.)
SAF 32 M	15.0	(33.1)
SAF 32 E	15.4	(33.9)

*Hexagonal socket head cap screws M 12x35-DIN 912 (Part HYDAC No. 00602100 have to be ordered separately

Dimensions in millimeters
Note: for "M" Type block the 2-way directional valve is replaced with a plug

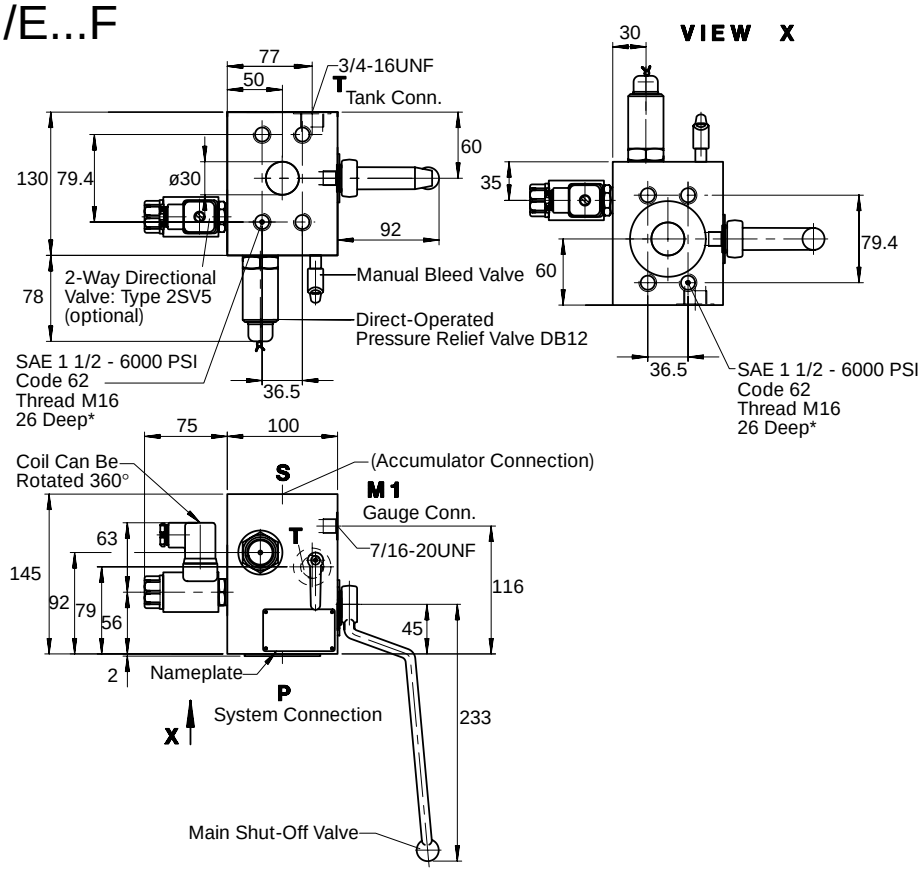


Dimensions: SAF 32 M/E...F

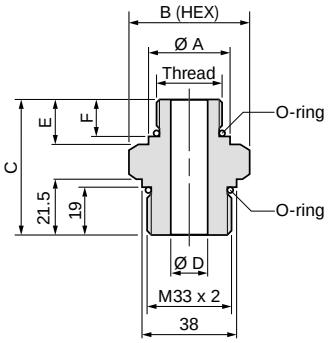
Type	Approximate Weight kg	(lbs.)
SAF 32 M	15.0	(33.1)
SAF 32 E	15.4	(33.9)

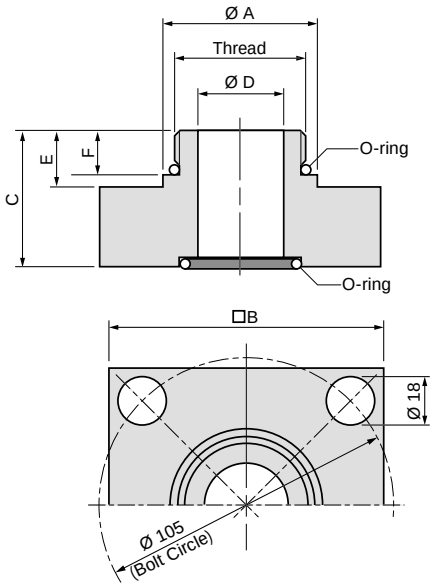
*Hexagonal socket head cap screws M 16x55-DIN 912 (Part HYDAC No. 00601496 have to be ordered separately

Dimensions in millimeters
Note: for "M" Type block the 2-way directional valve is replaced with a plug



Dimensions: S Adapters



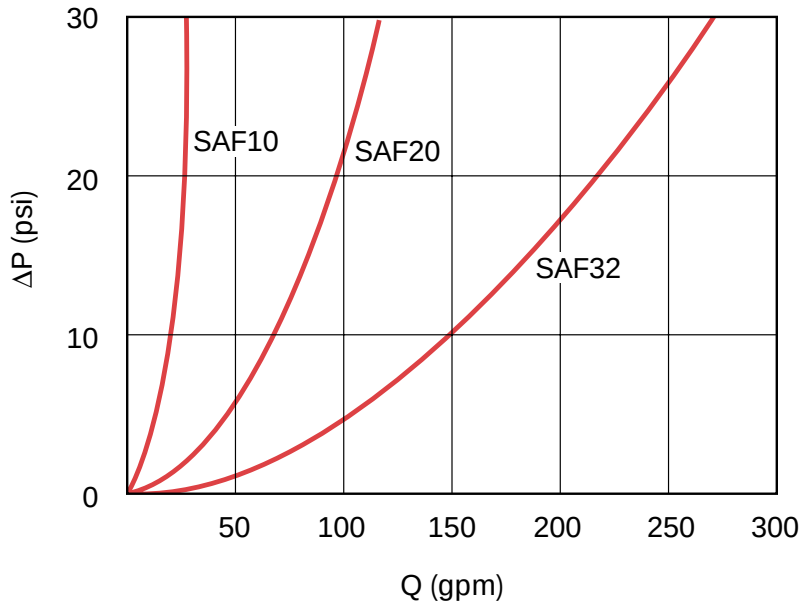


Type SAF	Accumulator Type	Adapter	Fig.	Thread	A	B	C	D	E	F
SAF 10/20	SB330-Size 1 / SBO-Size 2 to 3.5	S 60	1	1 1/16-12 UN	32	41	55	14	19	15
	SB330-Size 4 to 6 / SB600-Size 1 to 4	S 62	1	1 5/8-12 UN	48	66	57	23	19	15
	SB330/600-Size 10 to 54	S 63	1	1 7/8-12 UN	54	66	57	23	19	15
	SBO-Size 0.32 to 1.4	S 64	1	3/4-16 UNF	23	41	51	10	15	11
SAF 32	SB330-Size 4 to 6 / SB600-Size 1 to 4	S 620	2	1 5/8-12 UN	48	100	49	22	19	15
	SB330/600-Size 10 to 54	S 630	2	1 7/8-12 UN	54	100	49	30	19	15

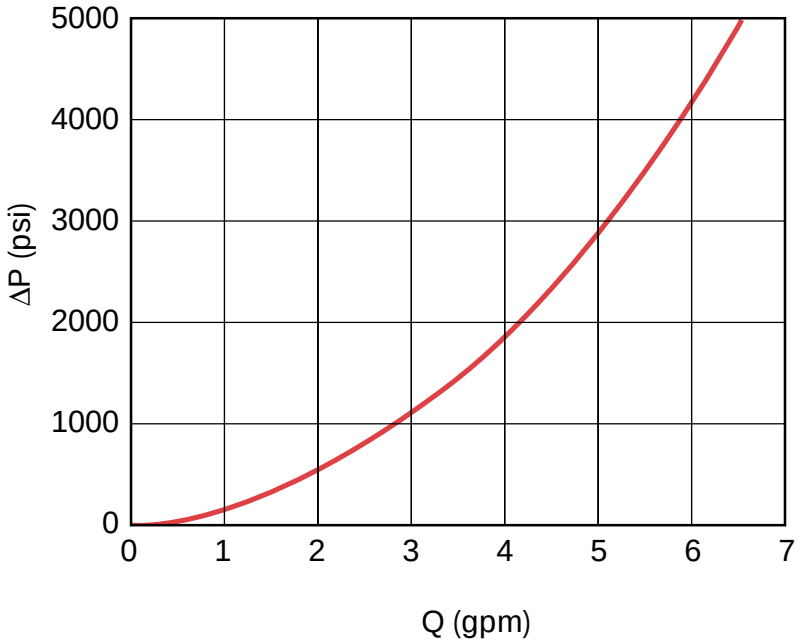
Dimensions In millimeters

Pressure Drops: SAF Blocks

Through Main Shut-off Valve



Through Solenoid Valve



Mounting Components

HYDAC mounting components are used to mount all types of hydro-pneumatic accumulators safely and simply, regardless of the mounting position. Our wide range includes suitable mounting components for every type of static hydro-pneumatic accumulator.

Function

Mounting components are used primarily for the following:

- to fix the accumulator into its position
- to carry the weight of the accumulator
- to counteract the forces exerted by the hydraulic lines

Types

HYDAC offers three styles of clamps:

- HyRac
- Regular Duty (HS)
- Heavy Duty (HSS)

Additionally, for larger accumulators, **HYDAC** offers:

- Base Brackets (KBK & KMS)
- Mounting Sets (SEB)

Refer to the illustrations and photos to the right.

Construction

They are constructed out of zinc-plated sheet steel or stainless steel strap (depending on style), utilizing a rubber insert to absorb vibration.

The HyRac and regular duty have a one piece construction with center adjustment.

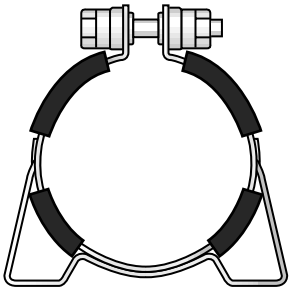
Conversely, the heavy duty clamps have a two piece construction. This allows for easy installation and removal while improving the strength to weight ratio.

HYDAC also offers base brackets for larger accumulators for proper support and isolation from system vibrations. The brackets incorporate a rubber support ring for this reason.

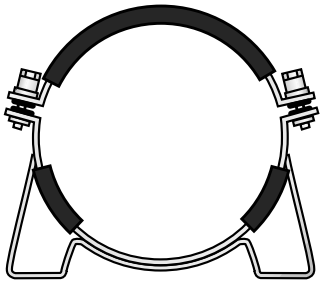
All mounting components can be easily bolted to your system.

Application guides are provided on the following pages to easily match the appropriate mounting components with **HYDAC** accumulators.

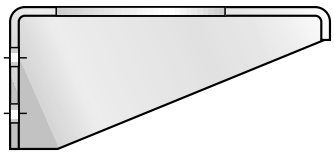
HS - Regular Duty Clamp:



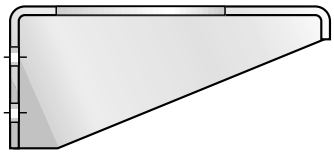
HSS - Heavy Duty Clamp:



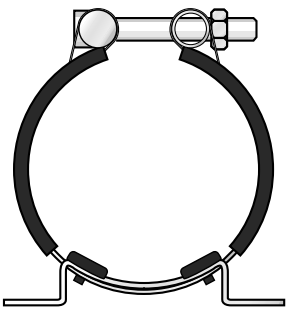
KBK - Base Bracket:



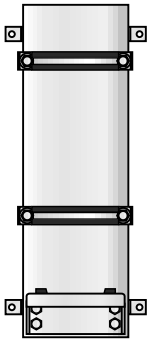
KMS - Base Bracket for threaded diaphragm:



HyRac Clamp:



SEB - Complete Mounting Sets:



Mounting Component Selection Guide

These are the mounting solutions that **HYDAC** recommends for Each Accumulator

Bladder Accumulators and Nitrogen Bottles

SB 330... & SN 330...

Accumulator Size (capacity)	Clamp Type (quantity)	Base Bracket Type
1 (0.25 gal)	HyRac 110-118 ST (1)	None
4 to 6 (1 to 1.5 gal)	HS 167 (1)	KBK 167/G
10 to 20 (2.5 to 5 gal)	HSS 222/229 (1)	KBK 222/G
32 to 54 (10 to 15 gal)	HSS 222/229 (2)	KBK 222/G

SB 600...

Accumulator Size (capacity)	Clamp Type (quantity)	Base Bracket Type
1 (0.25 gal)	HyRac 121-129 ST (1)	None
4 to 6 (1 to 1.5 gal)	HS 175 (1)	KBK 167/G
10 to 20 (2.5 to 5 gal)	HSS 222/229 (1)	KBK 222/G
32 to 54 (10 to 15 gal)	HSS 222/229 (2)	KBK 222/G

Piston Accumulators

SK 350... & SK 600...

Accumulator Piston Size[1]	Clamp Type (quantity)	Base Bracket Type
15 (150 mm)	consult factory	consult factory
18 (180 mm)	HSS 219 (2)	KBK 219
25 (250 mm)	HSS 310 (2)	KBK 310
35 (355 mm)	consult factory	consult factory

1) **Example:** SK 350 - 20 / 2112 S - 210 FCF - VE - **18** E - 1 (see page 15 for details)

Diaphragm Accumulators

SBO...E...(Welded type)

Accumulator Type	Clamp Type[2]
SBO 250-00.075 E	HyRac 62-65 ST
SBO 210-0.16 E	HyRac 73-76 ST
SBO 210-0.32 E	HyRac 89-92 ST
SBO 210-0.5 E	HyRac 100-105 ST
SBO 330-0.6 E	HyRac 110-118 ST
SBO 210-0.75 E	HyRac 121-129 ST
SBO 220-1 E	HyRac 133-142 ST
SBO 140-1.4 E	HyRac 143-151 ST
SBO 210-1.4 E	HyRac 152-159 ST
SBO 100-2 E	HyRac 160-167 ST
SBO 210-2 E	HS 167
SBO 210-2.8 E	HS 167
SBO 250-3.5 E	HS 167
SBO 330-0.75 E	HyRac 121-129 ST
SBO 330-1.4 E	HyRac 143-151 ST
SBO 330-2.0 E	HS 175
SBO 330-3.5 E	HS 175

SBO...A6...(Threaded type)

Accumulator Type	Clamp Type
SBO 350-0.25 A6	HyRac 110-118 ST
SBO 500-0.25 A6	HyRac 110-118 ST
SBO 250-0.6 A6	HyRac 133-142 ST
SBO 330-0.6 A6	HyRac 133-142 ST
SBO 600-0.25 A6	HyRac 143-151 ST
SBO 750-0.25 A6	HyRac 143-151 ST

Accumulator Type	Base Bracket Type
SBO 210-1.3 A6	KMS 200
SBO 400-1.3 A6	KMS 210
SBO 180-2 A6	KMS 220
SBO 250-2 A6	KMS 220

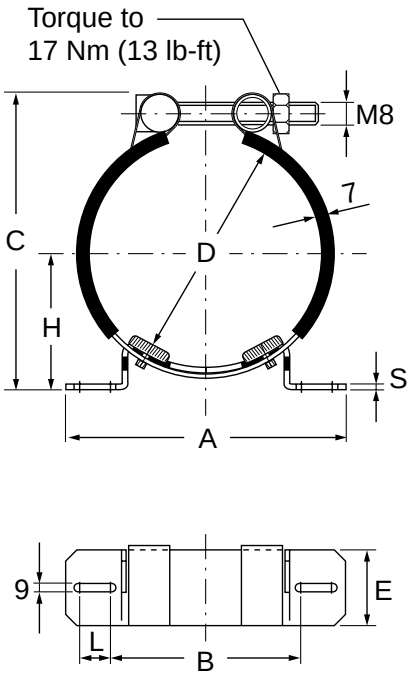
Note: Either one clamp or one Base Bracket is needed for each accumulator listed.

2) Only one clamp is needed for all accumulators listed.

Accumulator Clamps: Dimensions

Use the Selection Guide on page 34 to select the appropriate components.

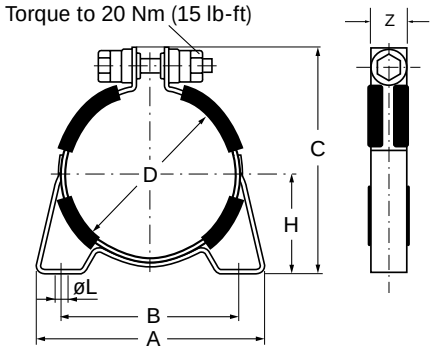
HyRac - Stainless Steel Strap with swivel-bolt adjustment



Clamp Model	A	B	C	D (range)	E	H	L	S	Weight kg.(lbs)
HyRac 62-65 ST	120 4.72	85 3.34	90 3.54	62-65 2.4-2.6	40 1.6	39-40.5 1.5-1.6	6 0.24	3 0.12	0.16 0.35
HyRac 73-76 ST	120 4.72	85 3.34	101 3.98	73-76 2.9-3.0	40 1.6	49.5-46 1.9-1.8	6 0.24	3 0.12	0.16 0.35
HyRac 89-92 ST	120 4.72	85 3.34	116 4.57	89-92 3.5-3.6	40 1.6	51.5-53 2.0-2.1	6 0.24	3 0.12	0.17 0.37
HyRac 100-105 ST	156 6.14	100 3.94	135 5.31	100-105 3.9-4.1	60 2.4	59-62 2.3-2.4	18 0.71	3 0.12	0.40 0.88
HyRac 106-114 ST	156 6.14	100 3.94	143 5.63	106-114 4.2-4.5	60 2.4	62.5-66 2.5-2.6	18 0.71	3 0.12	0.9 0.41
HyRac 110-118 ST	156 6.14	100 3.94	156 6.14	110-118 4.3-4.6	60 2.4	72.5-77 2.8-3.0	18 0.71	3 0.12	0.42 0.93
HyRac 121-129 ST	156 6.14	100 3.91	165 6.50	121-129 4.8-5.1	60 2.4	75.5-80 3.0-3.1	18 0.71	3 0.12	0.43 0.95
HyRac 133-142 ST	156 6.14	100 3.91	174 6.85	133-142 5.2-5.6	60 2.4	76.5-82 3.0-3.2	18 0.71	3 0.12	0.44 0.97
HyRac 143-151 ST	156 6.14	100 3.91	182 7.17	143-151 5.6-5.9	60 2.4	83-86.5 3.3-3.4	18 0.71	3 0.12	0.45 0.99
HyRac 152-159 ST	156 6.14	100 3.91	191 7.52	152-159 6.0-6.3	60 2.4	87-91 3.4-3.6	18 0.71	3 0.12	0.46 1.01
HyRac 160-167 ST	236 9.29	152 5.98	197 7.76	160-167 6.3-6.6	60 2.4	89-93 3.5-3.7	32 1.3	4 0.16	0.7 1.54
HyRac 202-210 ST	236 9.29	152 5.98	245 9.65	202-210 7.9-8.3	60 2.4	116-120 4.6-4.7	32 1.3	4 0.16	1.68 0.76
HyRac 209-217 ST	236 9.29	152 5.98	255 10.04	209-217 8.2-8.5	60 2.4	122.5-126.5 4.8-5.0	32 1.3	4 0.16	1.70 0.77

Dimensions in mm (inches shown below)

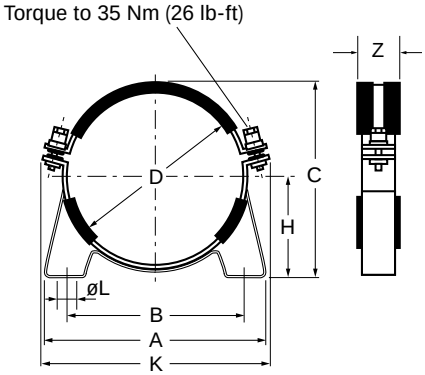
HS - Regular Duty Clamp, with single center adjustment



Clamp Model	D	D (range)	A	B	C(ref.)	H	ØL	Z	Weight kg.(lbs)
HS 167	167 6.57	164-170 6.46-6.69	185 7.28	153 6.02	211 8.31	92.5 3.64	9 0.35	30 1.18	0.9 2.0
HS 175	175 6.89	171-176 6.73-6.93	193 7.60	160 6.30	222 8.74	99.5 3.92	9 0.35	30 1.18	1.0 2.2

Dimensions in mm (inches shown below)

HSS - Heavy Duty Clamp with two-piece construction



Clamp Model	D	D (range)	A	B	C(ref.)	H	K	ØL	Z	Weight kg.(lbs)
HSS 219	219 8.62	216-222 8.50-8.74	268 10.55	216 8.50	240 9.45	123 4.84	285 11.22	15 0.59	40 1.57	1.7 3.8
HSS 222/229	226 8.90	220-231 8.66-9.10	270 10.63	216 8.50	244 9.61	123 4.84	295 11.61	15 0.59	40 1.57	1.7 3.8
HSS 242	242 9.53	231-242 9.10-9.53	268 10.55	216 8.50	265 10.43	136 5.35	305 12.01	15 0.59	40 1.57	1.7 3.8
HSS 286	286 11.26	283-289 11.14-11.38	332 13.07	280 11.02	314 12.36	163 6.42	355 13.98	15 0.59	40 1.57	2.1 4.6
HSS 310	310 12.20	307-313 12.09-12.32	332 13.07	280 11.02	333 13.11	170 6.69	380 14.96	15 0.59	40 1.57	2.1 4.6

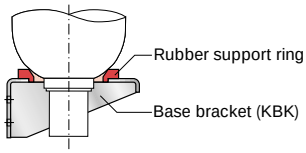
Dimensions in mm (inches shown below)

Accumulator Base Brackets: Dimensions

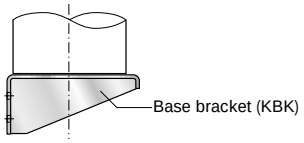
Use the Selection Guide on page 34 to select the appropriate components.

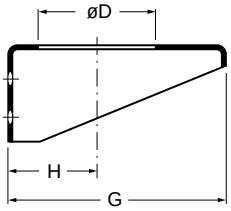
KBK - Base Bracket for Bladder and Piston Accumulators

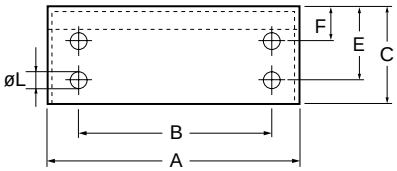
Bladder Accumulator



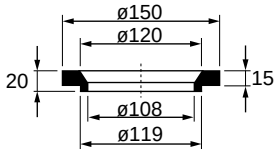
Piston Accumulator



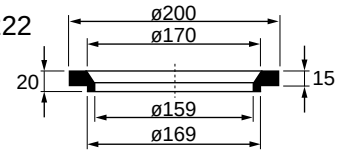




G 167



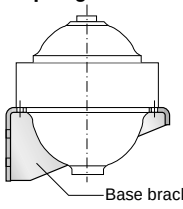
G 222

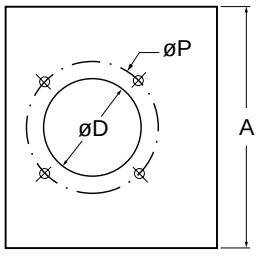


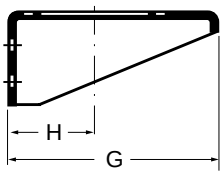
Base Bracket Model	A	B	C	øD	E	F	G	H	øL	Weight kg.(lbs)	Rubber Support Ring
	Dimensions are in millimeters / inches										
KBK 167/G	260 10.24	200 7.87	100 3.94	120 4.72	75 2.95	35 1.38	225 8.86	92 3.62	14 0.55	2.6 (5.7)	G 167
KBK 222/G	260 10.24	200 7.87	100 3.94	170 6.69	75 2.95	35 1.38	225 8.86	123 4.84	14 0.55	2.4 (5.3)	G 222
Base Brackets without Rubber Support Ring											
KBK 126	175 6.89	100 3.94	60 2.36	65 2.56	36 1.42	N/A	150 5.91	77 3.03	14 0.55	1.1 (2.43)	None
KBK 219	270 10.63	180 7.09	100 3.94	135 5.31	80 3.15	40 1.57	250 9.84	123 4.84	14 0.55	6.5 (14.4)	None
KBK 310	330 12.99	220 8.66	200 7.87	190 7.48	140 5.51	60 2.36	340 13.39	170 6.69	14 0.55	18.3 (40.4)	None

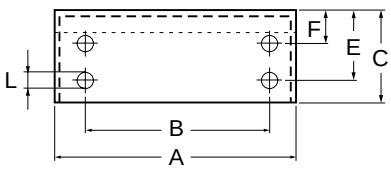
KMS - Base Bracket for Threaded Diaphragm Accumulators

Diaphragm Accumulator





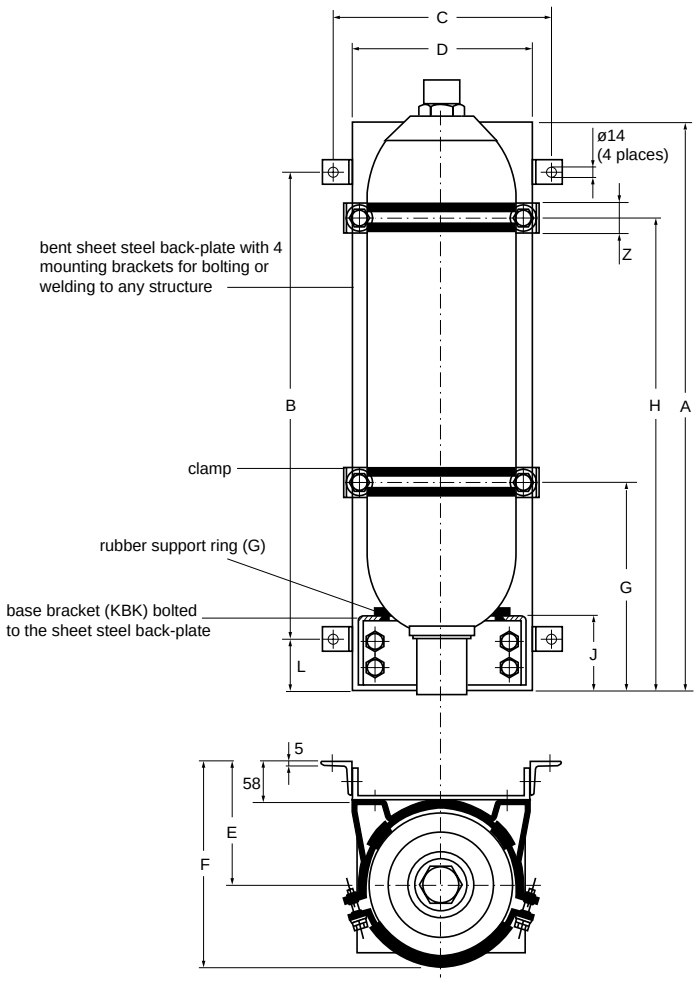




Base Bracket Model	A	B	C	øD	øP	E	F	G	H	øL	Weight kg.(lbs)
	Dimensions are in millimeters / inches										
KMS 200	270 10.63	180 7.09	100 3.94	148 5.83	160 6.30	80 3.15	40 1.57	250 9.84	123 4.84	14 0.55	6.5 (14.4)
KMS 210	260 10.24	200 7.87	100 3.94	170 6.69	180 7.09	75 2.95	35 1.38	225 8.86	123 4.84	14 0.55	2.4 (5.3)
KMS 220	260 10.24	200 7.87	100 3.94	170 6.69	188 7.40	75 2.95	35 1.38	225 8.86	123 4.84	14 0.55	2.4 (5.3)
KMS 250	260 10.24	200 7.87	100 3.94	192 7.56	204 8.03	75 2.95	35 1.38	225 8.86	123 4.84	14 0.55	2.4 (5.3)
KMS 280	330 12.99	220 8.66	200 7.87	215 8.46	230 9.06	140 5.51	60 2.36	340 13.39	170 6.69	22 0.87	18.3 (40.4)
KMS 300	330 12.99	220 8.66	200 7.87	220 8.66	235 9.25	140 5.51	60 2.36	340 13.39	170 6.69	22 0.87	18.3 (40.4)
KMS 310	330 12.99	220 8.66	200 7.87	245 9.65	265 10.43	140 5.51	60 2.36	340 13.39	170 6.69	22 0.87	18.3 (40.4)
KMS 320	330 12.99	220 8.66	200 7.87	290 11.42	305 12.01	140 5.51	60 2.36	340 13.39	170 6.69	22 0.87	18.3 (40.4)

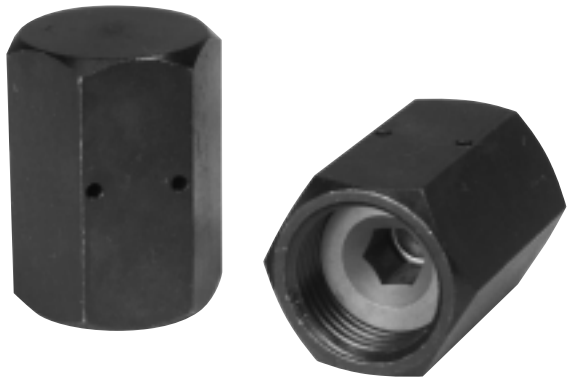
Accumulator Mounting Sets: Components & Dimensions

SEB - Mounting Sets for SB 330 Bladder Accumulators



Sets For Bladder Accumulators SB 330

Set type	Accum. size in gallons	Base bracket		Clamp		Dimensions in mm (inches shown below)									
		Type	Qty.	Type	Qty.	A	B	C	D	E	F (Ref)	G	H	L	J
SEB 4	1	KBK 167/G	1	HS 167	1	410 16.14	320 12.60	330 12.99	270 10.63	152 5.98	265 10.43	-	270 10.63	45 1.77	95 3.74
SEB 10	2.5	KBK 222/G	1	HSS 222/229	1	570 22.44	420 16.54	330 12.99	270 10.63	180 7.09	317 12.48	-	330 12.99	75 2.95	111 4.37
SEB 20	5	KBK 222/G	1	HSS 222/229	1	570 22.44	420 16.54	330 12.99	270 10.63	180 7.09	317 12.48	-	500 19.69	75 2.95	111 4.37
SEB 32	10	KBK 222/G	1	HSS 222/229	2	1340 52.76	1190 46.85	330 12.99	270 10.63	180 7.09	317 12.48	500 19.69	1160 45.67	75 2.95	111 4.37
SEB 54	15	KBK 222/G	1	HSS 222/229	2	1340 52.76	1190 46.85	330 12.99	270 10.63	180 7.09	317 12.48	500 19.69	1160 45.67	75 2.95	111 4.37



Description

HYDAC Thermal Fuse Caps are safety devices that automatically bleed accumulator gas pressure in the event of a fire. These devices are installed on the **HYDAC** version 4 gas valve. When the critical temperature (320˚F to 340˚F) is reached, a support ring melts, allowing for the spring to press down the gas valve core.

Applications

HYDAC Thermal Fuse Caps can be applied as a safety measure on any **HYDAC** accumulator with a Version 4 Gas Valve. Application of these devices may result in a reduction in insurance premium (check with provider.)

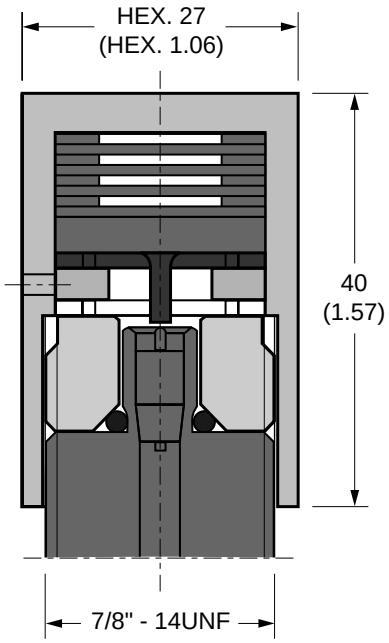
Installation

Simply remove and discard the standard Gas Valve Protection Cap and Valve Seal Cap. Screw on the Thermal Fuse Cap and torque to 30 N-m (22 lb-ft.)

Operation

Once installed, the thermal fuse cap requires no attention. In the event of a fire, the support ring will melt and the spring will expand, causing the pin to depress the gas valve core. The melted support and gas will then exit through the gas bleed ports in the side of the thermal fuse cap.

DIMENSIONS: Thermal Fuse Cap



Model Code:

There are no options for this product, therefore a model code is not given.

Order Part No. **00363501**

Technical Data: Thermal Fuse Cap

MAXIMUM WORKING PRESSURE

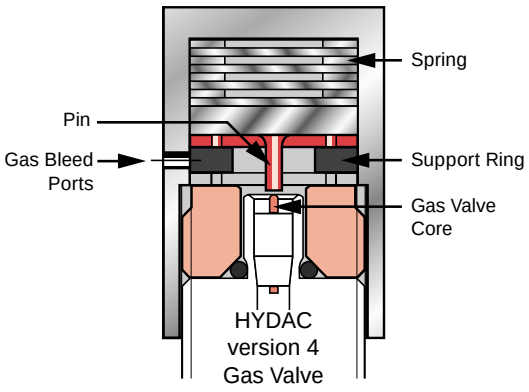
- 5000 psi (345 bar)

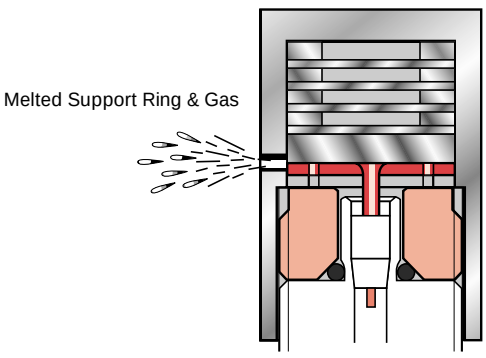
MAXIMUM WORKING TEMPERATURE

- 200˚F (93.5˚C)

FUSING TEMPERATURE

- 320 to 340˚F (160 to 171˚C)





Description

To maintain system performance **HYDAC** recommends that the gas precharge pressure is checked regularly. A loss in the gas precharge pressure will cause a drop in the system efficiency and could cause damage to the bladder, diaphragm, or piston accumulator.

HYDAC charging and gauging units allow hydro-pneumatic accumulators to be precharged with dry nitrogen. For these purposes, a charging and gauging unit is connected to a commercially available nitrogen bottle via a flexible charging hose.

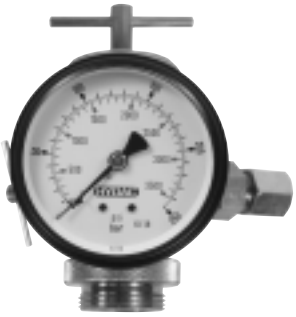
These units also allow maintenance personnel to check the current gas precharge pressure of an accumulator. For critical systems, consider the use of a permanent gauging block (see page 43) which will allow constant monitoring.

All **HYDAC** charging and gauging units incorporate a gauge and check valve in the charging connection, and a manual bleed valve with a T-handle.

HYDAC offers two types of charging and gauging units:

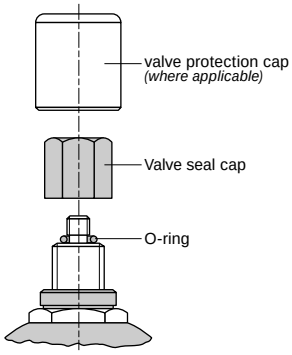
Model FPS:

For use with gas valve version 4. (except on top repairable bladder accumulators)



GAS VALVE VERSION 4

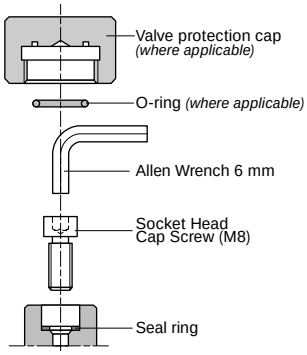
on a Bottom Repairable Bladder Accumulator



Model FPK:

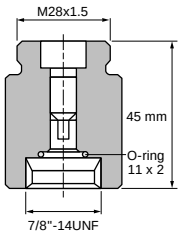
For use with gas valve version 1.

GAS VALVE VERSION 1



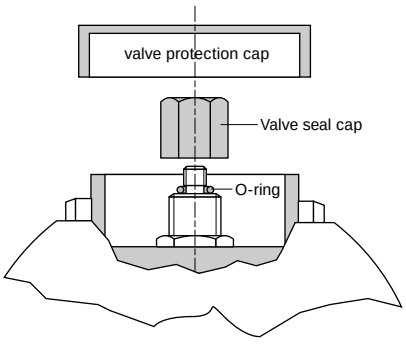
Adapter A3 (FPK/SB):

An adapter that must be used with the FPK model in order to fit **HYDAC** gas valve version 4, including top repairable bladder accumulators.



GAS VALVE VERSION 4

on a Top Repairable Bladder Accumulator



Model Code

FPS 250 F 2.5 - G4 - K

Charging and Gauging Unit

FPK = for use with Gas Valve Version 1 (M28 x 1.5) for SBO and SK
FPS = for use with Gas Valve Version 4 (8VI-ISO 4570) for SB, SBO and SK
NOTE: SB Top repairable bladder accumulators must use FPK with FPK/SB adapter

Gauge Pressure Range

10	=	0 to 145 psi	(0 to 10 bar)
25	=	0 to 350 psi	(0 to 25 bar)
100	=	0 to 1400 psi	(0 to 100 bar)
250	=	0 to 3500 psi	(0 to 250 bar)
400	=	0 to 5800 psi	(0 to 400 bar)

Charging Hose

F = with cap screw G1 (thread W24, 32x1/14 - DIN477)

Charging Hose Length

2.5 = 8 ft. (2.5 m)
4.0 = 13 ft. (4 m)

Adapter

G4 = USA *(only for CGA 580 gas bottle connections)*
G4.1 = USA *(only for CGA 680 gas bottle connections)*
only available with 400 bar Guage and integral 4m high-pressure hose
G1 = Germany *(integral part of charging hose)*
G2 = Australia, Great Britain, India
G3 = France
G5 = Italy
G6 = Japan - Taiwan
G7 = Japan - South Korea
G8 = Brazil
G9 = China
G10 = Russia

Case

K = plastic carrying case *(standard)*

Additional Accessories:

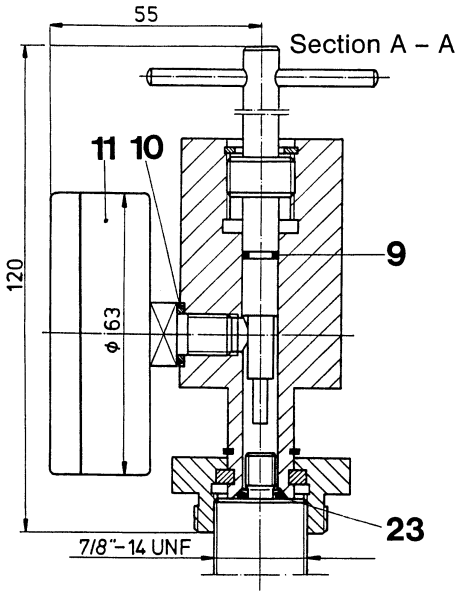
ADAPTER A3 (FPK/SB) = adapter for using FPK Charging Unit with top repairable bladder accumulators
NOTE: for other adapters please consult factory.

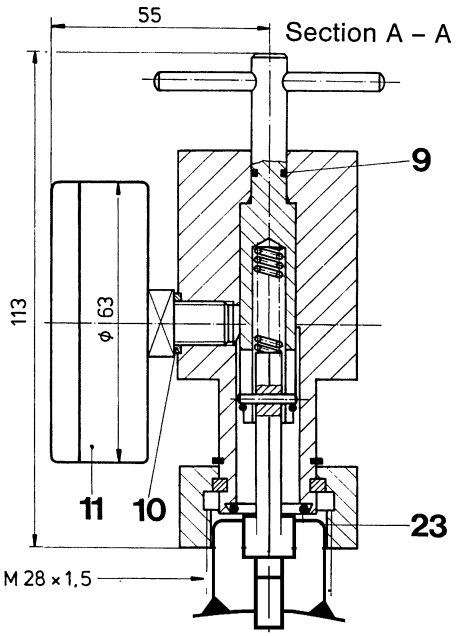
6mm Allen Wrench *(for HYDAC Gas Valve Version 1)*

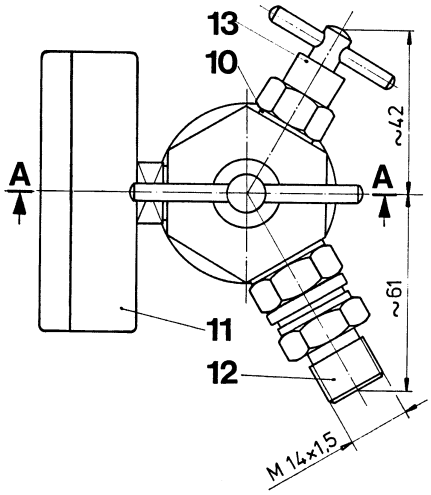
14mm Open End Wrench *(for HYDAC gauge)*

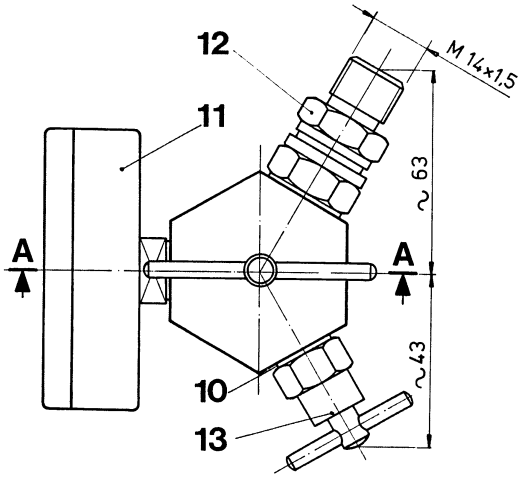
Operating and Installation Instructions are included with each charging kit.
This is also available for download in PDF format on our web site: **www.hydacusa.com**

DIMENSIONS: Charging and Gauging Units







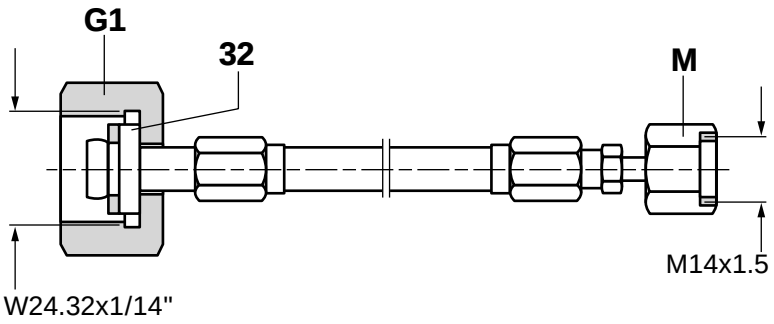


SPARE PARTS

Charging and Gauging Unit Type:		FPS		FPK	
Item	**Description**	**Dimensions**	**Part No.**	**Dimension**	**Part No.**
9	O-Ring	6 x 1	00601032	6 x 1	00601032
10	Seal-Ring	A 10 x 13.5	00601228	A 10 x 13.5	00601228
11	Gauge	Ø 63, conn. G 1/8 (ISO 228)	*(see page 55)*	Ø 63, conn. G 1/8 (ISO 228)	*(see page 55)*
12	Check Valve	DN 3	00610004	DN 3	00610004
13	Manual Bleed Valve	M 10x1	00236445	M10x1	00236445
23	O-Ring	7.5 x 2	00626488	15 x 2	00626488

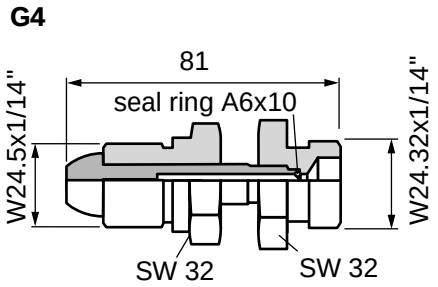
DIMENSIONS: Charging Hose and Adapters

Charging Hose (standard hose rated to 3000 psi)



Length	Model Code	Part No.
2.5	HOSE FPS/FPK 2.5M	00236514
4	HOSE FPS/FPK 4M	00236515
10	HOSE FPS/FPK 10M	00373405

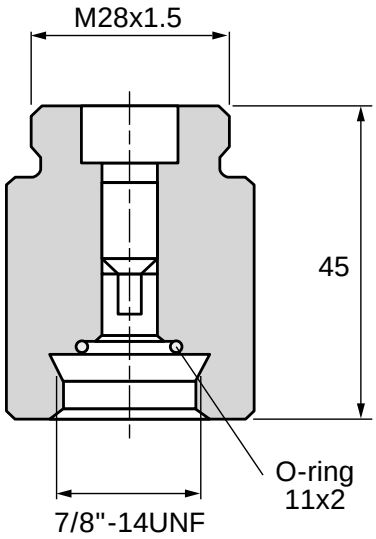
Adapter G4



Model Code	Part No.
ADAPTER G4	02068737

For additional adapters Contact **HYDAC.**

Adapter FPK/SB



Model Code	Part No.
ADAPTER A3 (FPK/SB)	00291533

Note: Dimensions in mm

SPECIAL TOOLS REQUIRED

- Charging and Gauging Unit
- Gas Valve Core Tool
- 50 mm Open End Wrench (for bottom repairable accumulator)
- 32 mm Open End Wrench (for top repairable accumulator)
- Torque Wrench(es)

Currently the **HYDAC** Permanent Gauging Block is only available for use with **HYDAC** gas valve version 4.

Read all instructions thoroughly before beginning any type of service or repair work.

Refer to additional information contained in the "Operating and Installation Instructions for **HYDAC** Accumulators."

Description

The **HYDAC** Permanent Gauging Block allows constant monitoring of gas pressure while a system is in operation. This helps users monitor pressure loss, and determine when charging is needed. They are designed to fit bladder, diaphragm, and piston style accumulators with **HYDAC** Gas Valve Version 4. Use of these blocks facilitates trouble shooting and simplifies maintenance by eliminating the need to attach a charging and gauging unit to monitor pressure.

Model Code: Permanent Gauging Blocks

PERM GAUGING BLOCK **VER4** ___ **850**

Permanent Gauging Block
PERM GAUGING BLOCK

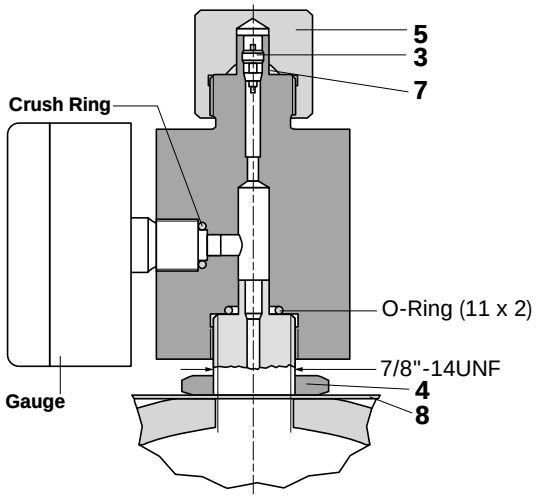
Gas Valve Type
VER4 = HYDAC gas valve version 4 (7/8”-14UNF)

Accumulator Type
(omit) = Bottom Repairable *(standard)*
TR = Top Repairable

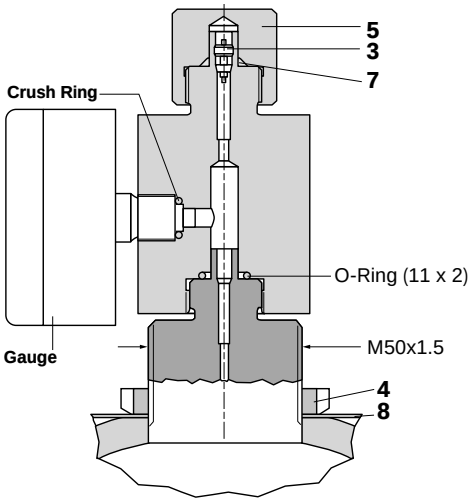
Gauge Pressure Range
850 = 0 to 850 psi
1450 = 0 to 1450 psi
2300 = 0 to 2300 psi
3600 = 0 to 3600 psi
5800 = 0 to 5800 psi

Installation Drawings: Permanent Gauging Blocks for HYDAC Gas Valve Version 4

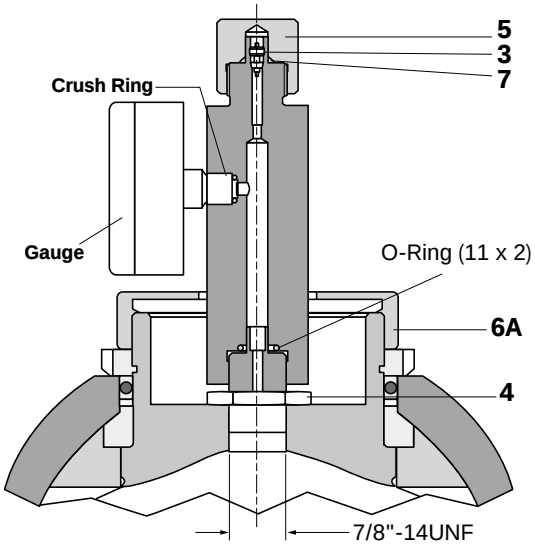
Bottom Repairable Bladder



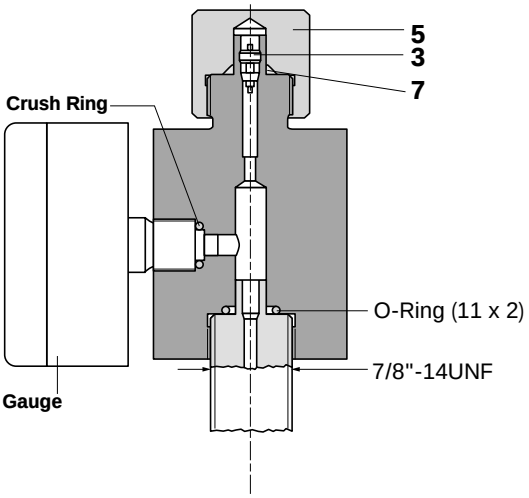
Bottom Repairable Bladder with M50 Gas Valve



Top Repairable Bladder (1



Piston & Diaphragm



Parts Legend	
3	Gas Valve Core
4	Lock Nut
5	Valve Seal Cap
6A*	Modified Valve Protection Cap
7	O-ring (7.5 x 2)
8	Name Plate

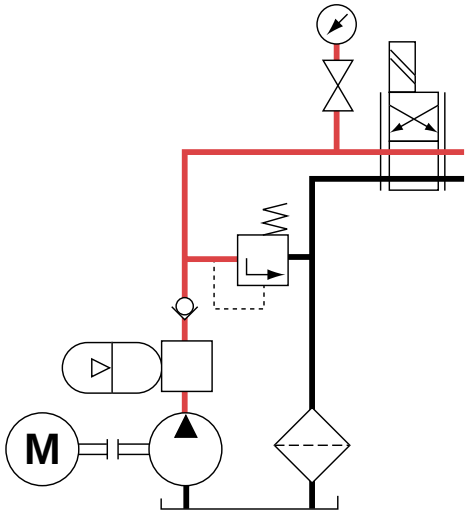
1) When ordering a permanent gauging block for top repairable bladder accumulators, it is recommended that you replace the standard valve protection cap with the modified protection cap (item 6A) Part Number 02054749.

Typical Applications

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

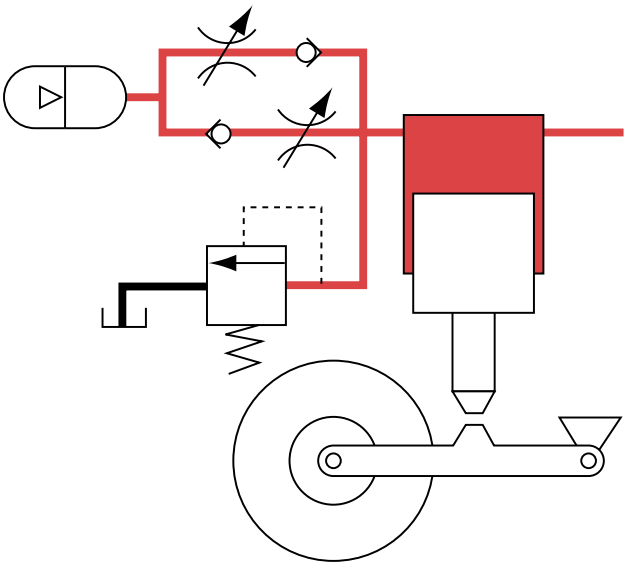
- Shock Absorption
- Pulsation Dampening
- Energy Storage
- Emergency Operation
- Force Equilibrium
- Leakage Compensation
- Volume Compensation

The following schematics are examples showing how **HYDAC** accumulators are used in the above listed applications



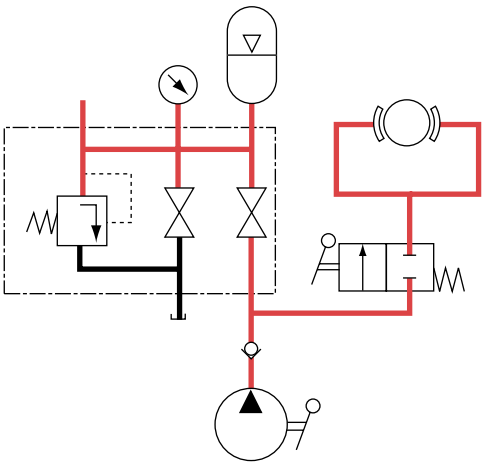
Pulsation Dampeners for Displacement Pumps

The non-uniformity of displacement pumps creates pulsations in the fluid which can be dampened with a pulsation dampener.



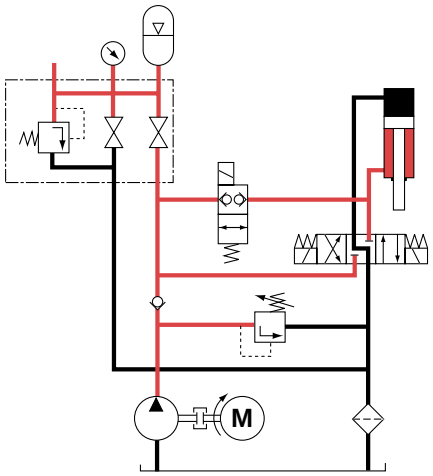
Spring Element

The compressibility of the gas in the accumulator works like a spring. By throttling the flow in and out of the accumulator, the spring stiffness can be adjusted.



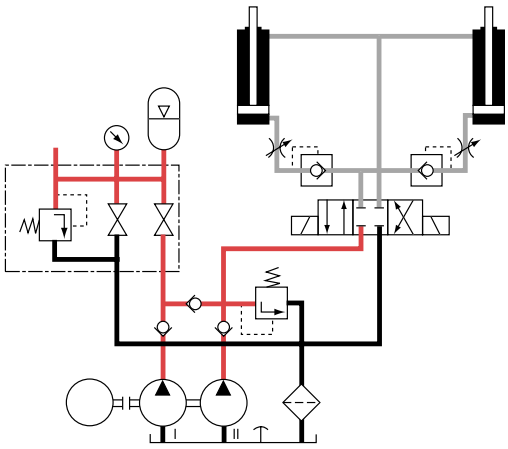
Emergency Brakes

Emergency actuation, the accumulator provides the stored hydraulic energy to apply the brake should the main power source fail.



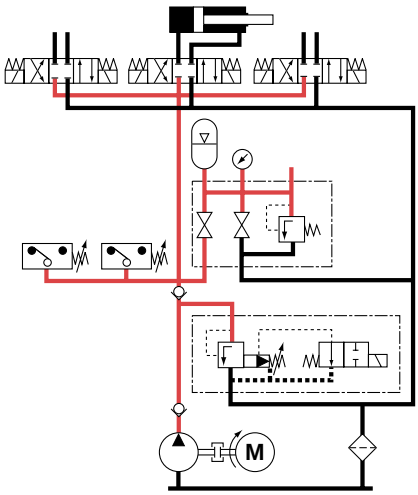
Emergency Operation of a Hydraulic Cylinder

In an emergency condition, e.g., during a power failure, the accumulator automatically drives the system (cylinder) to a fail safe position



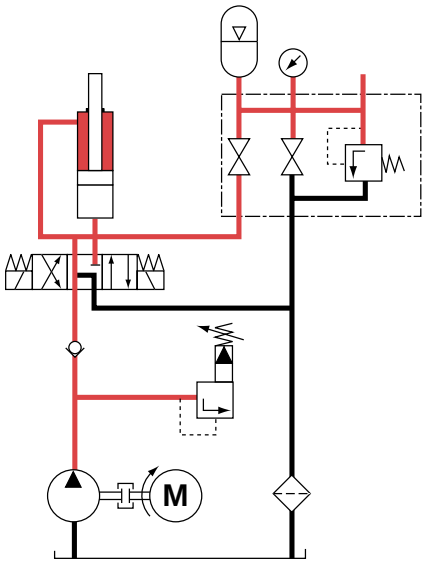
Energy Storage and Shortening of Stroke Time

The hydraulic energy stored during a pause in the work cycle, is used to supplement the pump and shorten the stroke time.



Energy Storage in an Injection Molding Machine

The hydraulic energy stored during a pause in the work cycle, is used to supplement the pump and increase the power output for peak requirements. Through design, the electrical power requirement is reduced.



Leakage Oil Compensation

The accumulator is charged to a pre-determined pressure. The pump is switched off. Now the accumulator makes up for the leakage of the system until the minimum pressure is reached and the pump is switched on again.

Accumulator Simulation Program

Contact HYDAC to request a copy

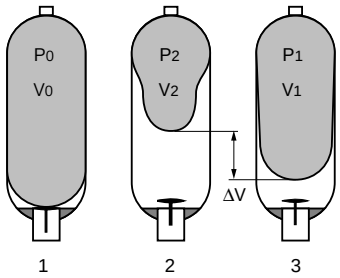
Operation

Bladder

1 The bladder is precharged with nitrogen. This causes the fluid valve to close, preventing the bladder from extruding out of the fluid port.

2 Accumulator at maximum working pressure. The difference in volume *(ΔV)* between the maximum and the minimum working pressure corresponds to the effective fluid volume.

3 When the minimum working pressure is reached, a small amount of fluid should remain in the accumulator. This is to prevent the valve from chafing the bladder on each cycle. Thus, p_0 should always be lower than p_1.



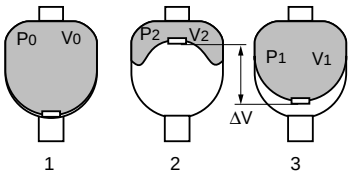
p_0 = gas precharge
p_1 = minimum working pressure
p_2 = maximum working pressure

Diaphragm

1 The diaphragm is precharged with nitrogen. This causes the poppet to close, preventing the diaphragm from extruding out of the fluid port.

2 Accumulator at maximum working pressure. The difference in volume *(ΔV)* between the maximum and the minimum working pressure corresponds to the effective fluid volume:

3 When the minimum working pressure is reached, a small amount of fluid should remain in the accumulator. This is to prevent the poppet from impacting the base on each cycle. Thus, p_0 should always be lower than p_1.



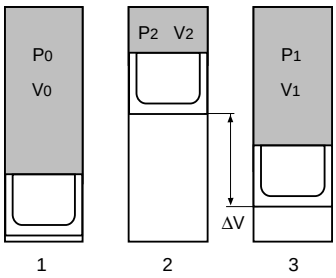
V_0 = effective gas volume of the accumulator
V_1 = gas volume at p_1
V_2 = gas volume at p_2

Piston

1 The piston accumulator is precharged with nitrogen. The piston sits against the end cap and covers the fluid connection.

2 Accumulator at maximum working pressure. The difference in volume *(ΔV)* between the maximum and the minimum working pressure corresponds to the effective fluid volume:

3 When the minimum working pressure is reached, a small amount of fluid should remain in the accumulator. This is to prevent the piston from impacting the end cap on each cycle. Thus, p_0 should always be lower than p_1.



T_0 = temperature at precharging
T_1 = minimum operating temperature
T_2 = maximum operating temperature

Precharge Recommendations

For energy storage:
$p_0 = 0.9 \times p_1$
p_1 = minimum working pressure

For shock absorption:
$p_0 = (0.6 \text{ to } 0.9) \times p_m$
p_m = median working pressure at free flow

For pulsation dampening:
$p_0 = (0.6 \text{ to } 0.8) \times p_m$
p_m = median working pressure

Temperature Effect

To ensure that the recommended gas precharge pressure is maintained, even at relatively low or high operating temperatures, the gas precharge pressure should be adjusted for temperature. The formula below relates the precharge temperature (T_0) to the operating temperature (T). Please refer to the sizing example on page 48.

Fahrenheit

$$p_0,T_0 = p_0,T_2 \times \left(\frac{T_0 + 460}{T_2 + 460}\right)$$

T_0 = precharge temperature in °F
T_2 = maximum operating temperature in °F
p_0,T_0 = gas precharge pressure at precharge temperature
p_0,T_2 = gas precharge pressure at maximum operating temperature

Celsius

$$p_0,T_0 = p_0,T_2 \times \left(\frac{T_0 + 273}{T_2 + 273}\right)$$

T_0 = precharge temperature in °C
T_2 = maximum operating temperature in °C
p_0,T_0 = gas precharge pressure at precharge temperature
p_0,T_2 = gas precharge pressure at maximum operating temperature

Formulas

The compression and expansion processes taking place in hydro-pneumatic accumulator are governed by the general gas laws.

The following applies for ideal gases:

$p_0 \times V_0^n = p_1 \times V_1^n = p_2 \times V_2^n$,

where the time related change of state is represented by the polytropic exponent "n". For slow expansion and compression processes which occur almost isothermically, the polytropic exponent can be set at n = 1.
For rapid processes, the adiabatic change of state can be calculated using n = k = 1.4 *(for nitrogen as a diatomic gas)*[1].

For pressures above 3000 psi the real gas behavior deviates considerably from the ideal one, which reduces the effective fluid volume ΔV. In such cases a correction is made which takes into account a change in the adiabatic exponent (k).

By using the following formulas, the required gas volume V_0 can be calculated for various calculations.

Low pressures of up to 150 psi must always be used as absolute pressures in the formulas.

Calculation Formulas

polytropic:

$$V_0 = \frac{\Delta V}{\left(\frac{P_0}{P_1}\right)^{1/n} - \left(\frac{P_0}{P_2}\right)^{1/n}}$$

isothermal: (n=1)

$$V_0 = \frac{\Delta V}{\frac{P_0}{P_1} - \frac{P_0}{P_2}}$$

adiabatic: (n = k = 1.4)

$$V_0 = \frac{\Delta V}{\left(\frac{P_0}{P_1}\right)^{0.714} - \left(\frac{P_0}{P_2}\right)^{0.714}}$$

Correction factors to take into account the real gas behavior[2]

For isothermal change of condition:

$V_{0,real} = C_i \times V_{0,ideal}$ or

$$\Delta V_{0,real} = \frac{\Delta V_{ideal}}{C_i}$$

for adiabatic change of condition:

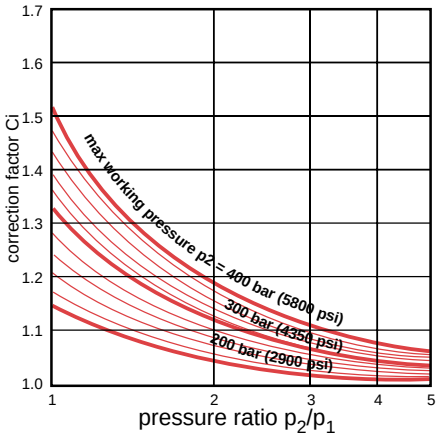
$V_{0,real} = C_a \times V_{0,ideal}$ or

$$\Delta V_{real} = \frac{\Delta V_{ideal}}{C_a}$$

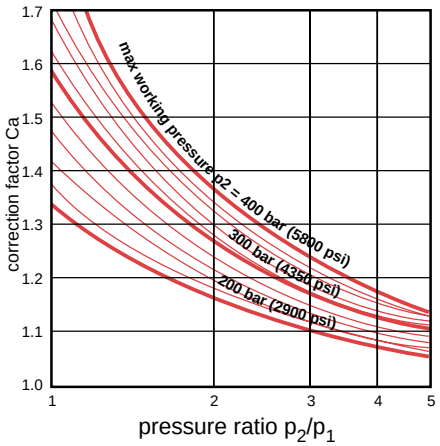
1 An estimate of the accumulator size and a selection of precharge pressure can be calculated similar to the sample shown. For more accurate sizing and design assistance, please contact HYDAC.

2 The correction factors can be taken from the graphs in the next column, depending on the pressure ratio p_2/p_1 and the maximum working pressure p_2, which is given as a parameter, for an isothermal or adiabatic change of condition.

Correction factor for isothermal change of condition



Correction factor for adiabatic change of condition



Sizing Example

An additional operation is to be added to an existing machine which requires 1.35 gallons of oil in 2.5 seconds for optimal operation. The system must operate between 3000 psi and 1500 psi. The required recharge time is 8 seconds with an operating temperature range of 75 to 120°F.

Given:

maximum working pressure
p_2 = 3000 psi

minimum working pressure
p_1 = 1500 psi

effective fluid volume
ΔV = 1.35 gallons

maximum operating temperature
T_2 = 120°F

minimum operating temperature
T_1 = 75°F

Required:

1. necessary accumulator size, taking into account the real gas behavior

2. gas precharge pressure p_0 at 68°F (T_0)

3. select accumulator size and type

Solution:

Since it is a rapid process, the change of condition of the gas can be assumed to be adiabatic.

1. Determination of required gas volume:

a) gas precharge pressure at T_2:

$p_0, T_2 = 0.9 \times p_1$

$= 0.9 \times 1500 = 1350$ psi

b) gas precharge pressure at T_1:

$$p_0 = P_{0,\,T_2} \times \left(\frac{T_1 + 460}{T_2 + 460}\right)$$

$$= 1350 \text{ psi} \times \left(\frac{75 + 460}{120 + 460}\right)$$

$\approx$ 1245 psi

c) ideal gas volume:

$$V_{0\ ideal} = \frac{\Delta V}{\left(\frac{P_{0,\,(T1)}}{P_1}\right)^{0.714} - \left(\frac{P_{0,\,(T1)}}{P_2}\right)^{0.714}}$$

$$= \frac{1.35}{\left(\frac{1245}{1500}\right)^{0.714} - \left(\frac{1245}{3000}\right)^{0.714}}$$

= 3.95 gallons

d) correction factor from diagram:

$\frac{p_2}{p_1}$ = 2 - Ca $\approx$ 1.16

e) real gas volume:

$V_{0,\,real} = C_a \times V_{0,\,ideal}$

$= 1.16 \times 3.95$

= 4.6 gal.

2. Determination of gas precharge pressure p_0 at 68°F:

$$p_0, T_0 = p_0, T_2 \times \left(\frac{T_0 + 460}{T_2 + 460}\right)$$

$$= 1350 \text{ psi} \times \left(\frac{68 + 460}{120 + 460}\right)$$

$\approx$ 1230 psi

3. Selected: Size 20 (5 gallon)

Model: SB 330 -20A1 / 112S - 210C

Precharged to 1230 psi at 68°F

Accumulator Simulation Program

Contact HYDAC to request a copy

Sizing Pulsation Dampeners and Suction Flow Stabilizers

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

Not only is the gas volume V_0 a decisive factor but also the connection size of the pump has to be taken into account when selecting the pulsation dampener. In order to avoid additional cross section changes which represent reflection points for vibrations, and also to keep pressure drops to a reasonable level, the connection cross section of the dampener has to be the same as the pipe line.

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

A simulation of the pressure performance can be carried out by means of a computer program for real pipe line conditions.

Formulas:

$$V_0\,(l) = \frac{\Delta V}{0.695 \times \left[1 - \left(\frac{100}{100 + x}\right)^{0.714}\right]}$$

$$X\,(\pm\%) = \frac{100}{\left(1 - \frac{\Delta V}{0.695 \times V_0}\right)^{1.4}} - 100$$

$$\Delta V\,(l) = \varphi \times q$$

$$X\,(\pm\%) = \frac{\hat{p} - p_m}{p_m} \times 100 = \frac{\check{p} - p_m}{p_m} \times 100$$

V_0 = required gas volume

ΔV = fluctuating fluid volume

q(l) = stroke volume per cylinder

$p - p_m = p - p_m$ = amplitude of pressure fluctuations

X = residual pulsations

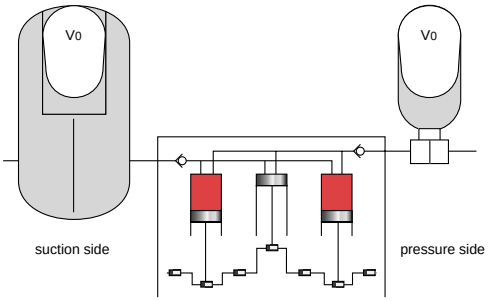
p = max. working pressure

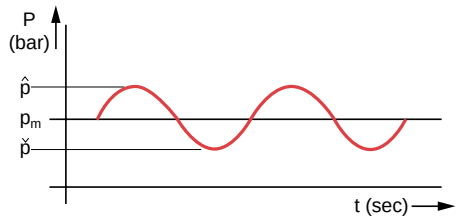
p = min. working pressure

p_m = pump flow rate or pressure in the suction line

φ = Coefficient of cyclic variation of the pump

z = No. of compressions / effective cylinders per revolution
factors for other types, i.e. gear, axial, and radial piston pumps on request





Types of Pump	z	φ
Gear Pump	7 - 14	0.1 - 0.3
Piston Pump	1 - 11	0.01 - 0.6
e.g.	1	0.6
	2	0.25
	4	0.12
	3	0.13
	5	0.05
	6	0.13
	7	0.02
	9	0.01

Calculation Example

Parameters:

Single acting 3-plunger pump

piston diameter	2.36 inches	(60 mm)
piston stroke	3.15	(80 mm)
rpm 370 min-1		
flow rate	64.44 gpm	(244 l/min.)
operating temp.	68°F	(20°C)
operating pressure		
pressure side	3625 psi	(250 bar)
suction side	58 psi	(4 bar)

Required:

Suction flow stabilizer for a residual pulsation of ± 0.5%

Solution:

a) Determination of required suction flow stabilizer

$$V_0\,(in^3) = \frac{0.13 \cdot \left(\frac{2.36^2 \times \pi}{4}\right) \cdot 3.15}{0.695 \left[1 - \left(\frac{100}{100 + 2.5}\right)^{0.714}\right]}$$

Selected: SB 330 P-20 *(see table on page 24)*

b) Determination of required pulsation dampener

$$V_0\,(in^3) = \frac{0.13 \cdot \left(\frac{2.36^2 \times \pi}{4}\right) \cdot 3.15}{0.695 \left[1 - \left(\frac{100}{100 + 0.5}\right)^{0.714}\right]}$$

Selected: SB 330 P-20 *(see table on page 24)*

For assistance in sizing pulsation dampeners, shock absorbers, and suction stabilizers, please contact the HYDAC Accumulator Group at **1-877-GO HYDAC.**

Accumulator Sizing Worksheet

HYDAC

Name:

Company:

Phone:

Email:

Preferred method of response: ☐ Phone ☐ Email

HYDAC Corporation Accumulator Division
phone: 610-264-9503 **fax:** 610-264-7529

Operation of Pump:

☐ Continuous Operation

☐ Emergency Operation

Maximum Operating Pressure	**(P2)**		PSI
Minimum Operating Pressure	**(P1)**		PSI
Precharge Pressure at 68˚F (20˚C)	**(P0)**		PSI
Temperature Range of Environment	**(T)**		˚F
Temperature Range of Fluid or System	**(TF)**		˚F
Pump Flow Rate	**(QP)**		GPM
Total Cycle Time of System	**(TE)**		Sec.
Number of Actuators (cylinders, etc.)	**(NV)**		

Actuator Time Schedule and Flow:

QVi = Required Actuator Flow (GPM) **Ei** = Actuator Start Time **Ai** = Actuator Shut Down Time
(**i** = 1 for first actuator, **i** = 2 for second actuator, etc. up to **NV**)

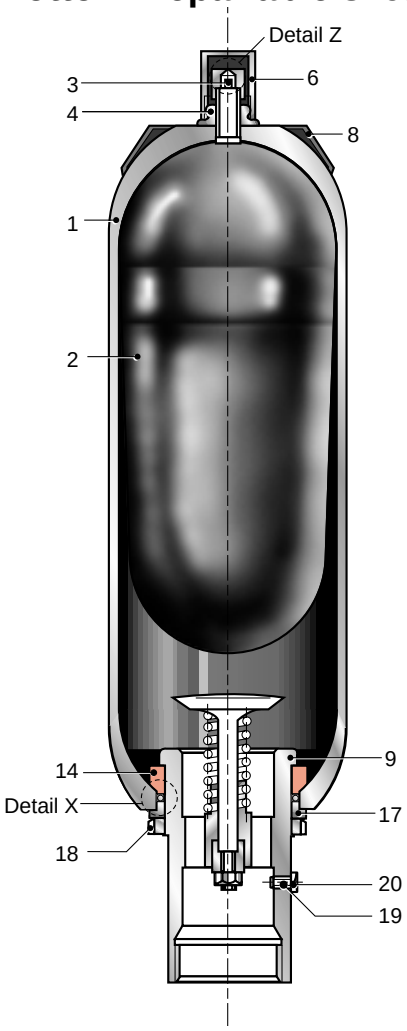
QV1 =	E1 =	A1 =
QV2 =	E2 =	A2 =
QV3 =	E3 =	A3 =
QV4 =	E4 =	A4 =
QV5 =	E5 =	A5 =

Fluid:

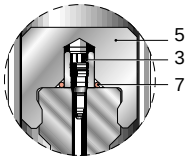
Additional Remarks:

Bladder Accumulators: Spare Parts

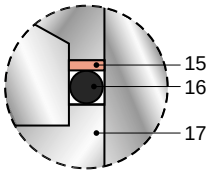
Bottom Repairable SB330, SB300H, SB 600



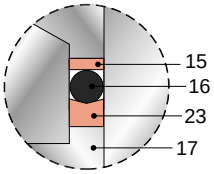
Detail Z



Detail X
SB 330: size 1 to 54
SB 600: size 1 to 4



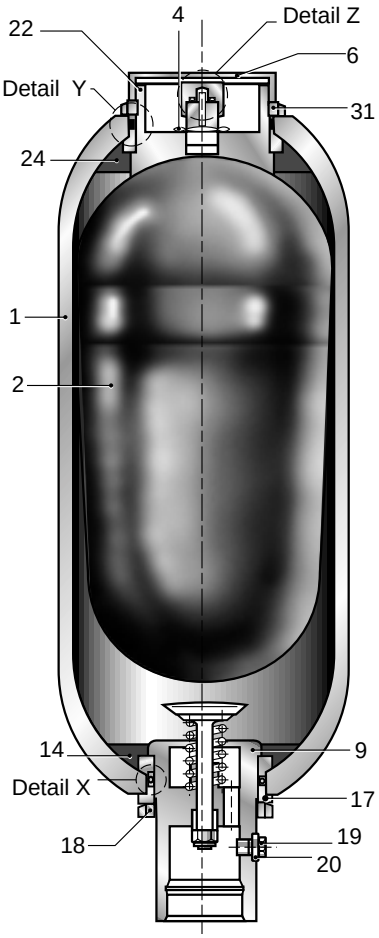
SB 600: size 10 to 54



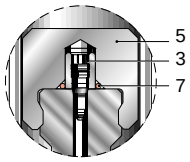
Repair Kits consist of items
2, 3, 4 *(SB 600 only)*, 5, 7, 15, 16, 23 *(where applicable)*

Seal Kits consist of items
15, 16, 23 *(where applicable)*

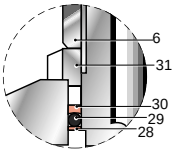
Top Repairable SB330T, SB330HT, SB 600T



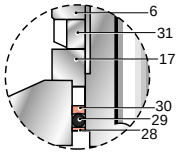
Detail Z



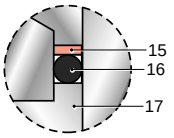
Detail Y
SB 330 T: size 10 to 54
SB 330 HT: size 20 to 54



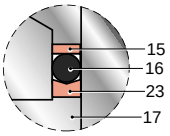
SB 600 T: size 20 to 54



Detail X
SB 330 T: size 10 to 54



SB 330 HT: size 20 to 54
SB 600 T: size 20 to 54



Repair Kits consist of items
SB330T, SB600T: 2, 3, 5, 7, 15, 16, 23 *(where applicable)*, 28, 29, 30
SB330HT: 2, 3, 5, 7, 23 *(where applicable)*, 28, 29, 30

Seal Kits consist of items
15, 16, 23 *(where applicable)*, 28, 29, 30

Item Description:

Gas Side

1	Shell
2	Bladder
3	Gas Valve Core
4	Bladder Stem Lock Nut
5	Valve Seal Cap
6	Valve Protection Cap
7	O-ring
8	Name Plate
22	Gas Port Adapter
24	Anti-extrusion Ring
28	Flat Ring
29	O-ring
30	Back-up Ring
31	Gas Port Lock Nut

Fluid Side

9	Fluid Port
14	Anti-extrusion Ring
15	Flat Ring
16	O-ring
17	Spacer Ring
18	Fluid Port Lock Nut
19	Vent Screw
20	Seal Ring
23	Back-up Ring

Bladder Accumulators: Seal Kits

For seal kits and repair kits other than Buna N, and for sizes not listed please consult factory.

Bottom Repairable - Buna N*				
	3000 PSI		5000 PSI	
Size	Fluid Port Seal Kit	Repair Kit	Fluid Port Seal Kit	Repair Kit
1 (1 qt.)	02054031	02054034	02054032	02054557
4 (1 gal.)	02054032	02054035	02054032	02050357
6 (1.5gal.)	02054032	02054677	*N/A*	*N/A*
10 (2.5 gal.)	02054033	02054036	02054283	02052798
20 (5 gal.)	02054033	02054037	02054283	02052808
32 (10 gal.)	02054033	02054038	02054283	02052818
42 (11 gal.)	02054033	02075963	*N/A*	*N/A*
54 (15 gal.)	02054033	02054039	02054283	20542828

* For seal kits and repair kits other than Buna N, and for sizes and types not listed please consult factory.

Bladder Accumulators: Tools

Item	Part Number
Pull Rod	00172054
Gas Valve Torque Wrench	01007948
Gas Valve Core Tool	00616886
Spanner Wrenches:	
1 Qt. -	02054547
1-15 Gal -	02054545
High Flow and Top Repairable	02054548

Pull Rod - comes complete with fittings for both **HYDAC** gas valve types, and 3 extension segements to accomodate accumulators up to 54 liter

Gas Valve Torque Wrench

Gas Valve Core Tool

Spanner Wrench

WARNING: Only qualified persons should perform maintenance on any type of accumulator. Complete maintenance instructions are available - Contact HYDAC.

Bladder Accumulators: Competitive Crossover

Standard Bottom Repairable - 3000 PSI / Oil Service / Buna N / SAE Thread

Size	HYDAC	Accum Inc.	Bosch	Greer	Oil Air	Parker
1 qt	02054003	A1QT31003	0-531-112-640	851550	1QT-100-3	AB01B3T1A1
1 gal	02054004	A131003	0-531-113-640	841720	1-100-3	AB04B3T1A1
2.5 gal	02054005	A2.531003	0-531-114-640	849760	2.5-100-3	AB10B3T1A1
5 gal	02054006	A531003	0-531-115-640	849392	5-100-3	AB20B3T1A1
10 gal	02054007	A1031003	0-531-115-650	850670	10-100-3	AB40B3T1A1
15 gal	02054008	A1531003	0-531-116-640[1]	849910	15-100-3	AB60B3T1A1

Repair Kits[10] Replacement Bladder

Size	HYDAC	Accum Inc.	Bosch[2]	Greer	Oil Air	Parker
1 qt 5/8" Gas Valve	02054655	AI-1QT-3KT[3]	N/A	702928[3]	A1QT-300[3]	0850693002[3]
1 qt 7/8" Gas Valve	02054034 *(HYDAC standard)*	N/A	9-534-232-024[3]	N/A	N/A	N/A
1 gal	02054035	AI-1-3KT	9-534-232-025	702956	A1-300	0850693010
2.5 gal	02054036	AI-2.5-3KT	9-534-232-026	702970	A2.5-2-300	0850693025
5 gal	02054037	AI-5-3KT	9-534-232-027	702984	A5-2-300	0850693050
10 gal	02054038	AI-10-3KT	9-534-232-028	702998	A10-2-300	0850693100
15 gal	02054039	AI-15-3KT	9-534-232-029[1]	703026	A15-2-300	0850693150

Top Repairable - 3000 PSI / Oil Service / Buna N / SAE Thread

Size	HYDAC	Accum Inc.	Bosch[5]	Greer	Oil Air	Parker
5 gal	02054000	A5TR31003	9-530-230-085	851430	TR-5-100-3	AB20C3T1A1
10 gal	02054001	A10TR31003	9-530-230-095	851590	TR-10-100-3	AB40C3T1A1
15 gal	02054002	A15TR31003	9-530-230-105[1]	852480	TR-15-100-3	AB60C3T1A1

Repair Kits[10] Replacement Bladder

Size	HYDAC	Accum Inc.[4]	Bosch[2, 4]	Greer[4]	Oil Air[4]	Parker[4]
2.5 gal	02054036	AI-2.5-3KT	N/A	702970	A2.5-5-300	0850693025
5 gal	02054104	AI-5-3KT	9-534-232-027	702984	A5-2-300	0850693050
10 gal	02054105	AI-10-3KT	9-534-232-028	702998	A10-2-300	0850693100
15 gal	02054106	AI-15-3KT	9-534-232-029[1]	703026	A15-2-300	0850693150

Standard Bottom Repairable - 5000 PSI / Oil Service / Buna N / SAE Thread

Size	HYDAC	Accum Inc.	Bosch[5]	Greer	Oil Air	Parker
1 qt	02054188	N/A	N/A	851120	N/A	N/A
1 gal	02054189	N/A	N/A	851130	N/A	N/A
2.5 gal	02054276	A2.5TR51003[6]	N/A	851150	G-2.5-5-100-3	AB10B5T1A1
5 gal	02054275	A5TR51003[6]	N/A	855360	G-5-5-100-3	AB20B5T1A1
10 gal	02054277	A10TR51003[6]	N/A	850680	G-10-5-100-3	AB40B5T1A1
15 gal	02054278	A15TR51003[6]	N/A	855370	G-15-5-100-3	AB60B5T1A1

Repair Kits[10] Replacement Bladder

Size	HYDAC	Accum Inc.[9]	Bosch	Greer[9]	Oil Air[9]	Parker[8]
1 qt	02054455[7]	N/A	N/A	704040	N/A	N/A
1 gal	02054035[7]	N/A	N/A	704060	N/A	N/A
2.5 gal	02054279[8]	AI-2.5-5-3KT	N/A	704080	AG-2.5-5-300	0861905025[8]
5 gal	02054280[8]	AI-5-5-3KT	N/A	704100	AG-5-5-300	0861905050[8]
10 gal	02054281[8]	AI-10-5-3KT	N/A	704120	AG-10-5-300	0861905100[8]
15 gal	02054282[8]	AI-15-5-3KT	N/A	704140	AG-15-5-300	0861905150[8]

Footnotes

1 Only 14 gallon
2 Bladder only
3 Size of gas valve stem may be different than HYDAC standard (7/8"-14 UNF)
4 Style of gas valve stem (top-repairable) may differ (i.e. has flat) from HYDAC
5 Not ASME approved; TUV approved accumulators only
6 Top-repairable only
7 Gas valve stem 7/8"-14 UNF
8 Gas valve stem 2"
9 Size and/or style of gas valve may be different than HYDAC standard
10 HYDAC Repair Kit consists of:
- Bladder
- Lock Nut (SB 600 only)
- Seal Kit
- Gas Valve Core
- Valve Seal Cap

Piston Accumulators: Seal Kits & Replacement Pistons

For seal kits other than Buna N, and for sizes not listed please consult factory.

Example: SK 350 - 20 / **2**112 S - 210 FCF - VE - **18** E - 1 (see page 15 for details)

Piston Type — Diameter

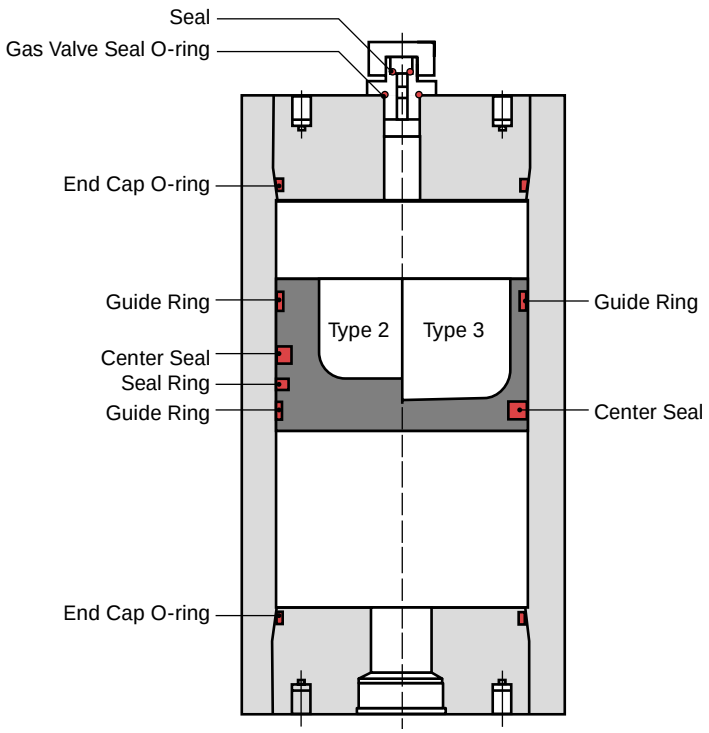
Piston Seal Kits - Buna N

Diameter	Type 2	Type 3
06 (60mm)	—	03016210
08 (80mm)	02123890	03013230
10 (100 mm)	00363268	02123414
12 (125 mm)	03016212	02128104
15 (150 mm)	03016235	03016239
18 (180 mm)	00363270	02123415
25 (250 mm)	00363266	03016213
35 (355 mm)	00363272	—

Replacement Pistons - Buna N

Diameter	Type 2	Type 3
06 (60mm)	—	03009372
08 (80mm)	00352225	02119931
10 (100 mm)	00356847	02115547
12 (125 mm)	03016232	03016150
15 (150 mm)	03016228	03016231
18 (180 mm)	00350244	02121568
25 (250 mm)	00353980	03016171
35 (355 mm)	00356382	—

Seals Included Seal in Piston Seal Kit



Piston Accumulators: Tools

When repairing a piston accumulator, it is critical to use the appropriate tools to avoid seal damage. There are two tools required:

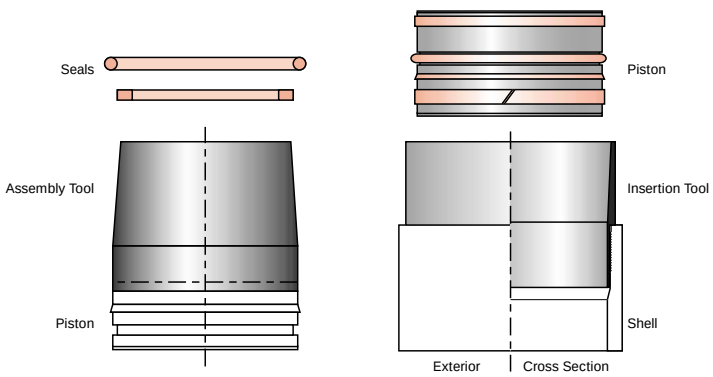
Seal Assembly Tool:
allows for gradual and even stretching of the seals when installing them onto the piston

Piston Insertion Tool:
a tapered shroud that protects the seals from the threaded portion of the shell, and provides even seal compression and piston alignment when inserting the piston into the shell.

Tools

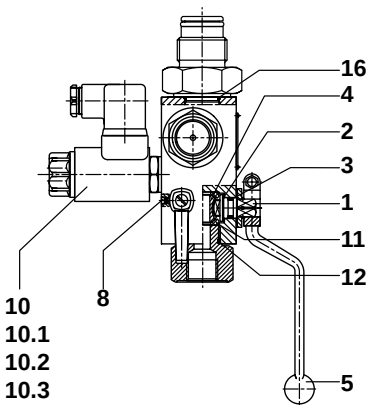
Diameter	Seal Assembly	Piston Insertion
08 (80 mm)	00359537	00359614
10 (100 mm)	00352198	00352198
15 (150 mm)	02124175	02124161
18 (180 mm)	00350148	00290049
25 (250 mm)	00290035	00290046
35 (355 mm)	00354147	00290985

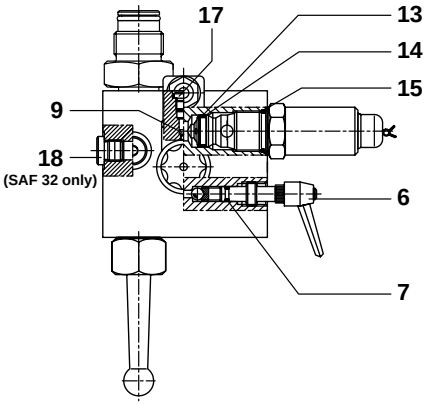
For items not listed please consult factory.



WARNING: Only qualified persons should perform maintenance on any type of accumulator. Complete maintenance instructions are available - Contact **HYDAC**.

Safety & Shut-off Blocks: Seal Kits, Repair Kits, Spare Parts

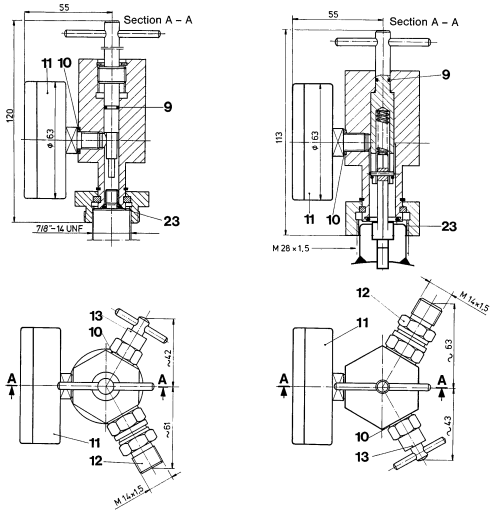




Item	# on drawing	SAF 10... Dimensions	SAF 20...	SAF 32...
Repair Kit		**Part No.** 03154715 (FPM)	**Part No.** 03154716 (FPM)	**Part No.** 03154717 (FPM)
Spindle	1			
Thrust Washer	2			
O-ring	3*	10 x 2	15 x 2.5	20 x 3
Ball	4			
Handle	5			
Spindle	6			
O-ring	7*		6 x 2	
Set Screw	8*			
Orifice	9*			
Backup Ring	10.1*			
O-ring	10.2*			
O-ring	10.3*			
Ball Seals	11*			
O-ring	12*	21 x 2	34 x 2.5	53 x 2.5
Usit-ring	13*	17.4 x 24 x 1.5	24.7 x 31.5 x 2	24.7 x 31.5 x 2
O-ring	14*	19 x 3	26 x 3	26 x 3
Backup Ring	15*	20.3 x 25 x 1	27.3 x 32 x 1	27.3 x 32 x 1
O-ring	16*	29.7 x 2.8	29.7 x 2.8	37.2 x 3
Plug	17*	7/16-20UNF	3/4-16UNF	3/4-16UNF
Plug	18*	N/A	N/A	G1/8
Seal Kit (includes parts marked with * in repair kit above)		**Part No.** 03154712 (FPM)	**Part No.** 03154713 (FPM)	**Part No.** 03154714 (FPM)
Manual Bleed Valve			**Part No.** 02115649 (FPM)	
Spindle, handle, ball	6			
O-ring	7	Dimensions See Above		
Set Screw	8			
2-way solenoid operated bleed valve (without coil)				**Part No.**
Normally Open (for SAF...E16Y)				00710953
Normally Closed (for SAF...E16Z)				00710952
Coil Kit for 2-way solenoid operated bleed valve				**Part No.**
24 V DC				00715003
110 V AC				00715033

O-ring dimensions are in mm

Charging & Gauging Units: Spare Parts



Item	Description	Part No.
9	O-Ring	00601032
10	Seal-Ring	00601228
11	Gauge *(select pressure range below)*	
	10 (0 to 145 psi)	00606759
	25 (0 to 350 psi)	00606760
	100 (0 to 1400 psi)	00606761
	250 (0 to 3500 psi)	00606762
	400 (0 to 5800 psi)	00606763
12	Check Valve	00610004
13	Manual Bleed Valve	00236445
23	O-Ring	00626488
-	2.5m Hose	00236514
-	4m Hose	00236515
-	10m Hose	00373405
-	ADAPTER G4	02068737
-	ADAPTER A3 (FPK/SB)	00291533

For additional adapters Contact **HYDAC.**

WARNING: Only qualified persons should perform maintenance on any type of accumulator.
Complete maintenance instructions are available - Contact **HYDAC**.

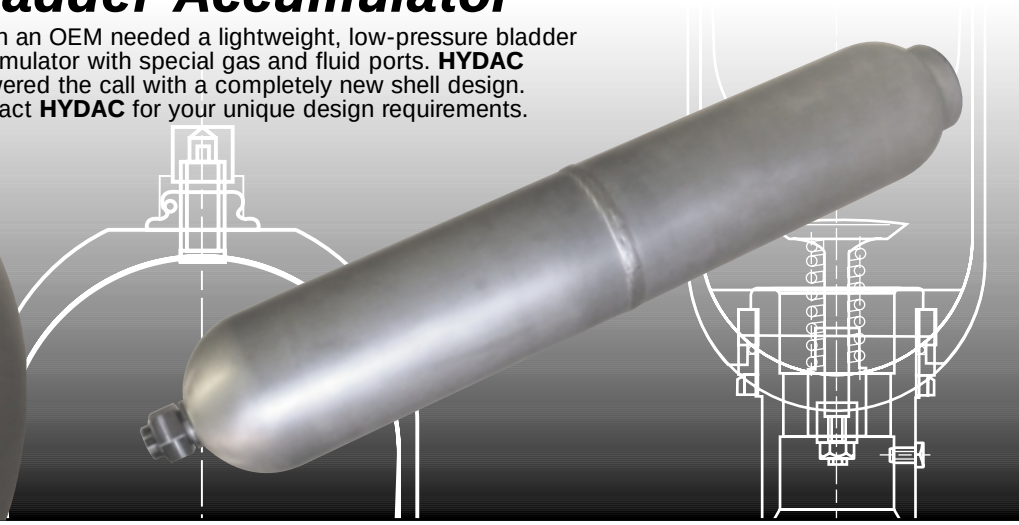
HYDAC Accumulators
Bladder, Piston, Diaphragm.

Custom Solutions & Design Assistance!

Let **HYDAC** help you solve your most difficult application challenges. Our team of engineers, and 40 years of global application experience become your asset when you work with **HYDAC**. Whether you simply require special porting, or a highly engineered accumulator system, the **HYDAC** team is there to provide the best technical and commercial solutions.

Lightweight Bladder Accumulator

When an OEM needed a lightweight, low-pressure bladder accumulator with special gas and fluid ports. **HYDAC** answered the call with a completely new shell design. Contact **HYDAC** for your unique design requirements.



HYDAC INTERNATIONAL

The Single Source for Hydraulic Components

HYDAC Accumulators
Bladder, Piston, & Diaphragm Types; Pulsation Dampeners & Shock Absorbers;
Safety & Shut-off Blocks; Charging & Gauging Units; Mounting Components & Accessories

HYDAC Filters
Hydraulic Oil; Lube Oil; Fuel & Fuel Oil; Water; Process;
High Pressure; Return Line; Suction; Strainers; Inline; Manifold-mount; Modular Stacking;
In-tank; Inside Tank; Circuit Protectors; Spin-on; Backflush; Selectable Duplex; Clogging Indicators;
Wide Variety of Elements Including Interchanges for All Major Brands; Private Labeling for OEM's

HYDAC Fluid Service Products
Offline & Portable Filters; Online & Portable Realtime Particle Counters; Water Sensors;
Fluid Sampling Kits; Fluid Analysis Kits; Vacuum Dehydration Water Removal Units

HYDAC Valves
High & Low Pressure Ball Valves; Flow, Needle, & Check Valves;
Hydraulic/Pneumatic Actuators; Custom Valve Design

HYDAC Clamps
Hose, Tube, & Pipe Clamps; Cushion Clamps; Band Straps;
U-bolts; Fixed Cylinder Clamps; Custom Clamping Solutions

HYDAC Accessories
TestPoints & Flexible Test Hoses; Fluid Level Indicators; Gauge Isolators;
Suction Strainers; Breathers; Filler/Breathers; Desiccant Breathers

HYDAC Electronics
Pressure & Temperature Transducers & Switches; Flow Rate Meters;
Current Probes; Digital Displays; Portable Data Recorders

HYDAC Coolers
Air-Cooled & Water-Cooled Models; Cooler, Pump/Filter, & Pump/Filter/Cooler Units;
AC Industrial Models; DC & Hydraulic Drive Mobile Models

HYDAC Power Units
High Pressure & Compact Power Units;
Standard & Custom Integrated Control Units

HYDAC Cartridge Valves
Pressure Controls — Reducing & Relieving Valves; Proportional Pressure & Flow Control Valves;
Check Valves; Flow Controls; Load Controls — Counterbalance & Pilot-Op. Check Valves;
Custom Manifold Design & Manufacturing; Solenoid Directional Valves — Poppet & Spool Types;
5000 psi, up to 40 GPM; Inline Mounting Bodies

HYDAC Mobile Systems
Central Valve Blocks; Suspension Control; Steering Control;
Power Attachment Controls; Design & Application Assistance

www.hydacusa.com

2280 City Line Road • Bethlehem, PA 18017
Phone: (610) 264-9503 • Fax: (610) 264-7529
Brochure - *Accumulator Catalog* #02068195 / 08.03