

HYDAC | **INTERNATIONAL**

Accumulators

Bladder, Piston, Diaphragm





HYDAC stands for worldwide presence and accessibility to the customer. HYDAC has over 1000 distributors worldwide and more than 40 wholly owned branches. HYDAC accumulators – a name synonymous with advanced technology, design, manufacturing and application engineering for more than 40 years, is considered a leader throughout the hydraulic industry, worldwide.

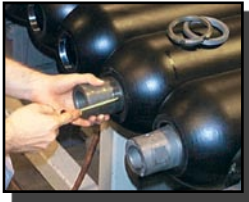
HYDAC Products



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.



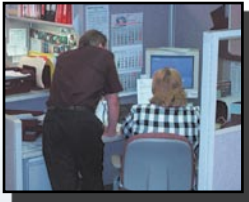
HYDAC Quality



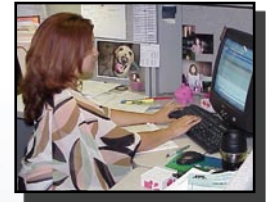
HYDAC stands for quality and customer service. HYDAC achieves the highest quality accumulators and related parts through continuous research and development in our laboratories for testing of physical, chemical, and mechanical properties. To ensure that HYDAC accumulators and related products are as 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.

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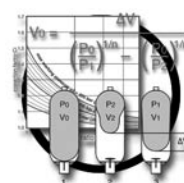
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Diaphragm Accumulators	Contact HYDAC

HYDAC (derived from **HYD**raulic **AC**cumulators) has been a name synonymous with advanced technology, design, manufacturing and application engineering for more than 40 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 longer life expectancy

Types

HYDAC offers all types of accumulators:

- bladder accumulators
- diaphragm accumulators
- piston accumulators
- dampeners

Accessories

- All accessories needed for proper installation and maintenance of accumulators are available, including:
- safety and shut off blocks
- mounting components
- accumulator sets
- charging and gauging units

Development and Engineering

Based on research and development in our laboratories for testing of physical, chemical and mechanical properties, HYDAC achieves the highest quality of accumulators and related parts.

Finite Element Analysis is implemented in the Computer Aided Design package supporting development and engineering to optimize the performance and safety of the components.

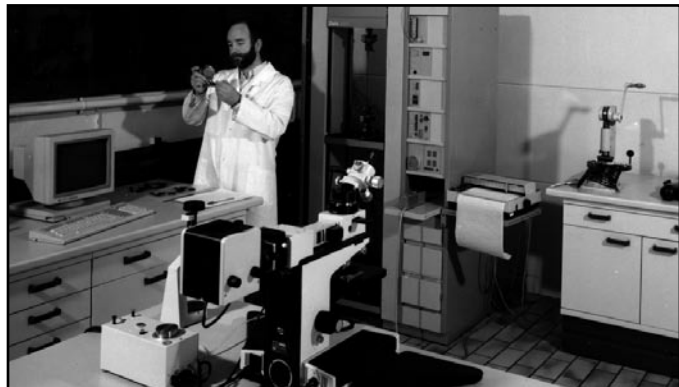
Application assistance is available utilizing HYDAC computer software to simulate your system and optimize the sizing for energy savings, shock absorption or pulsation dampening.

Manufacturing and Assembly

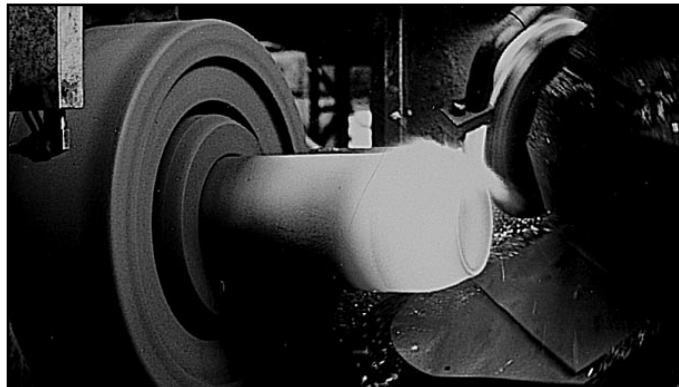
Manufacturing and assembly at HYDAC are subject to strict quality control. HYDAC utilizes state-of-the-art manufacturing and quality assurance techniques.



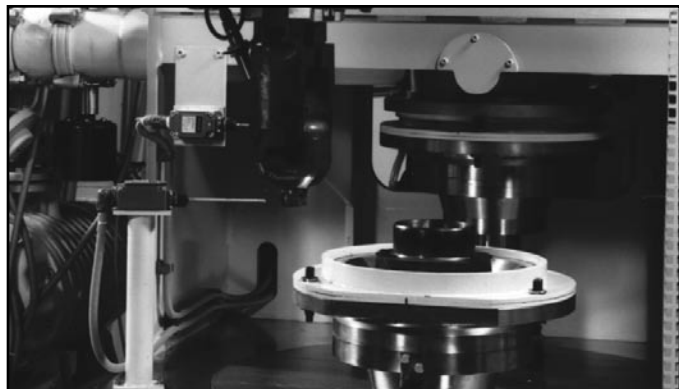
CAD and Finite Element Analysis (FEA)



Laboratory for elastomer testing



Spinning process of bladder accumulators shell manufacturing



Electron-beam welding of diaphragm accumulators



Machining Department - Sulzbach, Germany



Laboratory test stand



Assembly of bladder accumulators



Assembly of piston accumulators

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

(European Union Member States listed in bold below)

Algeria	U ³⁾	Hong Kong	A9	Pakistan	U ³⁾
Argentina	U ³⁾	Hungary	U ³⁾	Peru	U ³⁾
Australia	F ¹⁾	Iceland	U ³⁾	Philippines	U ³⁾
Austria	U	India	U ³⁾	Poland	U
Bahamas	E	Indonesia	U ³⁾	Portugal	U
Barbados	U ³⁾	Iran	U	Puerto Rico	E ³⁾
Belgium	U	Iraq	U ³⁾	Romania	U
Bermuda	U ³⁾	Ireland	U	Russia (CIS)	A6
Bolivia	S ³⁾	Israel	U ³⁾	Saudi Arabia	U ³⁾
Brazil	U ³⁾	Italy	U	Singapore	U
Canada	S1 ²⁾	Japan	P	Slovakia	A8
Chile	S ³⁾	Jordan	U ³⁾	South Africa	U ³⁾
China	A9	Korea	U	Spain	U
Costa Rica	E ³⁾	Kuwait	U ³⁾	Sudan	U ³⁾
Czech Republic	U	Lebanon	U ³⁾	Sweden	U
Denmark	U	Libya	U ³⁾	Switzerland	U
Ecuador	U ³⁾	Luxembourg	U	Syria	U
Egypt	U	Malaysia	U ³⁾	Taiwan	U ³⁾
Finland	U	Mexico	S ³⁾	Thailand	U ³⁾
France	U	New Zealand	T	Tunisia	U ³⁾
Germany	U	Netherlands	U	Turkey	U
Greece	U	Nigeria	U ³⁾	United Kingdom	U
		Norway	U ³⁾	USA	S
				Venezuela	S ³⁾
				Yugoslavia	U

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



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)



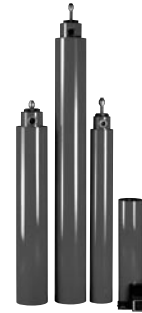
Automotive

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

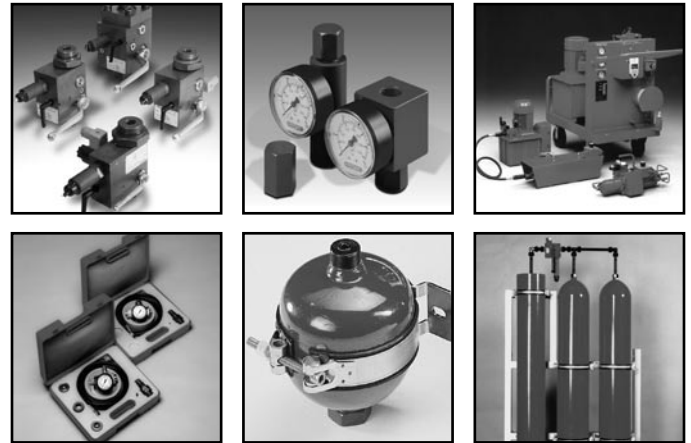
Dampeners

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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • best for large stored volumes • best for high flow rates • not recommended for shock applications • best for use with backup nitrogen bottles

SB Series Bladder Accumulators

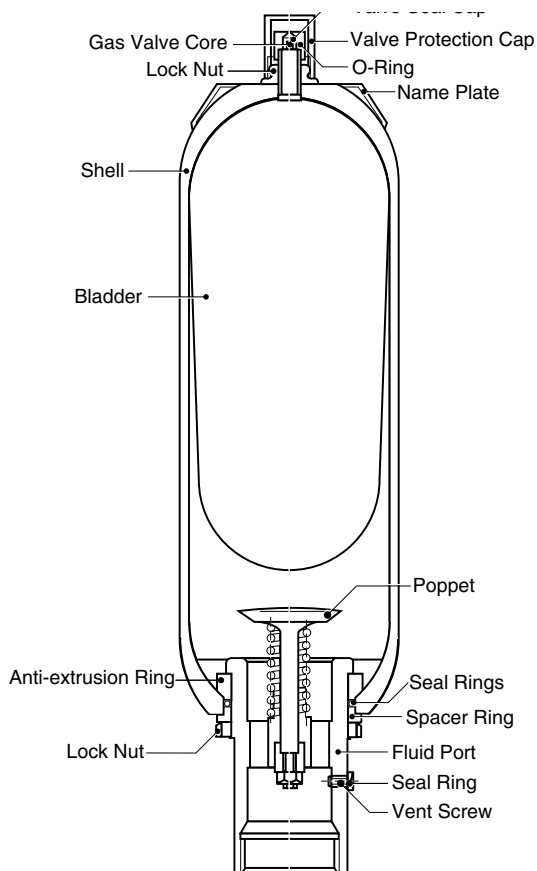


Description

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.

Bladder Accumulators **HYDAC**

Model Code

SB 330 - 20 A 1 / 112 S - 210 C

Series

- SB 330 = Bladder accumulator (3000 psi)
- SB 600 = Bladder accumulator (5000 psi)

Design

- (omit) = Standard (bottom repairable)
- N = Modified Flow (396 gpm)
- H = High Flow (480 gpm)
- TR = Standard (top repairable)
- NTR = Modified Flow (396 gpm) (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)
- 7 = Others available on request

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	mineral oils
	32° to 180°F	water & water-glycols
LT-NBR	-50° to 180°F	mineral oils
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
FPM	5° to 300°F	chlorinated hydrocarbons

Country of Installation

- S = USA
 - W1 = ABS Type Approval
 - W3 = DNV Type Approval
- (for other countries see page 2 for proper code designation)

Maximum Working Pressure

- 210 = 3000 psi
- 345 = 5000 psi

Fluid Port Connection

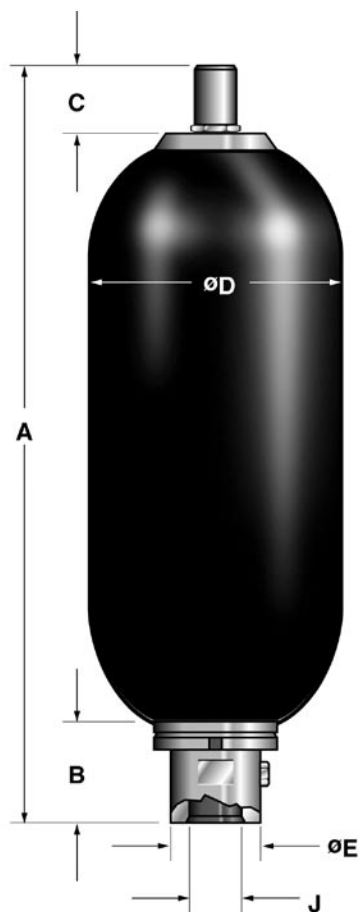
- Threaded
 - A = BSPP (ISO 228)
 - B = Metric (DIN 13)
 - C = SAE (ANSI B1.1)
 - D = NPT (ANSI B1.2)
- Flanged
 - E = SAE 2" - 3000 psi (Code 61)
 - F = SAE 1 1/2" - 6000 psi (Code 62)
 - G = SAE 1 1/4" - 3000 psi (Code 61)
 - H = SAE 1" - 6000 psi (Code 62)

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

Note: For Oil, Gas & Marine specific bladder accumulators please refer to page 48

HYDAC Bladder Accumulators

SB Series Bottom Repairable

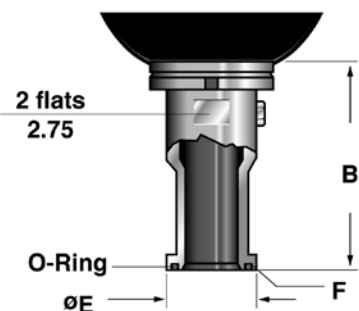


SB 330... (3000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in ³	Weight	A	B ⁽¹⁾	C	ØD	ØE	Thread J SAE 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. in ³	Weight	A	B ⁽¹⁾	C	ØD	ØE	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)	9.1-9.7 (232-247)	3.0 (76)	1 7/8-12 UN	240
20	5	1125	162 (73)	35.0 (888)	3.1 (80)	2.8 (70)	9.1-9.7 (232-247)	3.0 (76)	1 7/8-12 UN	240
32	10	2080	250 (113)	55.2 (1402)	3.1 (80)	2.8 (70)	9.1-9.7 (232-247)	3.0 (76)	1 7/8-12 UN	240
54	15	3180	370 (168)	78.8 (2002)	3.1 (80)	2.8 (70)	9.1-9.7 (232-247)	3.0 (76)	1 7/8-12 UN	240



Split Flange Connection (sizes 10 - 54)

Series	B	ØE	F Split Flange Connection	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" – 5000 psi Code 62	240

Dimensions are for general information only, all critical dimensions should be verified.
Dimensions are in inches/(mm) and lbs/(kg)

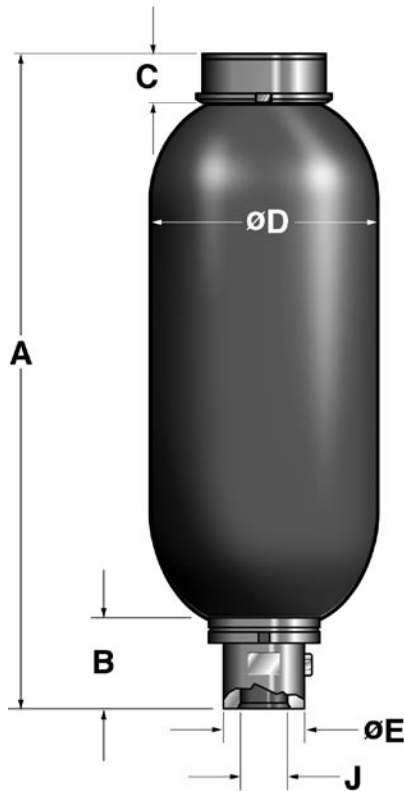
NOTE: Higher pressure may be available. Please consult HYDAC for more information.

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.

SB Series Top Repairable and High Flow



SB 330 TR... (3000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in ³	Weight	A	B ¹⁾	C	ØD	ØE	Thread J		Q ²⁾ gpm
									SAE	NPTF	
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
42	11	2320	270 (123)	60.2 (1530)	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... (5000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in ³	Weight	A	B ¹⁾	C	ØD	ØE	Thread J		Q ²⁾ gpm
									SAE		
20	5	1125	172 (78)	33.5 (851)	3.1 (80)	1.6 (40)	9.1-9.7 (232-247)	3.0 (76)	1 7/8-12 UN		240
32	10	2080	260 (118)	53.7 (1364)	3.1 (80)	1.6 (40)	9.1-9.7 (232-247)	3.0 (76)	1 7/8-12 UN		240
54	15	3205	380 (172)	77.3 (1964)	3.1 (80)	1.6 (40)	9.1-9.7 (232-247)	3.0 (76)	1 7/8-12 UN		240

SB 330 NTR... (3000 psi, High Flow)

Size	Nom. Vol. gal.	Eff. Gas Vol. in ³	Weight	A	B ¹⁾	C	ØD	ØE	Thread J		Q ²⁾ gpm
									SAE		
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		396
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		396
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		396

Dimensions are for general information only, all critical dimensions should be verified.
Dimensions are in inches/(mm) and lbs/(kg)

1) Applies to SAE thread type only. For Split Flange, see chart and illustration on previous page.

2) Maximum discharge flow rate recommended for vertically mounted accumulators.

SBO Series Diaphragm 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.

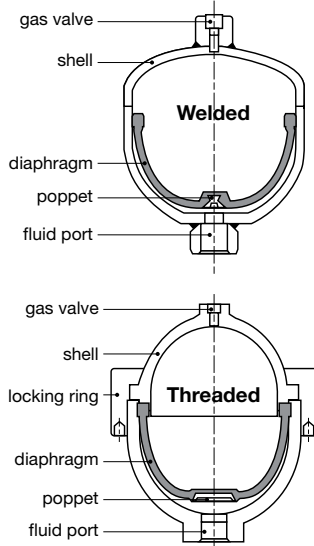
HYDAC manufactures two types of diaphragm accumulators:

- 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 50.

Diaphragm Accumulators **HYDAC**

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)
6 = FPM (fluoro-elastomer)
7 = Others (available on request)

Compound	Oper. Temp Range	Typical Fluids
NBR	5° to 180°F	mineral oils
	32° to 180°F	water & water-glycols
NBR	-50° to 180°F	mineral oils
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
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

AK = BSP connection
AB = Male / Female combination connection
CK = Standard SAE connection
(other fluid ports available upon request — consult factory)

Gas Precharge Pressure (P_g) in bar (always required for E2 model gas valve)

= 3 digits

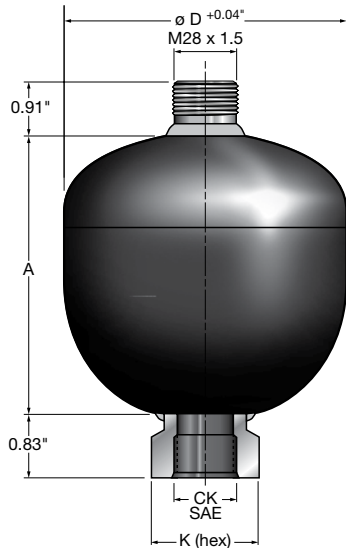
Model Codes containing **RED** selections are non-standard items – Contact **HYDAC** for information and availability
Not all combinations are available

HYDAC Diaphragm Accumulators

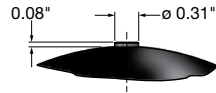
SBO Series

Non-Repairable Welded Diaphragm Accumulators

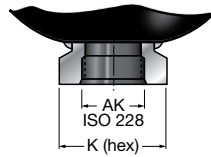
Version E1



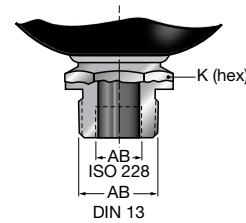
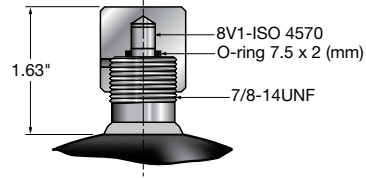
Version E2



Not available on SBO330 or on any accumulator larger than 1.4 liters.



Version E4



Series	Max. $p_2:p_0$	Size (liters)	Effective Gas Vol in ³	MAWP psi/(bar)	Weight	A	$\varnothing D^2$	F Thread				K (hex)	Q gpm
								CK (SAE)	AK (ISO 228)	AB (ISO 228)	AB (DIN 13)		
SBO 250	8 : 1	0.075	5	3600 (250)	1.5 (0.7)	2.68 (68)	2.52 (64)	9/16-18 UNF	G 1/2	N/A	N/A	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	G 1/2	N/A	N/A	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	G 1/2	N/A	N/A	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	G 1/2	N/A	N/A	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	G 1/2	G 1/2	M33 x 1.5	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	G 1/2	G 1/2	M33 x 1.5	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	G 1/2	G 1/2	M33 x 1.5	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	G 1/2	G 1/2	M33 x 1.5	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	G 1/2	G 1/2	M33 x 1.5	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	G 1/2	G 1/2	M33 x 1.5	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	G 1/2	G 1/2	M33 x 1.5	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	G 3/4	G 3/4	M45 x 1.5	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	G 3/4	G 3/4	M45 x 1.5	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	G 3/4	G 3/4	M45 x 1.5	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	G 3/4	G 3/4	M45 x 1.5	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	G 3/4	G 3/4	M45 x 1.5	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	G 3/4	G 3/4	M45 x 1.5	1.81 (46)	40

Dimensions are for general information only, all critical dimensions should be verified.

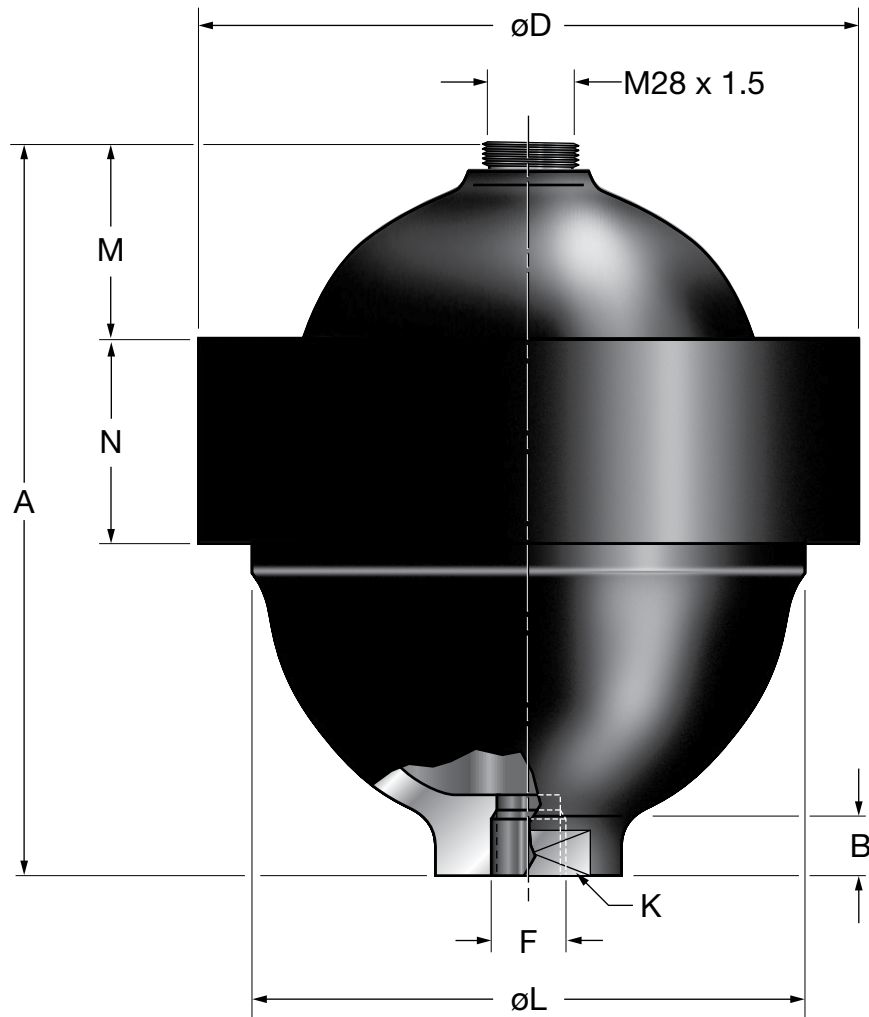
Dimensions are in inches/(mm) and lbs/(kg)

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

SBO Series Repairable Threaded Diaphragm Accumulators

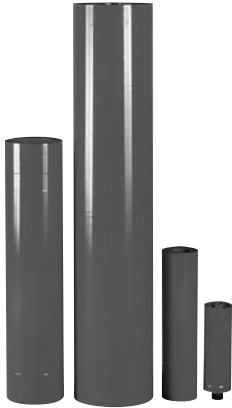


Series	Max. $p_2:p_0$	Size (liters)	Effective Gas Vol in ³	MAWP psi/(bar)	Wt.	A	B	$\varnothing D^{(2)}$	Thread F		K	$\varnothing L$	M	N	Q gpm
									SAE	BSPP					
SBO 500	10 : 1	0.1	6	7200 (500)	4.2 (1.9)	4.33 (110)	1.18 (30)	3.74 (95)	3/4-16	G 1/2	1.26 (68)	2.68 (68)	0.87 (22)	1.38 (35)	25
SBO 500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

Dimensions are for general information only, all critical dimensions should be verified.
Dimensions are in inches/(mm) and lbs/(kg)

1) Only available in stainless steel construction

SK Series



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.

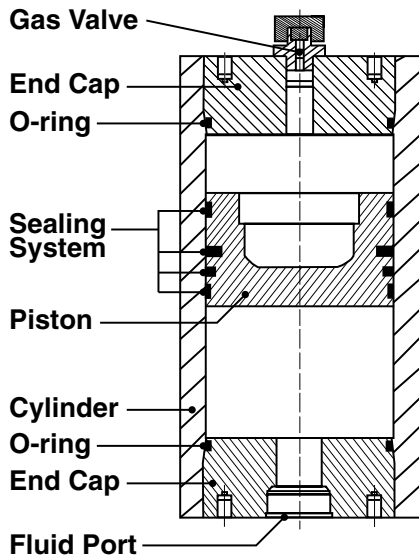
A piston accumulator consists of a fluid section and a gas section with the piston acting as a gas proof screen. The gas section is precharged with dry nitrogen gas.

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

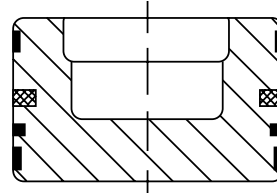
HYDAC piston accumulators consist of:

- 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

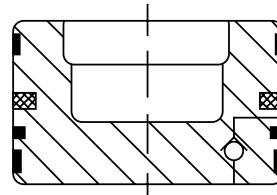


Application:

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 $\bar{O}10 \mu\text{m}$ absolute. (ISO 18/16/13)
Max. continuous velocity = 12 fps

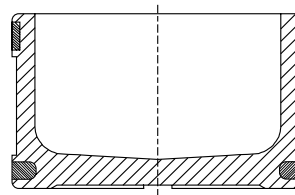
TYPE 2 with Check Valve



Application:

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

TYPE 3



Application:

Actual cycles achieved will vary with operating parameters.

Notes: Filtration $\leq 10 \mu\text{m}$ 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.

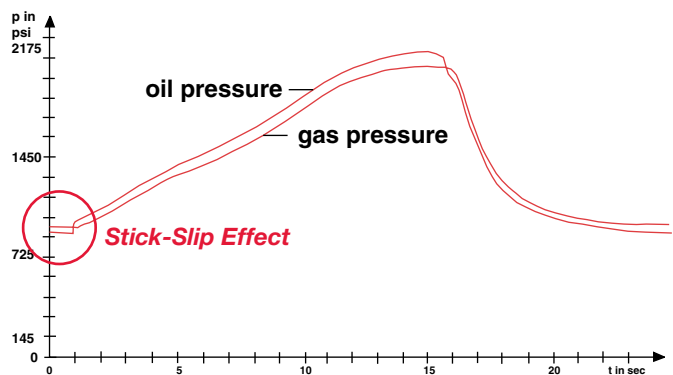
The measurement graphs below are a true representation of the gas and oil pressure of piston accumulators with

different sealing systems. The comparison of these two measurements clearly shows the difference in the pressure differential between gas and oil side:

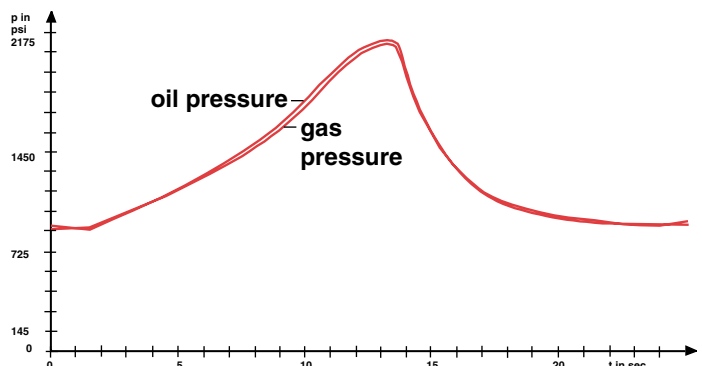
Graph 1: Δp max. \approx 125 psi

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)

HYDAC *Piston Accumulators*

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)

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 26)

*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: $A^{(1)}$ Sample Code = $A^{(1)} A^{(2)} A^{(3)}$

Code	Type of Connection	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 (red) as the second character of the connection code.

3) Enter the letter of the COLUMN (gray) as the third character of the connection code.

Flange Connections: $F^{(4)}$ Sample Code = $F^{(4)} C^{(5)} B^{(6)}$

Code	Type of Connection	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 (red) as the second character of the connection code.

6) Enter the letter of the COLUMN (gray) as the third character of the connection code.

Gas Valve Connections: $V^{(7)}$ Sample Code = $V^{(7)} (\text{omit})^{(8)} A^{(9)}$

Code	Type of Connection
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:

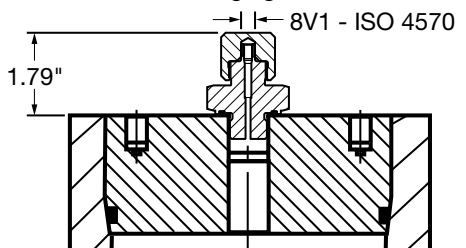
HYDAC has the capabilities to produce accumulators with many other types of connections. The options listed above are simply the most common, and most readily available. Other connection options include:

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

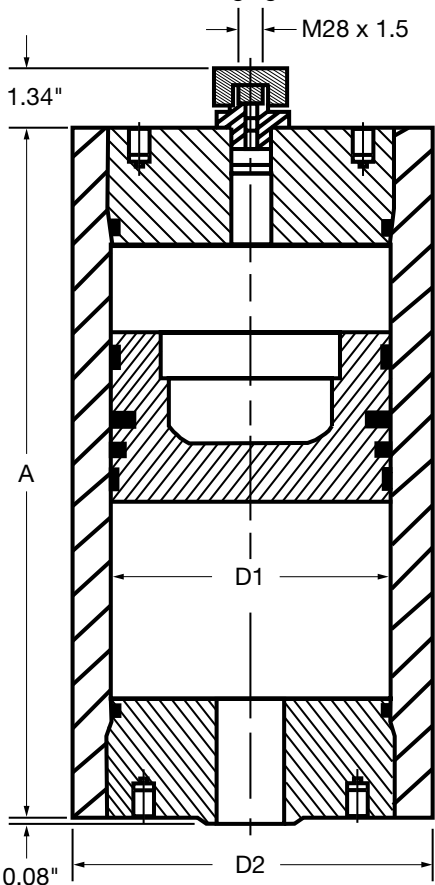
Custom solutions that incorporate valve/manifold assemblies are also available, for more information on special connections and custom solutions, consult factory.

SK 350 Series Type 2 Dimensions

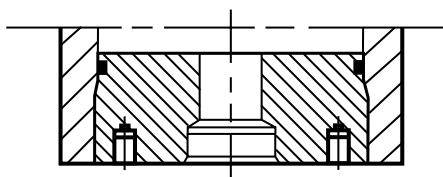
Gas Valve Version 4 (code designation VE)
Uses Charging Unit FPS



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)

3000 psi maximum working pressure

Size liters	Effective Gas Volume gal	Weight lbs / (kg)	A in / (mm)	ø D1 in / (mm)	ø D2 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)	9.84 (250)	12.21 (310)
40	10	788 / (357)	49 / (1245)		
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)	13.98 (355)	17.09 (434)
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)		
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)		

5000 psi maximum working pressure

Size liters	Effective Gas Volume gal	Weight lbs / (kg)	A in / (mm)	ø D1 in / (mm)	ø D2 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)	3.15 (80)	3.94 (100)
0.5	0.125	24 / (11)	9.8 / (250)		
1	0.25	29 / (13)	13.8 / (350)	3.94 (100)	4.96 (126)
2	0.5	40 / (18)	21.7 / (550)		
2.5	0.625	62 / (28)	20.9 / (532)	4.92 (125)	6.30 (160)
5	1.25	88 / (40)	33.5 / (850)		
7.5	1.875	115 / (52)	46.1 / (1170)	5.91 (150)	7.09 (180)
2	0.5	82 / (37)	13.6 / (345)		
5	1.25	115 / (52)	23.2 / (590)	5.91 (150)	7.09 (180)
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)		

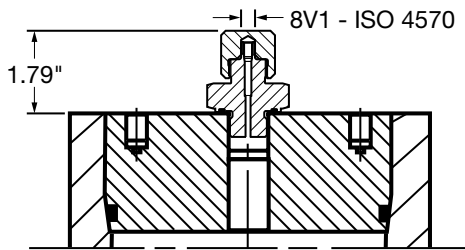
Note: Other sizes available on request. Intermediate sizes are possible, depending on the length/diameter required. Please consult factory for details on special sizes.

Dimensions are for general information only,
all critical dimensions should be verified.
Dimensions are in inches/(mm) and lbs/(kg)

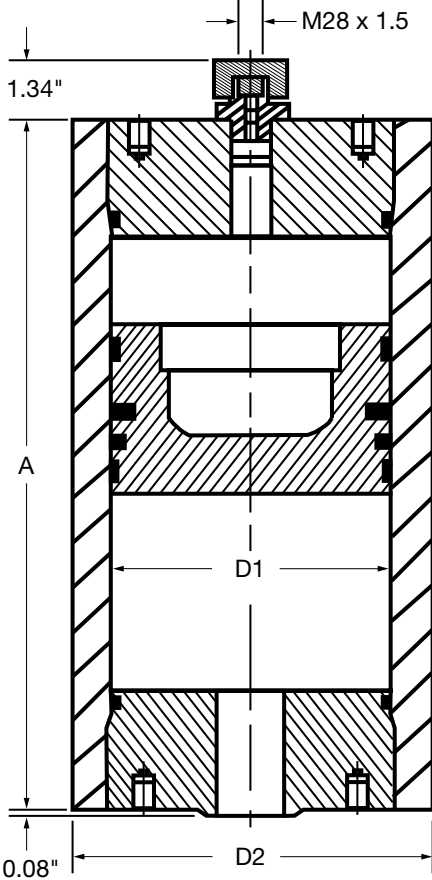
SK 600

Type 2 Dimensions

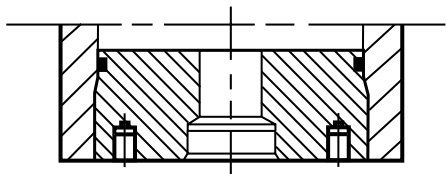
Gas Valve Version 4 (code designation VE)
Uses Charging Unit FPS



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)

3000 psi maximum working pressure

Size liters	Effective Gas Vol gal	Weight	A	ø D1	ø D2
10	2.5	302 / (137)	28 / (711)	7.09 (180)	9.61 (244)
16	4	402 / (182)	37.2 / (945)		
20	5	447 / (203)	43.4 / (1102)		
30	7.5	606 / (275)	58.9 / (1496)		
40	10	736 / (334)	74.4 / (1890)		
50	12.5	884 / (401)	89.9 / (2283)	9.84 (250)	13.31 (338)
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)		
115	30	2184 / (990)	109.2 / (2774)		
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)		

Dimensions are for general information only,
all critical dimensions should be verified.
Dimensions are in inches/(mm) and lbs/(kg)

SK 280 Series Piston Accumulators



Advantages

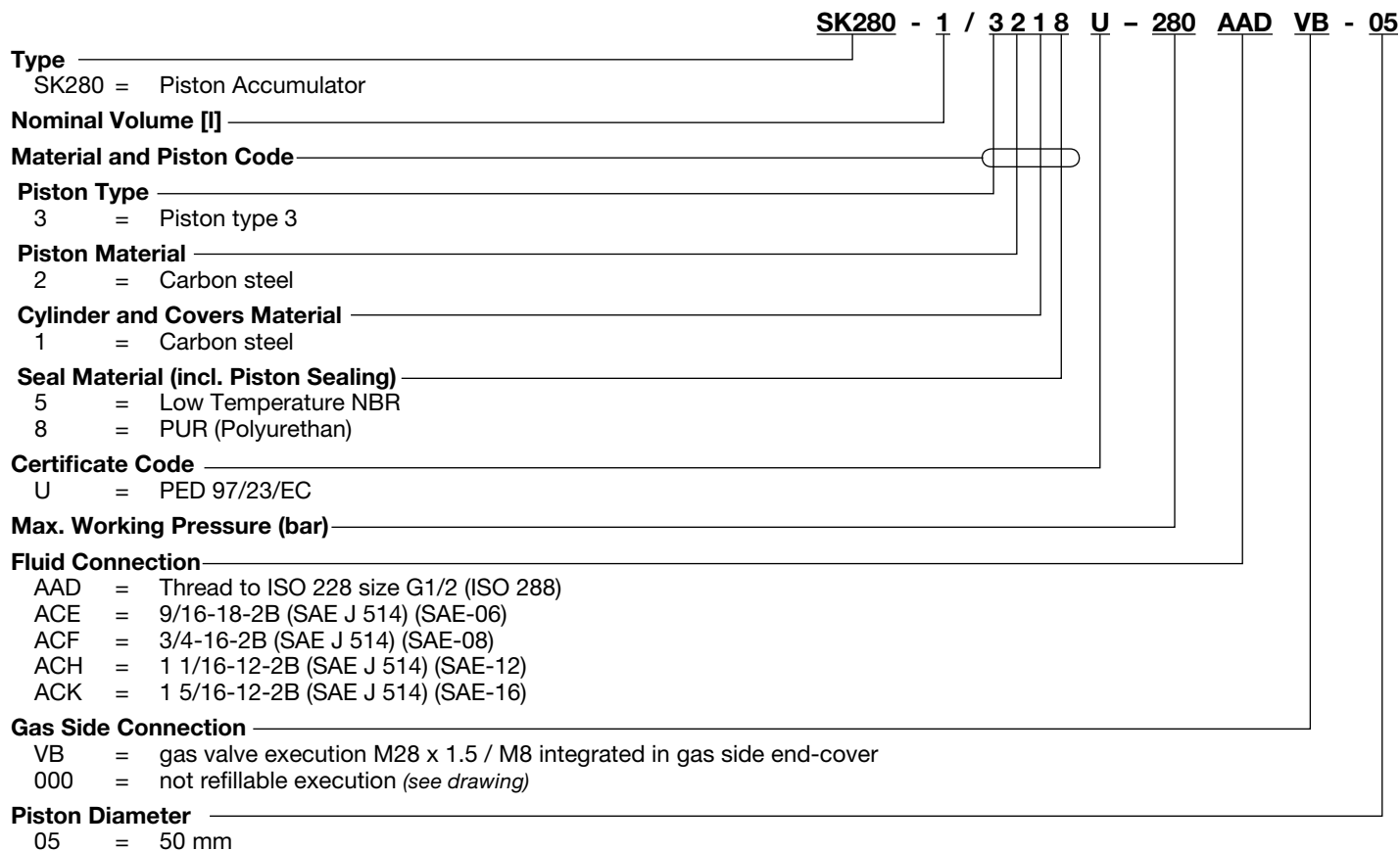
The new piston accumulator series: SK280 is non-repairable. The special production process of these HYDAC accumulators saves costs. Therefore it is possible to offer better sales prices.

- cost-effective – because of an optimized production process
- weight reduced series
- reduced installation space
- Standard-gas valve with integrated M28x1.5 male thread (non-refillable execution possible)
- Quick delivery for models with standard connection
- Fully tested (function test and fatigue test)
- SAE fluid ports are available

Application

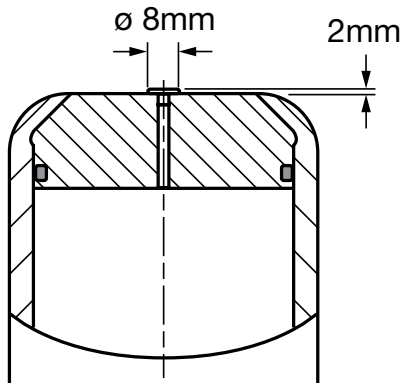
- Mobile Hydraulic
- Industrial Hydraulic

Model Code

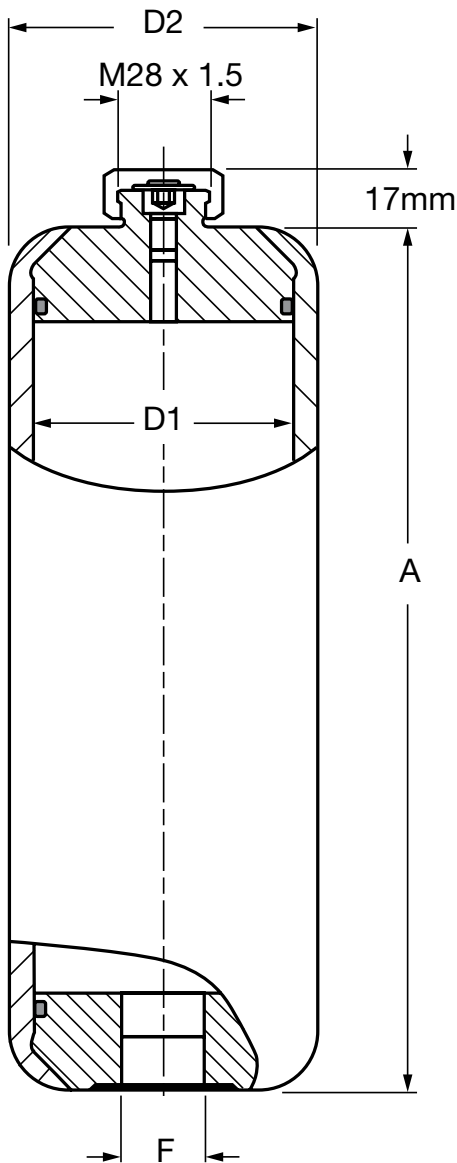


*Model Codes containing RED selections are non-standard items – Contact HYDAC for information and availability
Not all combinations are available – See page 16*

Dimensions 000 Connection



VB Connection - Refillable



Nominal Volume (Liter)	A +/- 3	F ISO 228	F SAE Ports	Weight	D1	D2
0.16	160	G 1/2	9/16-18-2B	2	50	60
0.32	240	G 1/2	9/16-18-2B	2.5		
0.5	335	G 1/2	3/4-16-2B	3.1		
0.75	460	G 1/2	3/4-16-2B	4		
1	590	G 1/2	3/4-16-2B	4.8		
0.32	205	G 1/2	3/4-16-2B	3	60	70
0.5	265	G 1/2	3/4-16-2B	3.5		
0.75	355	G 1/2	3/4-16-2B	4.2		
1	445	G 1/2	3/4-16-2B	5.1		
1.5	620	G 1/2	3/4-16-2B	6.4		
2	800	G 1/2	3/4-16-2B	7.8		
2.5	975	G 1/2	3/4-16-2B	9.2	80	95
0.5	210	G 3/4	1 1/16-12-2B	6.5		
0.75	260	G 3/4	1 1/16-12-2B	7.2		
1	310	G 3/4	1 1/16-12-2B	8		
1.5	410	G 3/4	1 1/16-12-2B	9.5		
2	510	G 3/4	1 1/16-12-2B	11.5		
2.5	605	G 3/4	1 1/16-12-2B	13		
3	705	G 3/4	1 1/16-12-2B	14.5		
3.5	805	G 3/4	1 1/16-12-2B	16		
4	905	G 3/4	1 1/16-12-2B	17.5		
0.75	235	G 1	1 5/16-12-2B	14	100	125
1	265	G 1	1 5/16-12-2B	15		
1.5	330	G 1	1 5/16-12-2B	17		
2	395	G 1	1 5/16-12-2B	19		
3	520	G 1	1 5/16-12-2B	23.5		
4	650	G 1	1 5/16-12-2B	28		
5	775	G 1	1 5/16-12-2B	32.5		
6	900	G 1	1 5/16-12-2B	37		

Dimensions are for general information only,
all critical dimensions should be verified.
Dimensions are in mm and kg

SN Series Nitrogen Bottles

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.

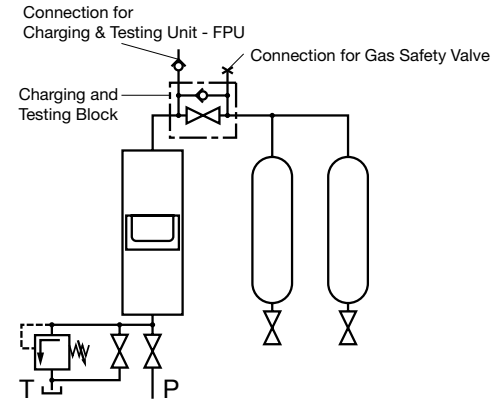
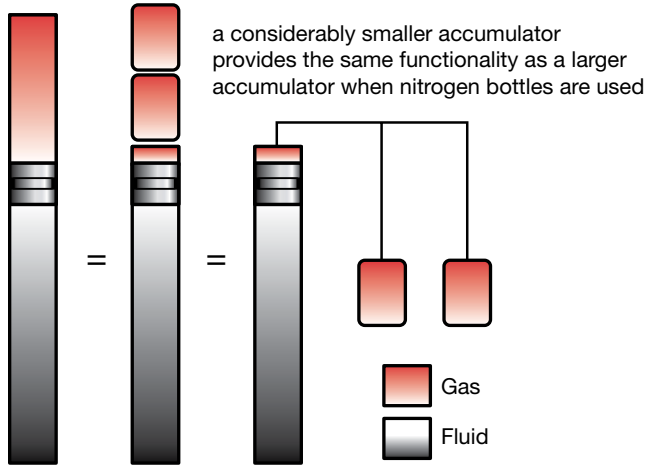
Model Code

	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	
57 = 57 Liters	
100 = 100 Liters	
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	
4 = Carbon steel (coated)	
Shell _____	
1 = Carbon steel (standard)	
2 = Carbon steel (coated)	
4 = Stainless steel	
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	
345 = 5000 psi	
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*

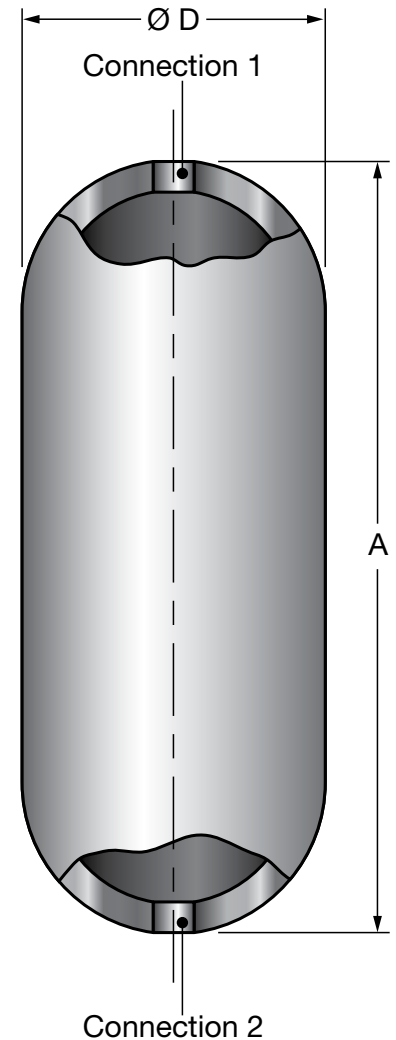
* Size offering listed is for standard nitrogen bottles. For Design Codes other than standard nitrogen bottles, refer to the model code of the accumulator type for sizes available.

SN Series Nitrogen Bottles



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



Connections

Size	A BSP (ISO228)	B Metric (DIN 13 Acc.ISO 965/1)	C (ANSI B1.1)	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

Items in RED are using the basic design with an adapter.

Dimensions are for general information only, all critical dimensions should be verified by requesting a certified print.

SB and SBO Series Pulsation Dampeners



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

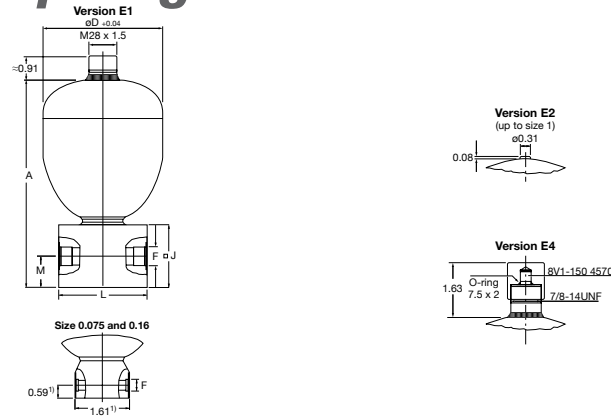
See illustration on page 25 for a graphic representation of a pressure spike with and without an accumulator being used as a shock absorber.

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											
(for other countries see page 2 for proper codes designation)												
Maximum Work Pressure	_____											
210	= 3000 psi											
345	= 5000 psi											
Fluid Port Connection	_____											
Threaded	_____											
AI	= BSPP (ISO 228)											
AK	= BSP (for sizes 0.075 & 0.16)											
CI	= SAE (ANSI B1.1)											
CK	= SAE (for sizes 0.075 & 0.16)											
Flanged	_____											
FI	= SAE 1 1/2" - 6000 psi (code 62)											
Precharged Pressure (P0) in bar	_____											

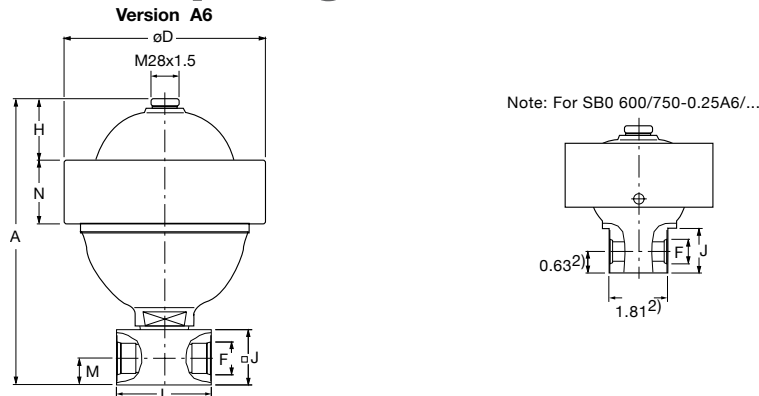
Model Codes containing RED selections are non-standard items – Contact HYDAC for information and availability
Not all combinations are available

SBO Welded Diaphragm Series Dimensions



Series	Size	Gas Volume (in ³)	Max. working pressure		Weight (lbs)	A (in)	$\phi D^{(3)}$ (in)	Thread F		J (in)	L (in)	M (in)	Q ² (gpm)
			psi	bar				SAE	BSP				
SBO250P	0.075	5	3600	250	2.2	4.57	2.52	9/16-18UNF	ISO 228-G1/4	-	-	-	5
SBO210P	0.16	10	3000	210	2.5	5.04	2.91	9/16-18UNF	ISO 228-G1/4	-	-	-	5
SBO210P	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
SBO210P	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
SBO330P	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
SBO210P	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
SBO200P	1	60	3000	210	12.9	8.02	5.35	1 5/16-12UNF	ISO228-G 1	2.36	4.13	1.18	40
SBO210P	2	120	3000	210	19.6	9.47	6.57	1 5/16-12UNF	ISO228-G 1	2.36	4.13	1.18	40

SBO Threaded Diaphragm Series Dimensions



Series	Size	Gas Volume (in ³)	Max. working pressure		Weight (lbs)	A (in)	ϕD (in)	Thread F		H (in)	J (in)	L (in)	M (in)	N (in)	Q ² (gpm)
			psi	bar				SAE	BSP						
SBO350P ⁽⁴⁾	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
SBO500P	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
SBO600P ⁽⁴⁾	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
SBO750P	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
SBO250P ⁽⁴⁾	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
SBO330P	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
SBO210P	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
SBO400P	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
SBO180P ⁽⁴⁾	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
SBO250P	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) For SAE threads only

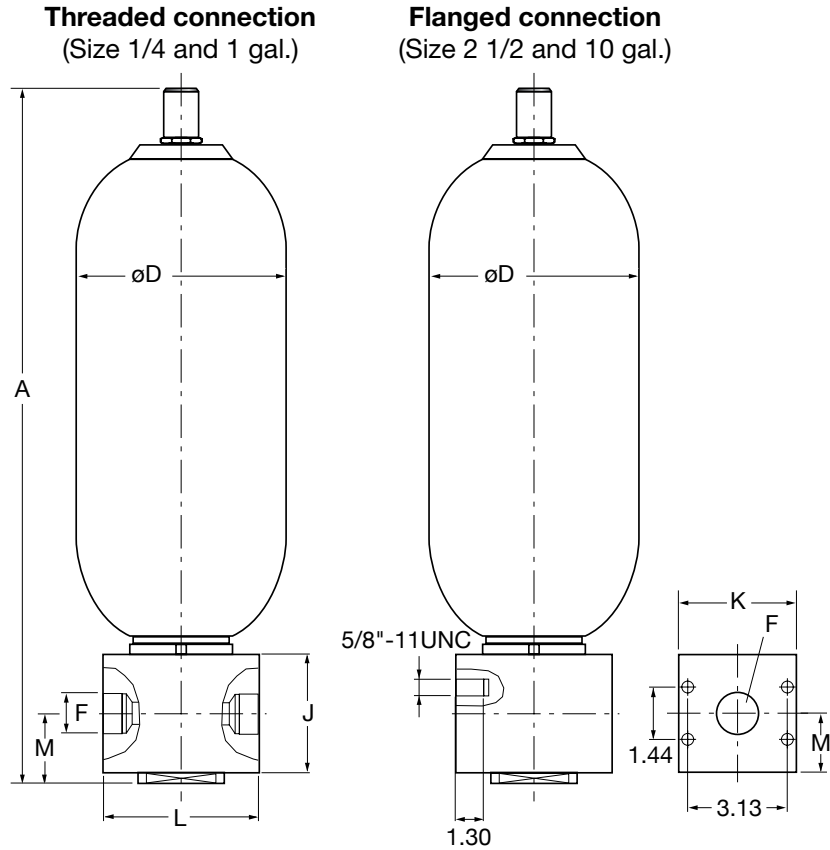
2) Pressure loss at Q (viscosity 32 cSt) approx. 50 psi

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

4) Only available in stainless steel

Dimensions are for general information only,
all critical dimensions should be verified by requesting a certified print.

SB Bladder Accumulator Series Dimensions



SB 330 P (3000 psi max. working pressure)

Size	Vol. (gal)	Gas Volume (in ³)	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

SB 600 P (5000 psi max. working pressure)

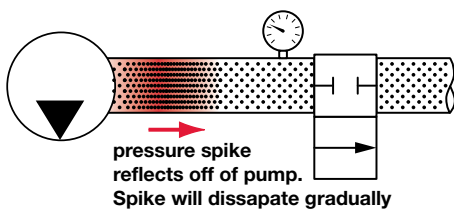
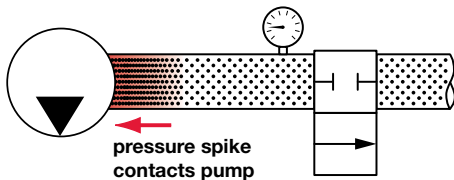
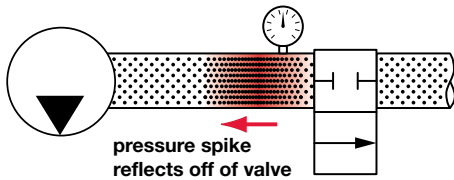
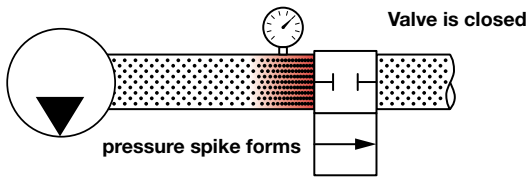
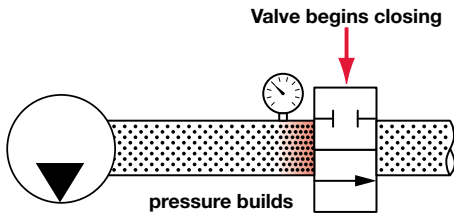
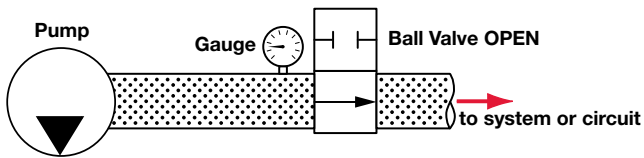
Size	Vol. (gal)	Gas Volume (in ³)	Weight (lbs)	A (in)	øD (in)	Connection F	J (in)	K (in)	L (in)	M (in)	Q ¹⁾ (gpm)
1	1/4	66	24	14.4	4.6	ISO 228-G1 1/4	3.15	3.15	4.72	2.24	80
4	1	226	49	18.0	6.6	ISO 228-G1 1/4	3.15	3.15	4.72	2.24	80
10	2 1/2	566	102	24.4	9.1	SAE 1 1/2" - 6000 psi (code 62 SAE)	3.94	4.50	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

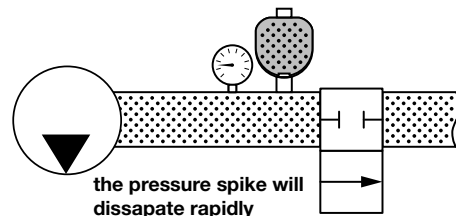
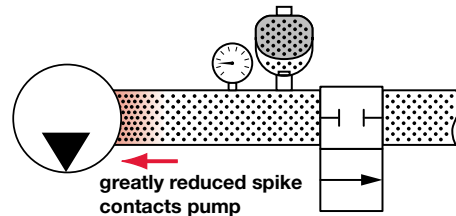
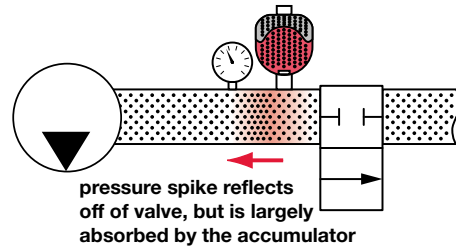
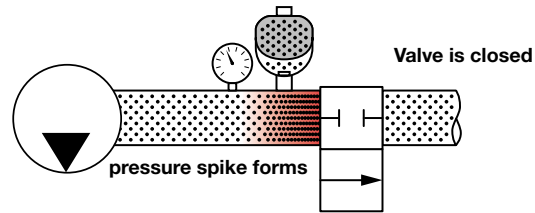
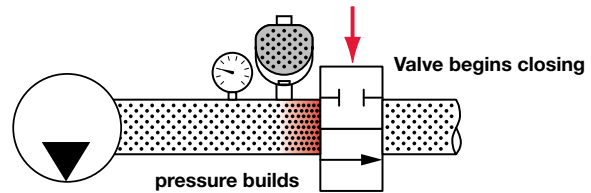
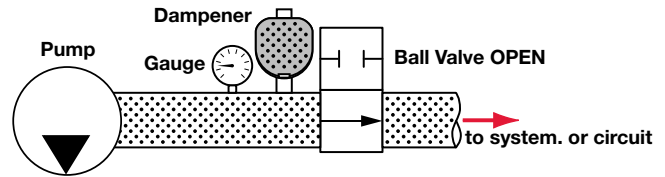
Dimensions are for general information only, all critical dimensions should be verified by requesting a certified print.

Graphic Example of a Pressure Spike

Without Accumulator

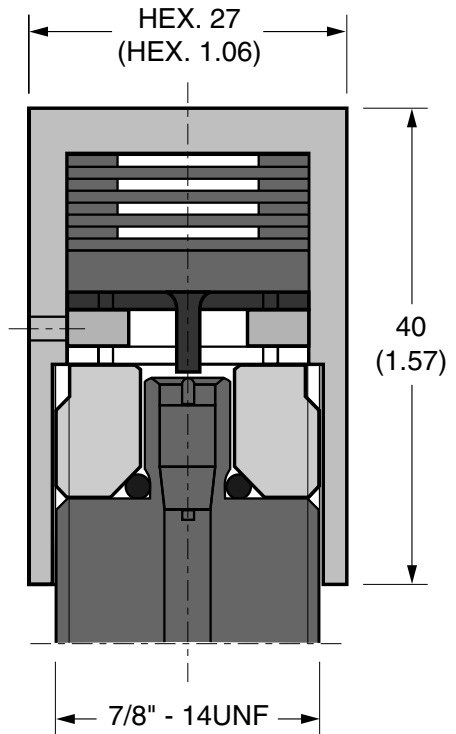
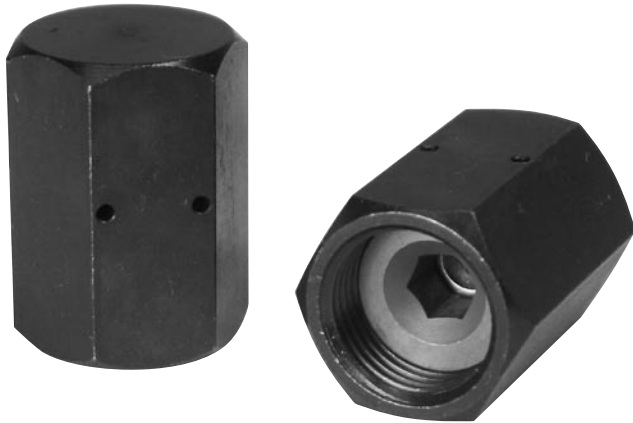


With Accumulator



For assistance in sizing pulsation dampeners, shock absorbers, and suction stabilizers, please contact the HYDAC Accumulator Group.

Thermal Fuse Caps



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.

Model Code

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

Order Part No. **00363501**

Technical Data

Maximum Working Pressure

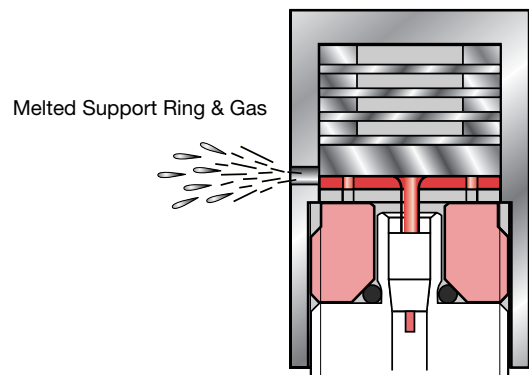
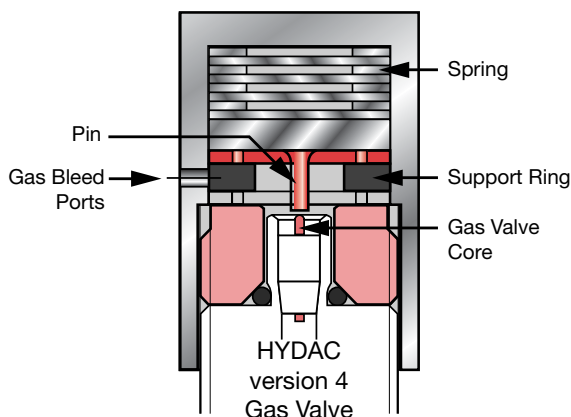
- 5000 psi (345 bar)

Maximum Working Temperature

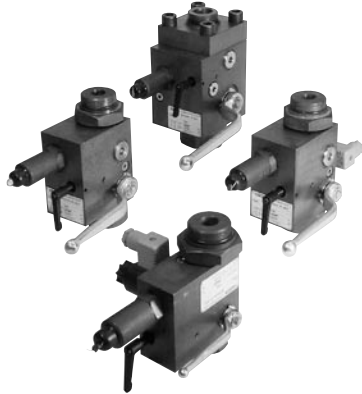
- 200°F (93.5°C)

Fusing Temperature

- 320 to 340°F (160 to 171°C)



SAF Series Safety & Shut-off Blocks



Description

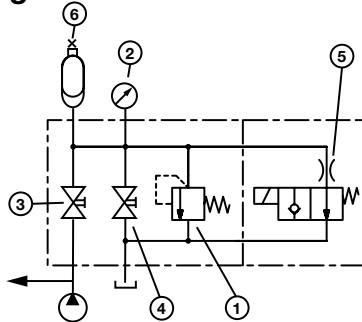
HYDAC safety and shut-off blocks are designed to protect, shut-off, and discharge hydraulic accumulators or user units. The compact design simplifies the hydraulic system connection and offers the following advantages:

- 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)

5° to 180°F (-15° to 80°C)

Maximum Working Pressure

up to 5800 psi (400 bar)

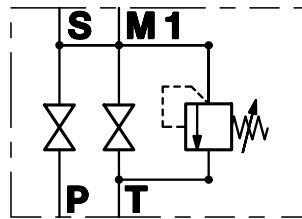
Construction

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

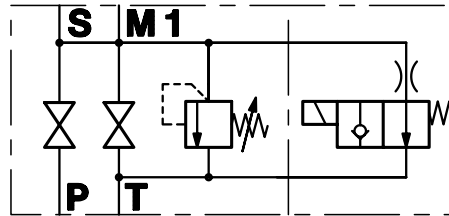
The basic model type "M" contains a manually operated bleed valve for manual pressure release of the accumulator.



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.



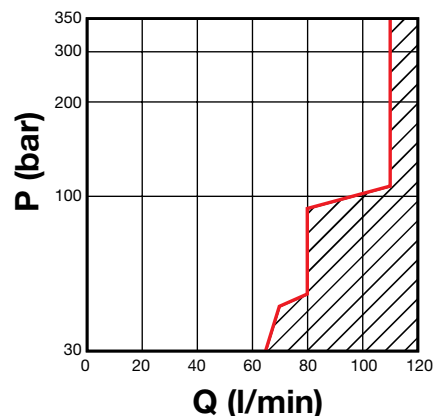
Sizes: SAF 10 E
SAF 20 E
SAF 32 E

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



Safety & Shut-off Blocks **HYDAC**

Model Code

		SAF 20 E 1 6 Y 1 - N 250 C - S 60 L
Series	SAF	= 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 (<i>Fluoro-elastomer</i>)
2-Way Solenoid Operated Bleed Valve Operating Function	(omit)	= if manual discharge was selected
	Y	= Normally Open (<i>standard</i>) (WSM06020Y)
	Z	= Normally Closed (WSM06020Z)
Solenoid	(omit)	= if manual discharge was selected
	1	= 0.8 AMP @ 24 VDC
	2	= 0.2 AMP @ 110 VAC – 60 Hz
Pressure Relief Valve (HYDAC DB12)	N 250	= Adjustable up to max pressure of 3625 psi (250 bar)
	N 350	= Adjustable up to max pressure of 5075 psi (350 bar)
	T XXX	= Factory set and lead sealed, certified Safety Relief Valve, non-adjustable (xxx is pressure in bar)
Connection Type		
Threaded	A	= BSPP (ISO 228)
	C	= SAE (ANSI B 1.1) (<i>standard</i>)
Flanged (SAF 32 only)	E	= SAE 2" – 3000 psi (<i>Code 61</i>)
	F	= SAE 1-1/2" – 6000 psi (<i>Code 62</i>)
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	= Locking device

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

SAF Series

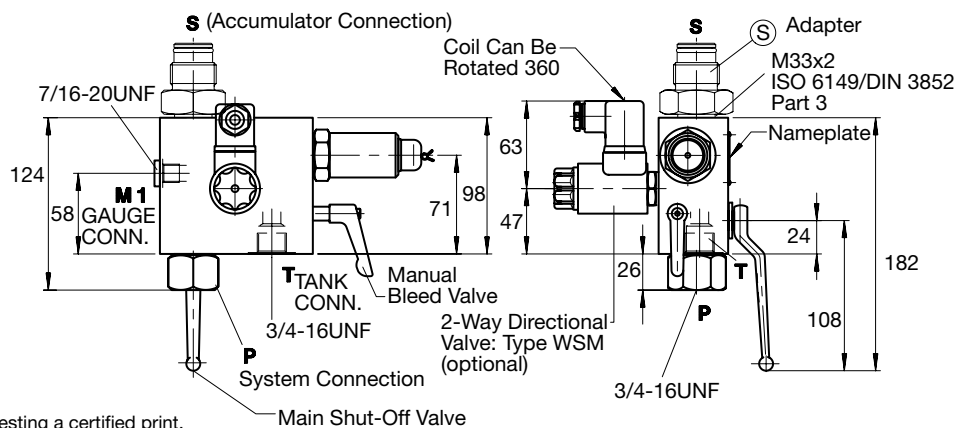
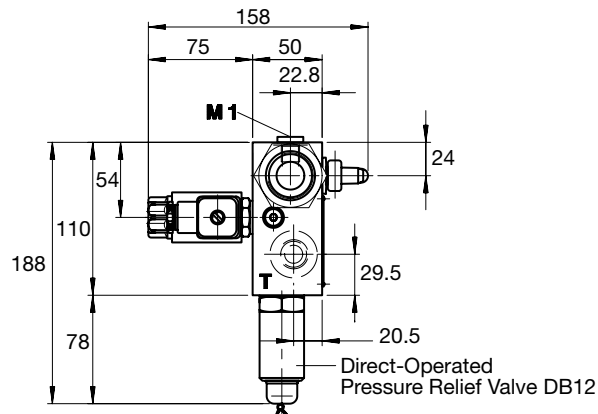
Dimensions

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



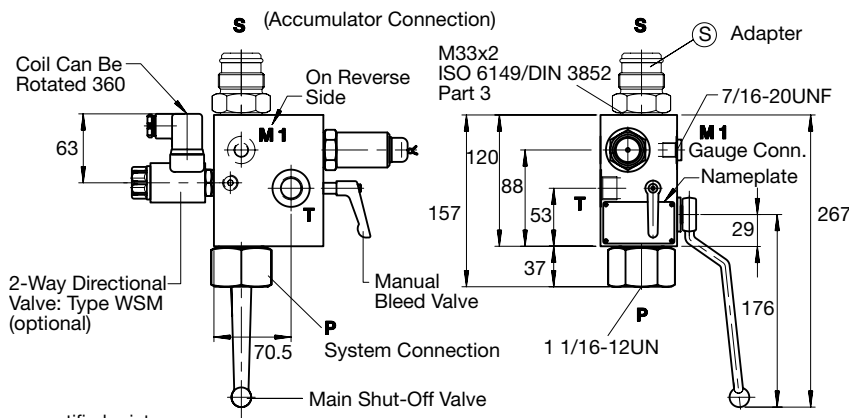
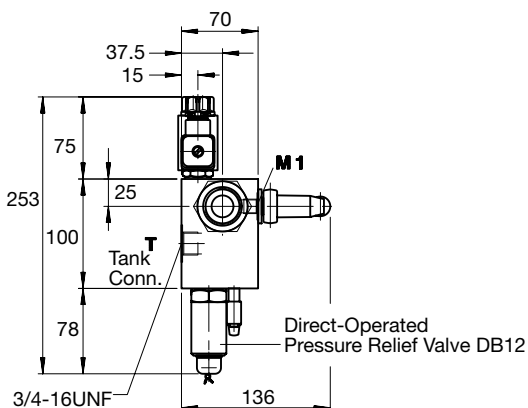
Dimensions are for general information only, all critical dimensions should be verified by requesting a certified print.

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 are for general information only, all critical dimensions should be verified by requesting a certified print.

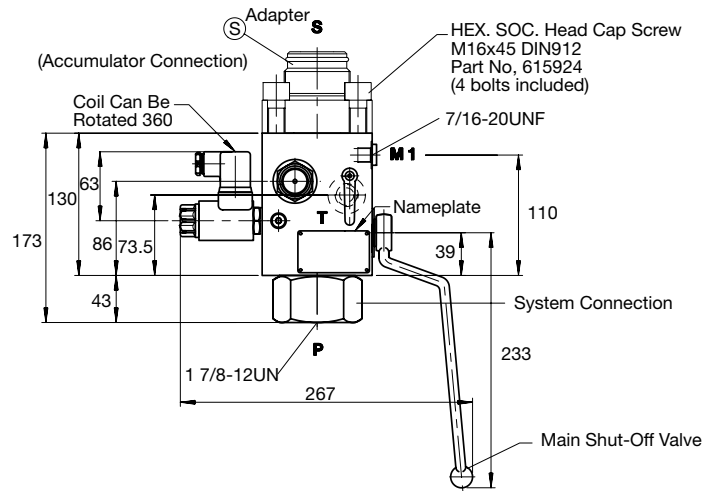
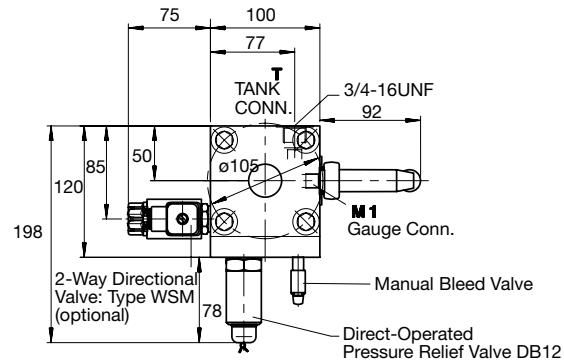
SAF Series

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



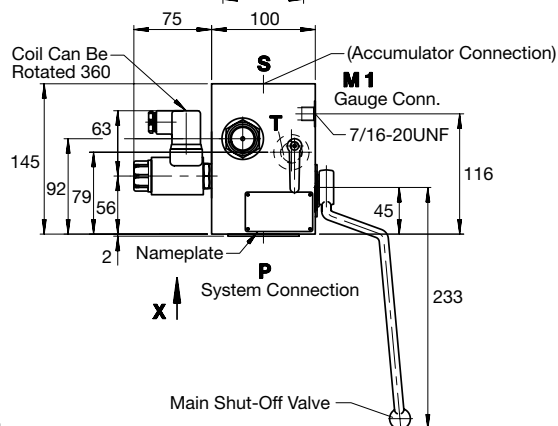
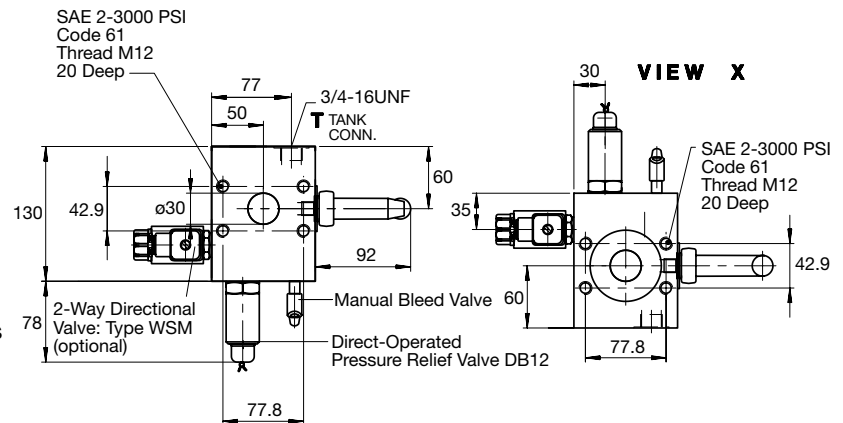
Dimensions are for general information only,
all critical dimensions should be verified by requesting a certified print.

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 16x55-DIN 912 (HYDAC Part 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 are for general information only,
all critical dimensions should be verified by requesting a certified print.

SAF Series

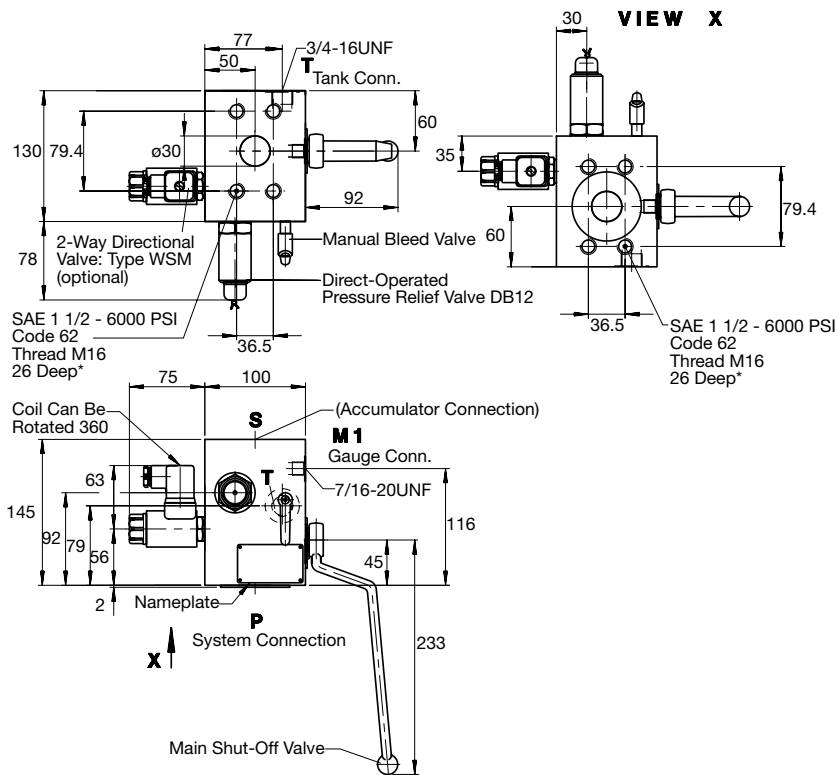
Dimensions

SAF 32 M/E...F

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

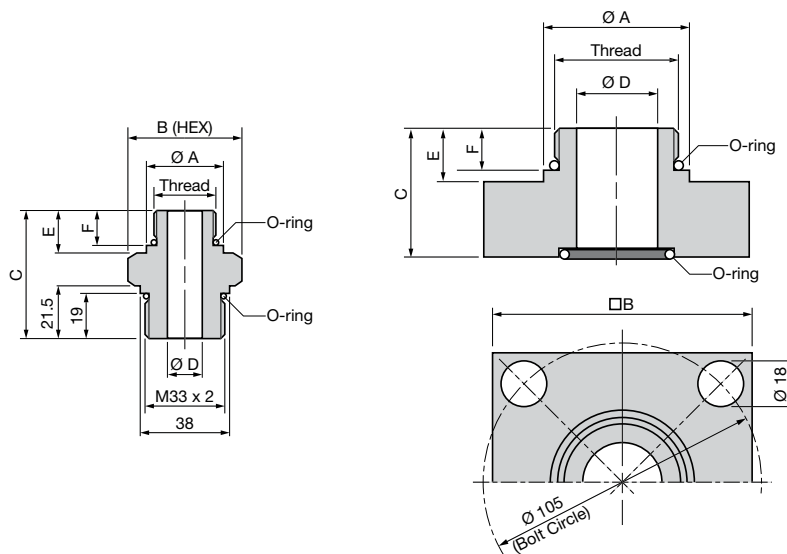
*Hexagonal socket head cap screws
M 16x55-DIN 912 (HYDAC Part No. 00601496)
have to be ordered separately

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



Dimensions are for general information only,
all critical dimensions should be verified by requesting a certified print.

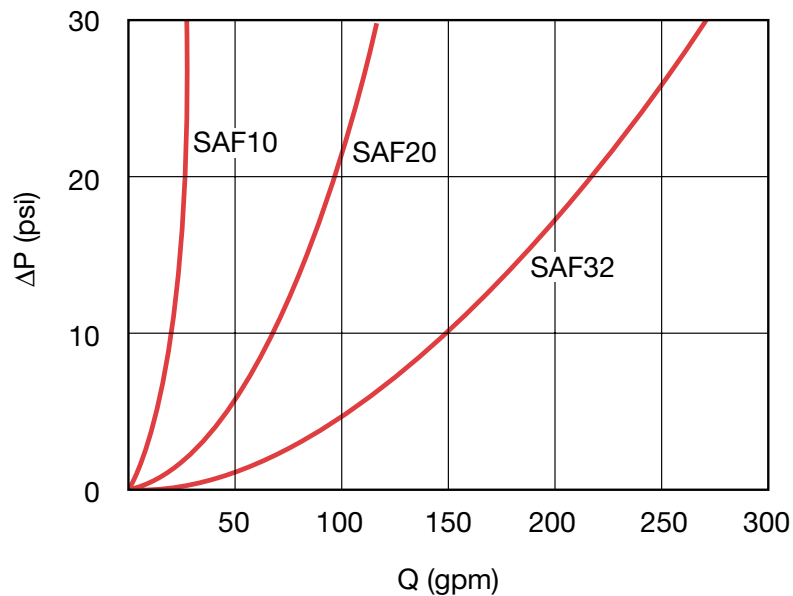
S Adapters



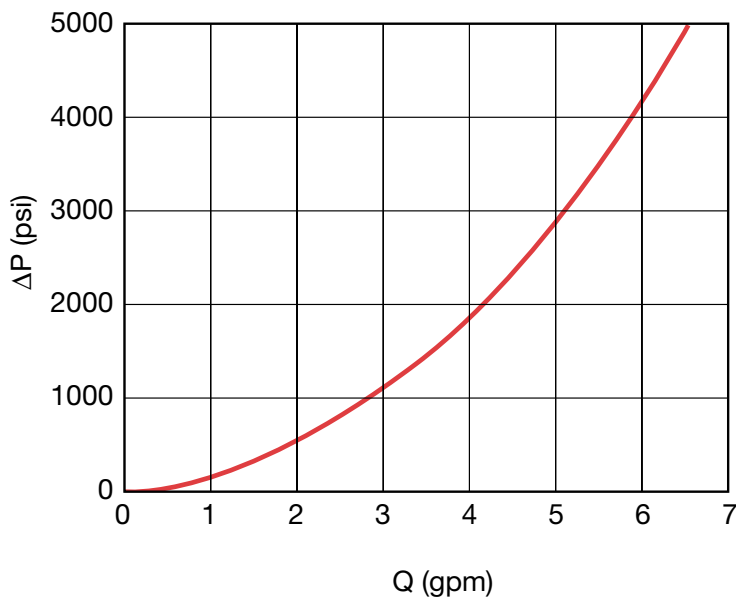
Type SAF	Accumulator Type	Adapter	Fig.	Thread	A	B	C	D	E	F
SAF 10/20	SB330-Size 1 / SBO-Size 2 to 3.5	S 60	1	1 1/16-12 UN	32	41	55	14	19	15
	SB330-Size 4 to 6 / SB600-Size 1 to 4	S 62	1	1 5/8-12 UN	48	66	57	23	19	15
	SB330/600-Size 10 to 54	S 63	1	1 7/8-12 UN	54	66	57	23	19	15
	SBO-Size 0.32 to 1.4	S 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
Dimensions are for general information only,
all critical dimensions should be verified by requesting a certified print.

Pressure Drops Through Main Shut-off valve



Through Solenoid Valve



FPK & FPS Series Charging & Gauging Units



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:

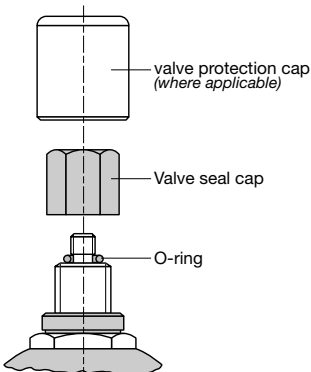
Model FPS

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



Gas Valve Version 4

on a Bottom Repairable
Bladder Accumulator

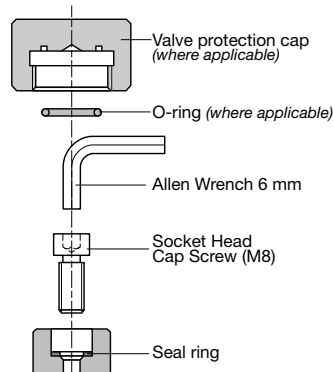


Model FPK

For use with gas valve version 1.

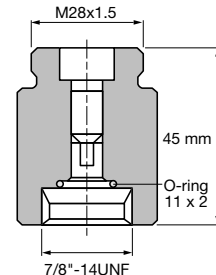


Gas Valve Version 1



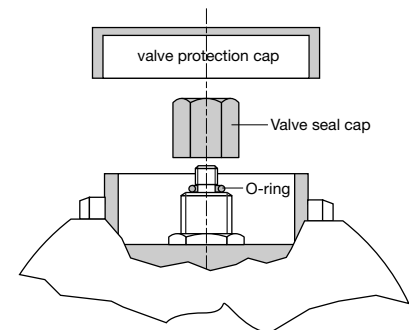
Adapter A3 (FPK/SB)

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



Charging & Gauging Units **HYDAC**

Model Code

FPS 250 F 2.5 - G4 - K

Series

- 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 Gauge 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
For spare parts see page 63.

Note: For Oil, Gas & Marine specific charging & gauging units please refer to page 46

Adapters

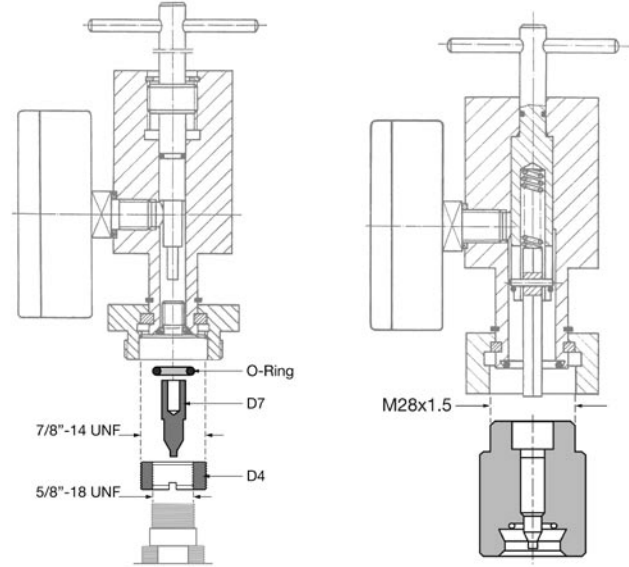
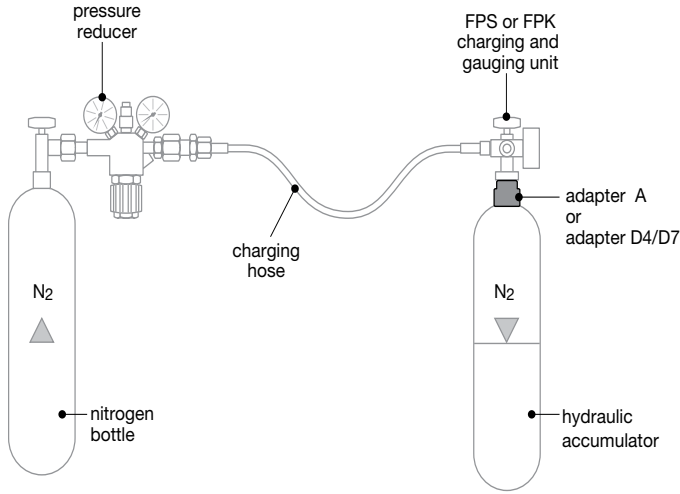
Connecting Charging & Gauging Units to 3000 psi Accumulators

FPS Unit

with Adapter D4/D7

FPK Unit

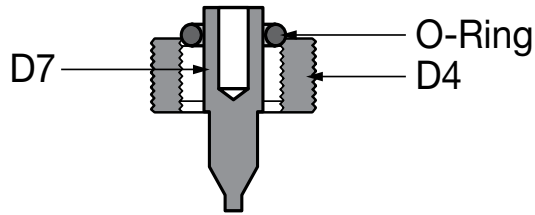
with Adapter A*



Adapter D4/D7

Part Number 02067646

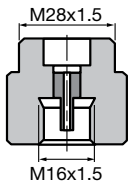
Used with FPS Charging & Gauging Unit



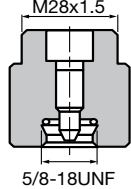
*A Adapters

Used with FPK Charging & Gauging Unit

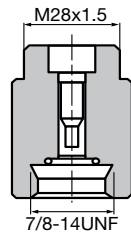
A1
PN 00361619



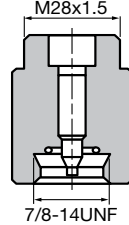
A2
PN 00361605



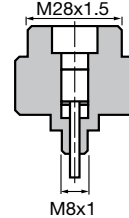
A3 (ADAPTER FPK/SB)
PN 00291533



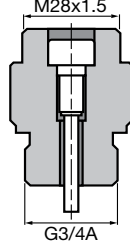
A4
PN 00291536



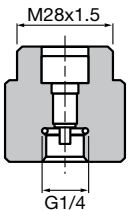
A5
PN 00291531



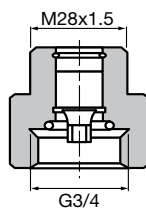
A6
PN 02108819



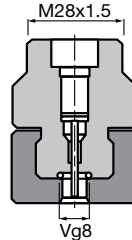
A7
PN 02110629



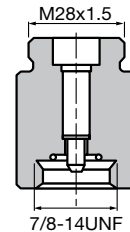
A8
PN 02124524



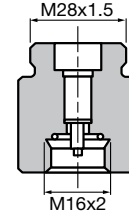
A9
PN 02128638



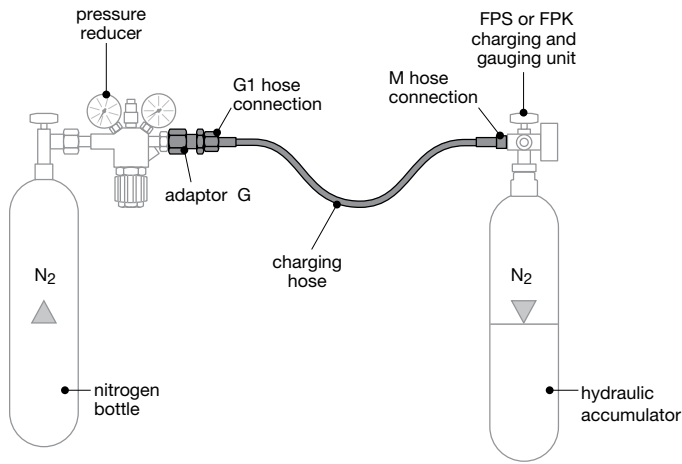
A10
PN 02128849



A11
PN 03018210

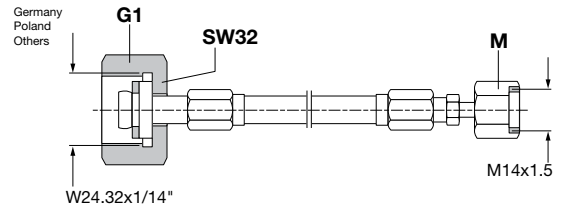


Adapters Connecting Charging Hose to Gas Bottle



Charging Hoses

Length	Part Number
2.5 m	00236514
4.0 m	00236515
10.0 m	00373405
15.0 m	02115552
20.0 m	02109765
28.0 m	02109574



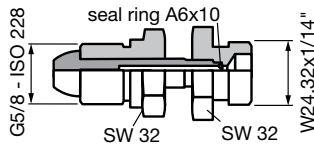
G Adapters

From N2 Bottle to Charging Hose

G2

PN 00236376

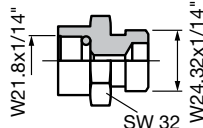
Australia
Argentina
Great Britain
Vietnam
Others



G3

PN 02103421

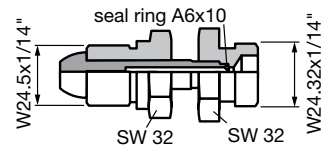
Egypt
Lebanon
Israel
Others



G4

PN 02068737

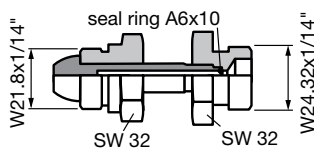
USA
Canada
Puerto Rico



G5

PN 00236373

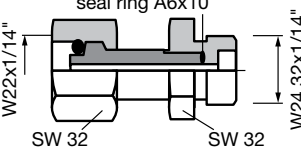
Italy



G6

PN 02103423

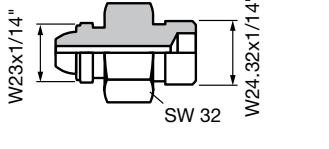
Japan



G7

PN 00236377

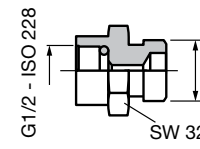
Korea



G8

PN 02103425

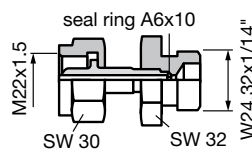
Brazil
Chile
Columbia
Others



G9

PN 00241168

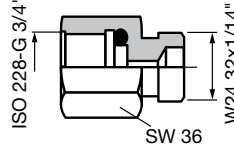
Taiwan



G10

PN 02103427

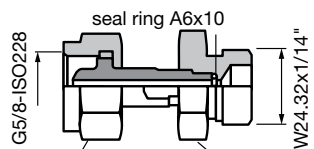
Russia
Trinidad
Tobago
Venezuela



G11

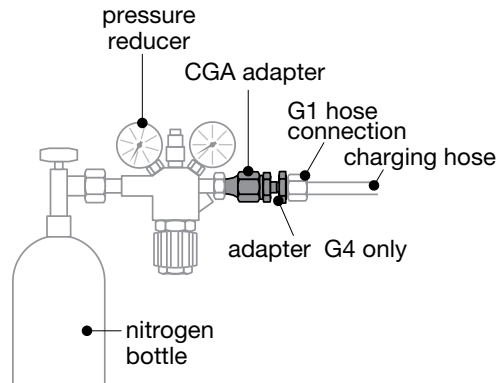
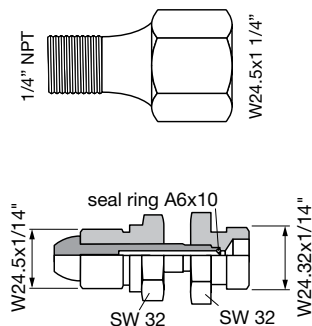
PN 03018678

China



CGA 580 Adapter (for USA only)

From G4 Adapter to Regulator



Permanent Gauging Block



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.

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."

Model Code

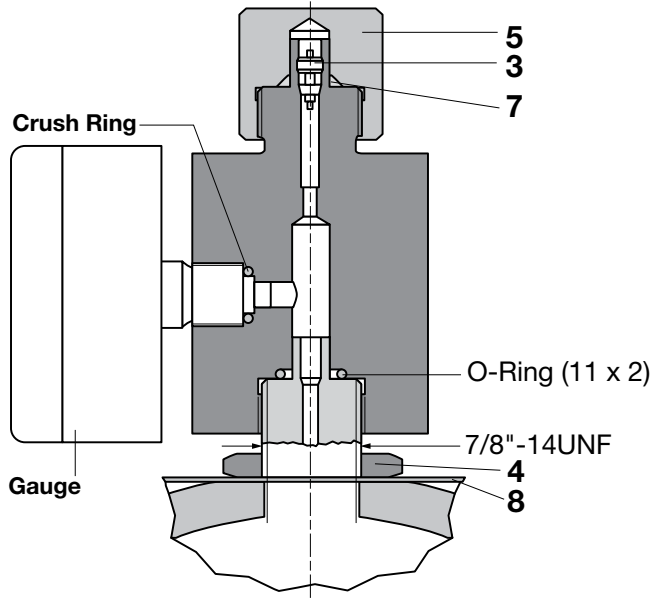
	PERM GAUGING BLOCK	VER4	850
Series	Perm Gauging Block		
Gas Valve Type	VER1 = HYDAC gas valve version 1 (M28x1.5) VER4 = HYDAC gas valve version 4 (7/8"-14UNF)		
Accumulator Type	(omit) = Bottom Repairable (standard) TR = Top Repairable		
Gauge Pressure Range	850 = 0 to 850 psi 1450 = 0 to 1450 psi 2300 = 0 to 2300 psi 3600 = 0 to 3600 psi 5800 = 0 to 5800 psi		

Permanent Gauging Blocks **HYDAC**

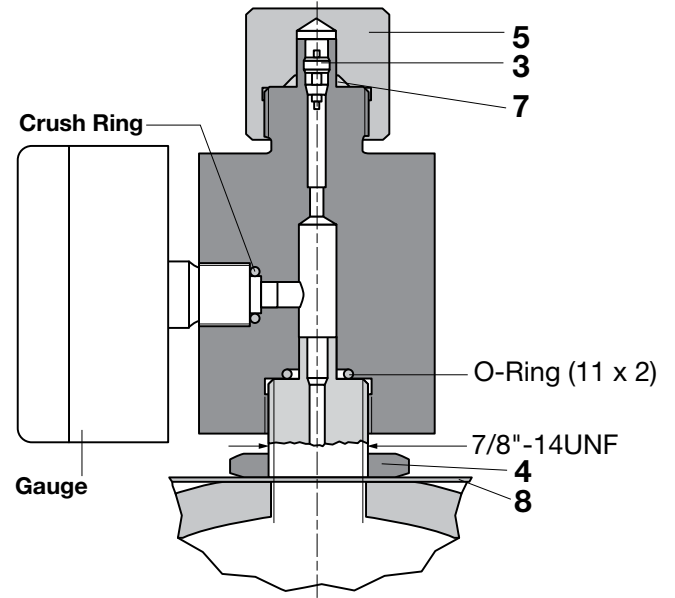
Installation Drawings

Permanent Gauging Blocks for HYDAC Gas Valve Version 4

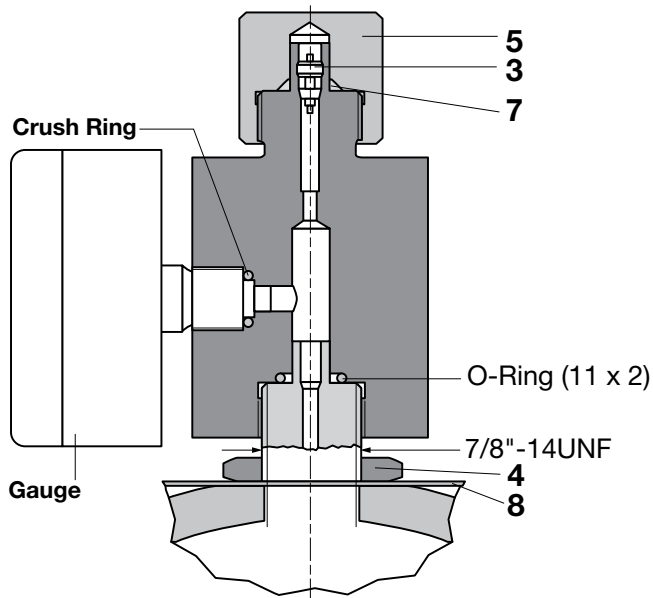
Bottom Repairable Bladder



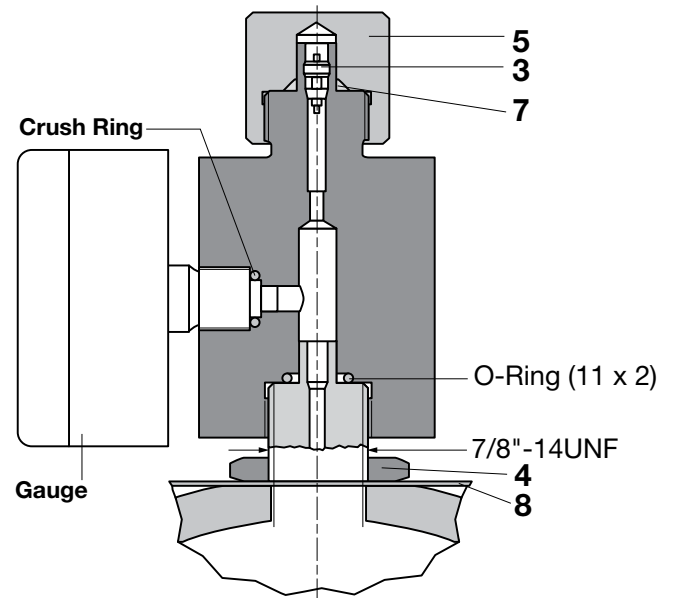
Bottom Repairable Bladder with M50 Gas Valve



Top Repairable Bladder¹



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.

HYDAC Mounting Components

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 steel with a 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.

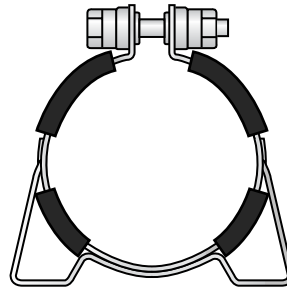
Conversely, the heavy duty clamps have a two piece construction. This allows for easy installation and removal while improving the strength to weight ratio.

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.

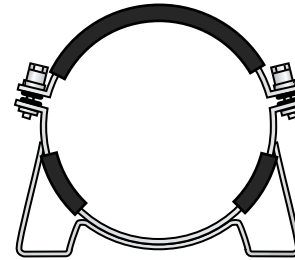
All mounting components can be easily bolted to your system.

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

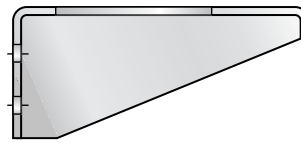
HS - Regular Duty Clamp



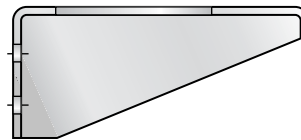
HSS - Heavy Duty Clamp



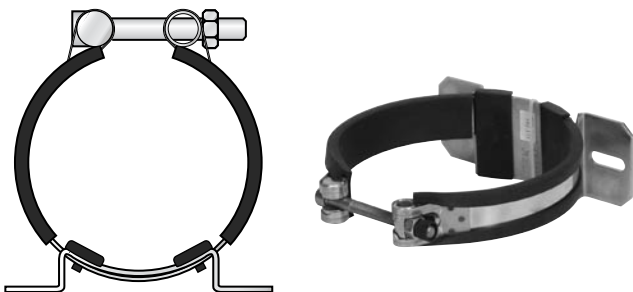
KBK - Base Bracket



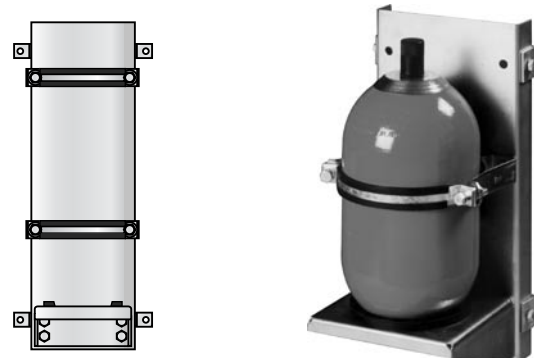
KMS - Base Bracket for Threaded Diaphragm



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)	Part Number	Base Bracket Type	Part Number
1 (0.25 gal)	HyRac 110-118 ST (1)	03059446	None	
4 to 6 (1 to 1.5 gal)	HS 167 (1)	02110642	KBK 167/G	02107989
10 to 20 (2.5 to 5 gal)	HSS 222/229 (1)	00235224	KBK 222/G	02100651
32 to 54 (10 to 15 gal)	HSS 222/229 (2)	00235224	KBK 222/G	02100651

SB 600...

Accumulator Size (capacity)	Clamp Type (quantity)	Part Number	Base Bracket Type	Part Number
1 (0.25 gal)	HyRac 121-129 ST (1)	03059450	None	
4 to 6 (1 to 1.5 gal)	HyRac 167-175 ST (1)	00444910	KBK 167/G	02107989
10 to 20 (2.5 to 5 gal)	HSS 222/229 (1) or HSS 242 (1)	00235224 or 00362712	KBK 222/G	02100651
32 to 54 (10 to 15 gal)	HSS 222/229 (2) or HSS 242 (2)	00235224 or 00362712	KBK 222/G	02100651

Piston Accumulators

SK 350...

Accumulator Piston Size ¹⁾	Clamp Type (quantity)	Part Number	Base Bracket Type	Part Number
15 (150 mm)	HyRac 176-185 ST	00445044	KBK 219	00238047
18 (180 mm)	HSS 219 (2)	00237401	KBK 219	00238042
25 (250 mm)	HSS 310 (2)	00237389	KBK 310	00238043
35 (355 mm)	consult factory		consult factory	

1) Example: SK350-20/2112S-210FCF-VE-18 (see page 15 for details)

SK 280...

Accumulator Piston Size ¹⁾	Clamp Type (quantity)	Part Number
05 (50 mm)	HRGKSM 0 R 58-61/62 ST (2)	03018442
06 (60 mm)	HRGKSM 0 R 70-73/73 ST (2)	03018444
08 (80 mm)	HRGKSM 0 R 92-95/96 ST (2)	00444995
10 (100 mm)	HRGKSM 0 R 119-127/124 ST (2)	00444505

1) Example: SK280-1/3218U-280 AAD VB 05 (see page 19 for details)

Diaphragm Accumulators

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

Accumulator Type	Clamp Type(2)	Part Number
SBO 250-00.075 E	HyRac 62-65 ST	00445037
SBO 210-0.16 E	HyRac 73-76 ST	00445038
SBO 210-0.32 E	HyRac 89-92 ST	00445039
SBO 210-0.5 E	HyRac 100-105 ST	00444904
SBO 330-0.6 E	HyRac 110-118 ST	03059446
SBO 210-0.75 E	HyRac 121-129 ST	03059450
SBO 200-1 E	HyRac 133-142 ST	03059449
SBO 140-1.4 E	HyRac 143-151 ST	03059448
SBO 210-1.4 E	HyRac 152-159 ST	03059447
SBO 100-2 E	HyRac 160-167 ST	00444910
SBO 210-2 E	HS 167	02110642
SBO 210-2.8 E	HS 167	02110642
SBO 250-3.5 E	HS 167	02110642
SBO 330-0.75 E	HyRac 121-129 ST	03059450
SBO 330-1.4 E	HyRac 143-151 ST	03059448
SBO 330-2.0 E	HyRac 167-175 ST	03059445
SBO 330-3.5 E	HyRac 167-175 ST	03059445

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

Accumulator Type	Clamp Type	Part Number
SBO 350-0.25 A6	HyRac 110-118 ST	03059446
SBO 500-0.25 A6	HyRac 110-118 ST	03059446
SBO 250-0.6 A6	HyRac 133-142 ST	03059449
SBO 330-0.6 A6	HyRac 133-142 ST	03059449
SBO 600-0.25 A6	HyRac 143-151 ST	03059448
SBO 750-0.25 A6	HyRac 143-151 ST	03059448

Accumulator Type	Base Bracket Type	Part Number
SBO 210-1.3 A6	KMS 200	00359931
SBO 400-1.3 A6	KMS 210	00358989
SBO 180-2 A6	KMS 220	00359922
SBO 250-2 A6	KMS 220	00359922

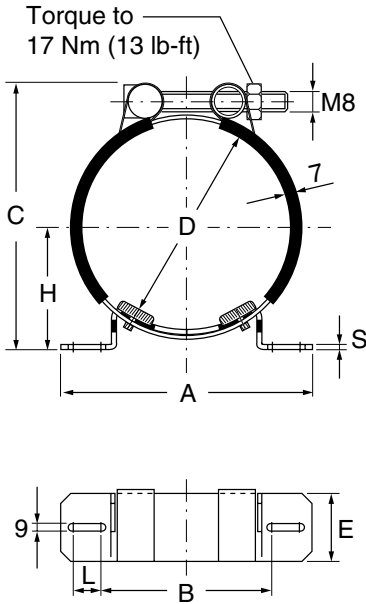
Note: Either one clamp or one Base Bracket is needed for each accumulator listed.

HYDAC Mounting Components

Dimensions

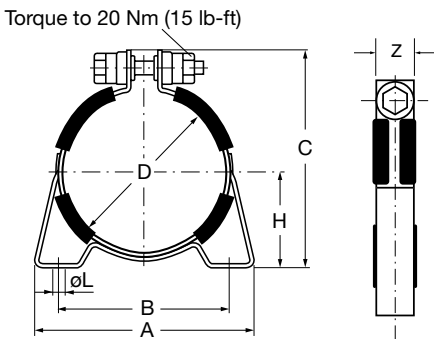
Use the Selection Guide on page 42 to select the appropriate components.

HyRac - Stainless Steel Strap with swivel-bolt adjustment



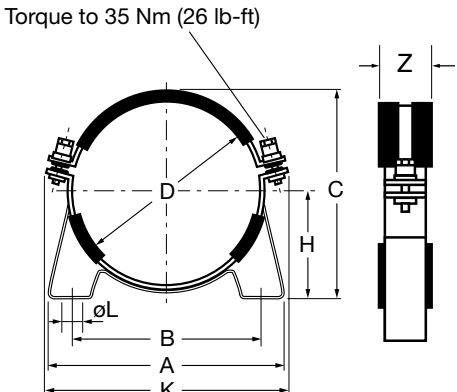
Clamp Model	A	B	C	D (range)	E	H	L	S	Weight kg.(lbs)
HyRac 62-65 ST	120 4.72	85 3.34	90 3.54	62-65 2.4-2.6	40 1.6	39-40.5 1.5-1.6	6 0.24	3 0.12	0.16 (0.35)
HyRac 73-76 ST	120 4.72	85 3.34	101 3.98	73-76 2.9-3.0	40 1.6	49.5-46 1.9-1.8	6 0.24	3 0.12	0.16 (0.35)
HyRac 89-92 ST	120 4.72	85 3.34	116 4.57	89-92 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	0.41 (0.9)
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 167-175 ST	236 9.29	152 5.98	207 8.15	167-175 6.6-6.9	60 2.4	92.5-96.5 3.6-3.8	32 1.3	4 0.16	0.72 (1.59)
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	0.76 (1.68)
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	0.77 (1.70)

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

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

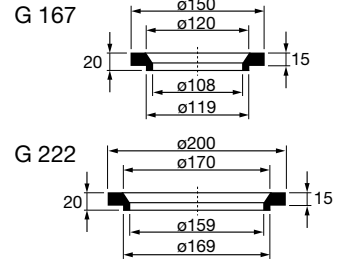
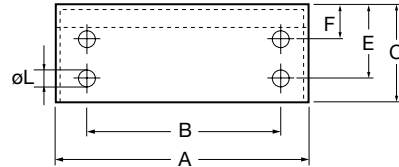
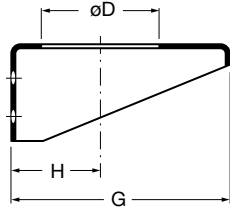
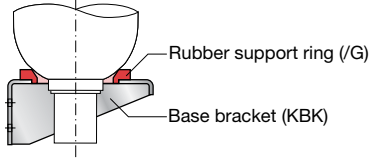
Dimensions are in mm with inches shown below.
Dimensions are for general information only,
all critical dimensions should be verified by requesting a certified print.

Dimensions

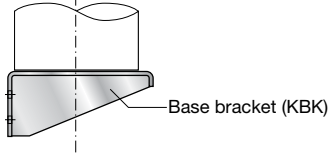
Use the Selection Guide on page 42 to select the appropriate components.

KBK - Base Bracket for Bladder and Piston Accumulators

Bladder Accumulator



Piston Accumulator



Base Bracket with Rubber Support Ring

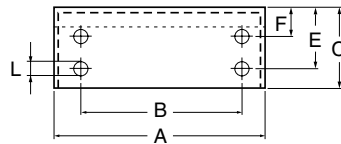
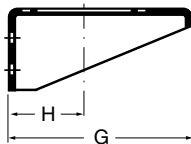
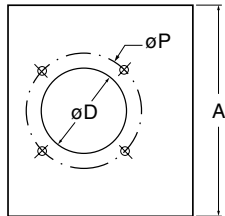
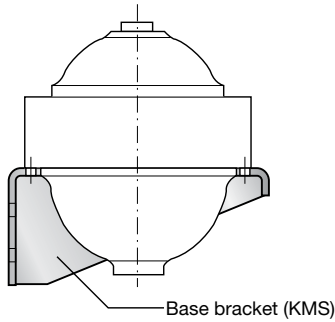
Model	A	B	C	ϕD	E	F	G	H	ϕL	Weight kg. (lbs)	Rubber Support Ring
KBK 167/G	260 10.24	200 7.87	100 3.94	120 4.72	75 2.95	35 1.38	225 8.86	92 3.62	14 0.55	2.6 (5.7)	G 167
KBK 222/G	260 10.24	200 7.87	100 3.94	170 6.69	75 2.95	35 1.38	225 8.86	123 4.84	14 0.55	2.4 (5.3)	G 222

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



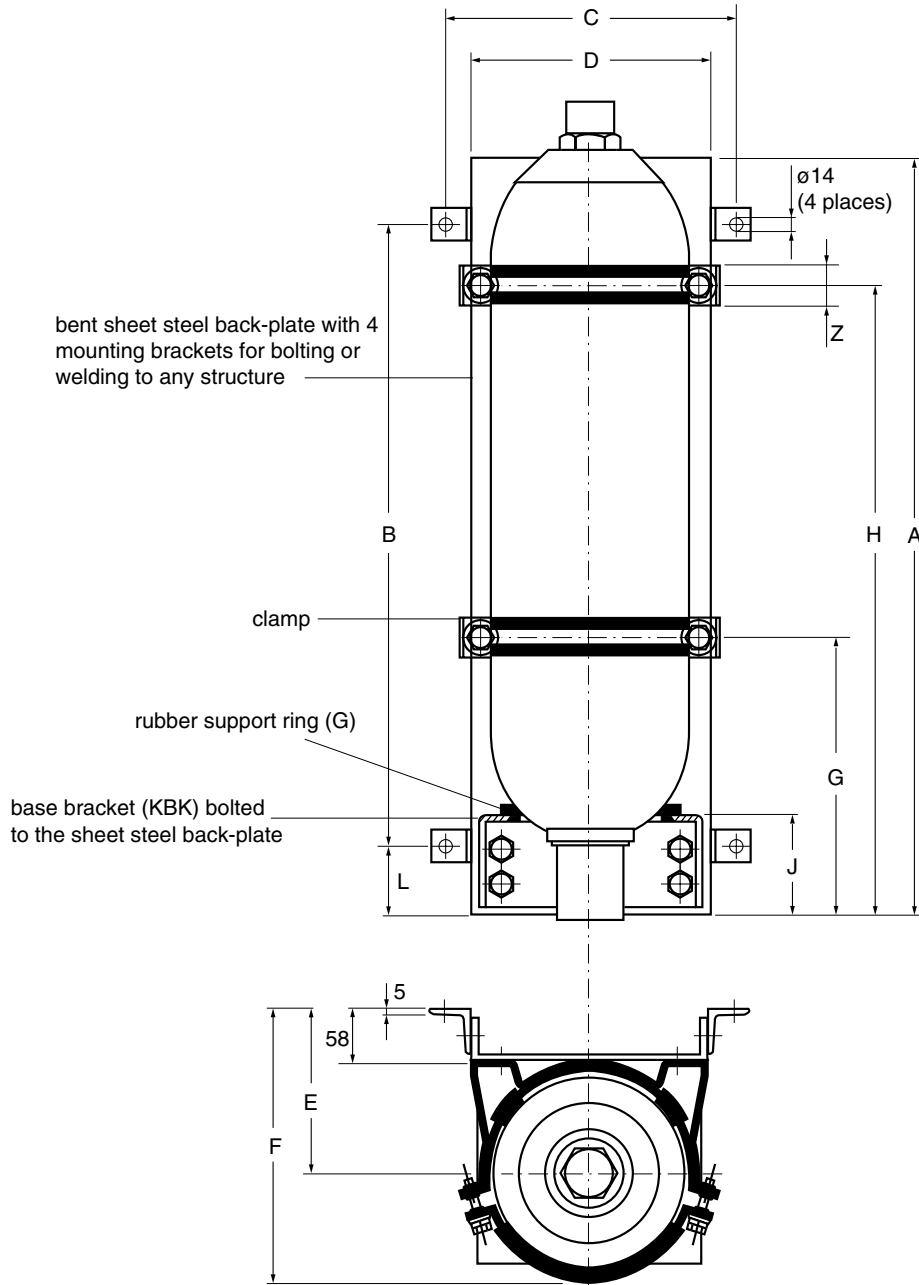
Base Bracket Model	A	B	C	ϕD	ϕP	E	F	G	H	ϕL	Weight kg. (lbs)
KMS 200	270 10.63	180 7.09	100 3.94	148 5.83	160 6.30	80 3.15	40 1.57	250 9.84	123 4.84	14 0.55	6.5 (14.4)
KMS 210	260 10.24	200 7.87	100 3.94	170 6.69	180 7.09	75 2.95	35 1.38	225 8.86	123 4.84	14 0.55	2.4 (5.3)
KMS 220	260 10.24	200 7.87	100 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)

Dimensions are in mm with inches shown below.
Dimensions are for general information only,
all critical dimensions should be verified by requesting a certified print.

HYDAC Mounting Components

Components & Dimensions

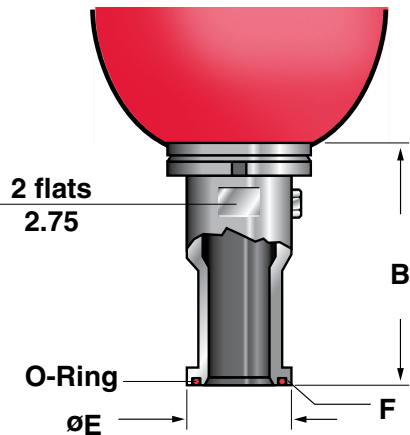
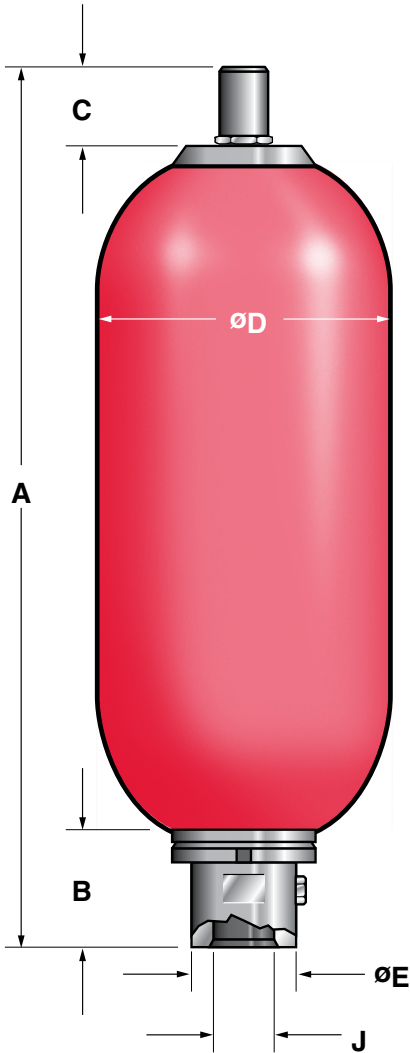
SEB - Mounting Sets for SB 330 Bladder Accumulators



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

SB Series

Bottom Repariable Bladder Accumulators for the Oil, Gas & Marine Markets



SB 330... (3000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in ³	Weight lbs./ (kg)	A	B	C	ØD	ØE	Thread J NPTF	Q ¹ gpm
10	2 1/2	566	86 (39)	22.0 (559)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 1/4 2"	240
20	5	1125	140 (63)	34.5 (876)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 1/4 2"	240
32	10	2080	226 (102)	54.7 (1390)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 1/4 2"	240
42	11	2320	270 (123)	60.2 (1530)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 1/4 2"	240
54	15	3205	330 (150)	78.3 (1990)	3.1 (80)	2.3 (58)	9.1 (231)	3.0 (76)	1 1/4 2"	240

SB 600... (5000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in ³	Weight lbs./ (kg)	A	B	C	ØD	ØE	Thread J NPTF	Q ¹ gpm
10	2 1/2	566	114 (52)	22.4 (568)	3.1 (80)	2.8 (70)	9.1 (232)	3.0 (76)	1 1/4 2"	240
20	5	1125	162 (73)	35.0 (888)	3.1 (80)	2.8 (70)	9.1 (232)	3.0 (76)	1 1/4 2"	240
32	10	2080	250 (113)	55.2 (1402)	3.1 (80)	2.8 (70)	9.1 (232)	3.0 (76)	1 1/4 2"	240
54	15	3180	370 (168)	78.8 (2002)	3.1 (80)	2.8 (70)	9.1 (232)	3.0 (76)	1 1/4 2"	240

Split Flange Connections (sizes 10 - 54)

Series	B	ØE	Split Flange Connection F	Q ¹ gpm
SB 330 SB 330 T ²	4.1 (104)	2.8 (71.4)	SAE 2" - 3000 psi Code 61	240
SB 600 SB 600 T ²	5.5 (140)	2.5 (63.5)	SAE 1 1/2" - 5000 psi Code 62	240

Dimensions are for general information only,

all critical dimensions should be verified.

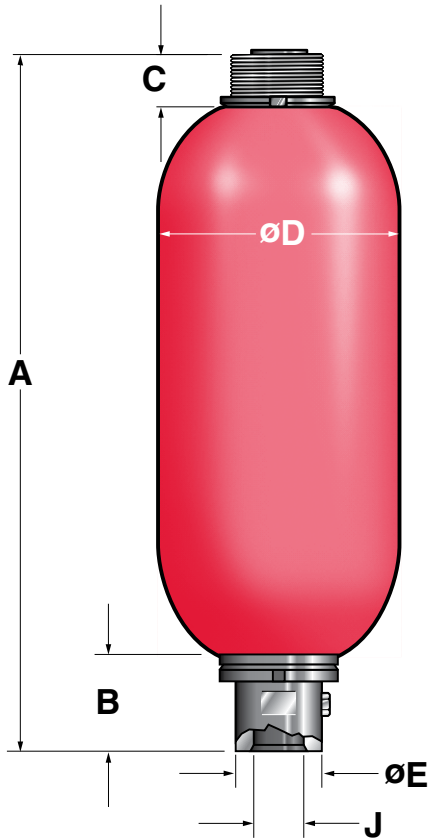
Dimensions are in inches/(mm) and lbs/(kg)

1) Maximum discharge flow rate recommended for vertically mounted accumulators.

2) sizes 20 to 54 only

SB Series

Top Repairable Bladder Accumulators for the Oil, Gas & Marine Markets



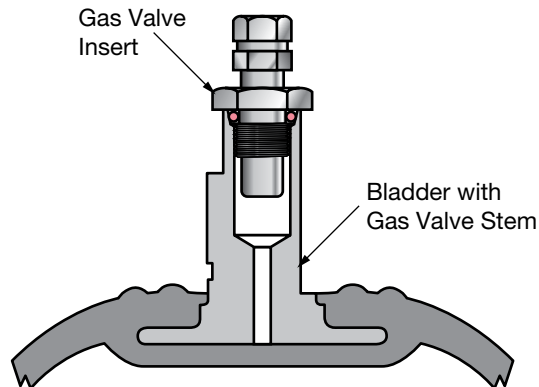
SB 330 TR... (3000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in ³	Weight	A	B	C	ØD	ØE	Thread J	J NPTF	Q ¹ gpm
10	2 1/2	566	94 (43)	21.3 (540)	3.1 (80)	1.6 (40)	9.1 (231)	3.0 (76)	1 1/4	2"	240
20	5	1125	140 (63)	34.8 (883)	3.1 (80)	1.6 (40)	9.1 (231)	3.0 (76)	1 1/4	2"	240
32	10	2080	226 (102)	55.0 (1397)	3.1 (80)	1.6 (40)	9.1 (231)	3.0 (76)	1 1/4	2"	240
42	11	2320	270 (123)	60.2 (1530)	3.1 (80)	1.6 (40)	9.1 (231)	3.0 (76)	1 1/4	2"	240
54	15	3205	330 (150)	78.6 (1997)	3.1 (80)	1.6 (40)	9.1 (231)	3.0 (76)	1 1/4	2"	240

SB 600 TR... (5000 psi)

Size	Nom. Vol. gal.	Eff. Gas Vol. in ³	Weight	A	B	C	ØD	ØE	Thread J	J NPTF	Q ¹ gpm
20	5	1125	172 (78)	33.5 (851)	3.1 (80)	1.6 (40)	9.1 (232)	3.0 (76)	1 1/4	2"	240
32	10	2080	260 (118)	53.7 (1364)	3.1 (80)	1.6 (40)	9.1 (232)	3.0 (76)	1 1/4	2"	240
54	15	3205	380 (172)	77.3 (1964)	3.1 (80)	1.6 (40)	9.1 (232)	3.0 (76)	1 1/4	2"	240

2 Piece Gas Valve



Dimensions are for general information only, all critical dimensions should be verified.
Dimensions are in inches/(mm) and lbs/(kg)

1) Maximum discharge flow rate recommended for vertically mounted accumulators.

Model Code

SB 330 - 20 S 11 / 112 S - 210 C

Series

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

Design

- (omit) = Standard (bottom repairable)
- TR = Top Repairable

Size (see dimension tables on the previous pages for most common sizes)

- 10 = 2.5 gallons
- 20 = 5 gallons
- 32 = 10 gallons
- 42 = 11 gallons
- 54 = 15 gallons

Line Connection

- S = Threaded (SAE Lock Nut)
- F = Flanged (SAE Lock Nut)

Gas Port

- 11 = 2 Piece Gas Valve

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)
- 7 = Others available on request

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)
- 7 = Others available on request

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	mineral oils
	32° to 180°F	water & water-glycols
NBR	-50° to 180°F	mineral oils
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
FPM	5° to 300°F	chlorinated hydrocarbons

Country of Installation

- S = USA
 - W1 = ABS Type Approval
 - W3 = DNV Type Approval
- (for other countries see page 2 for proper code designation)

Maximum Working Pressure

- 210 = 3000 psi
- 345 = 5000 psi
- 414 = 6000 psi

Fluid Port Connection

Threaded

- 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*

Note: For the full line of bladder accumulators please refer to page 5

FPO Series Charging and Gauging Units



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 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.

Model Code

	FPO 210 F 3 - K
Charging and Gauging Unit	_____
FPO = for use with Gas Valve Version 4 (8VI-ISO 4570) for SB, SBO and SK	
Gauge Pressure Range	_____
210 = 0 to 3000 psi (0 to 210 bar)	
Charging Hose	_____
F = with nitrogen bottle connection CGA-580	
Charging Hose Length	_____
3.0 = 10 ft. (3 m)	
Case	_____
K = plastic carrying case (standard)	

Additional Accessories:

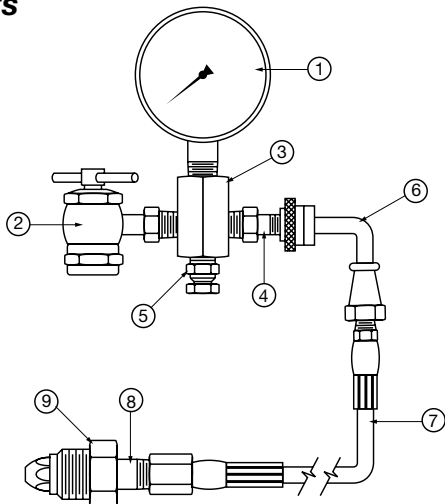
Gas Valve Extension Rod - to be used with top repairable accumulators

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

Note: For the full line of charging & gauging units please refer to page 35

Parts



Part Description	Item	Quantity	Part No.
FPO 210 Replacement Kit consists of:			
Pressure Gauge, 3000 PSI	1	1	02701622
T-Handle Lock Chuck	2	1	02701615
Charging Manifold, FPO	3	1	consult factory
Tank Valve	4	1	02701617
Bleeder Valve	5	1	consult factory
Hose Assembly FPO 210 (CGA 580) consists of:			
High Pressure Coupling (swivel)	6	1	02701590
Hose, FPO 3000 PSI, 3m	7	1	02701621
Nipple Gland, CGA-580	8	1	02701620
Nut, CGA-580	9	1	02701619

Typical Applications

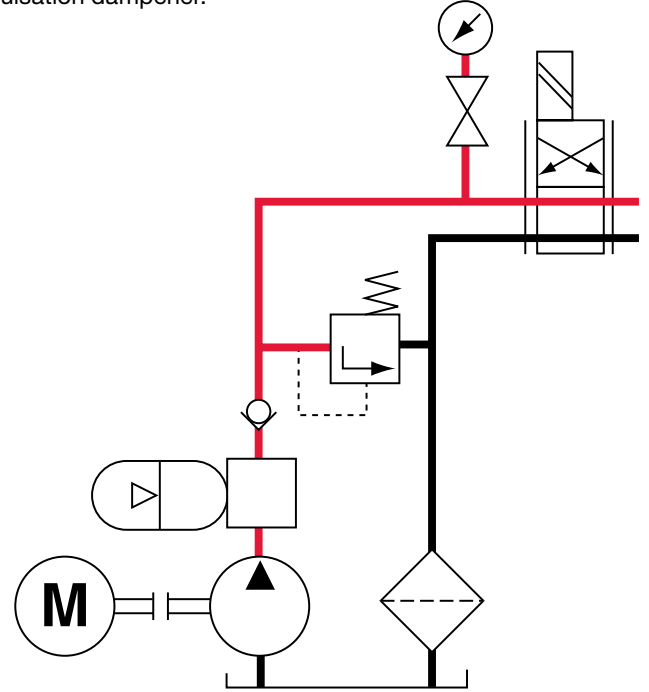
HYDAC accumulators can be used in a wide variety of applications, some of which are listed below:

- 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

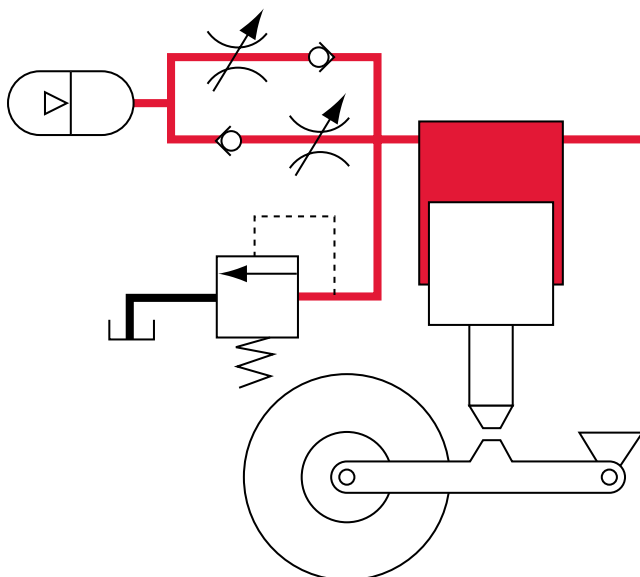
Pulsation Dampeners for Displacement Pumps

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



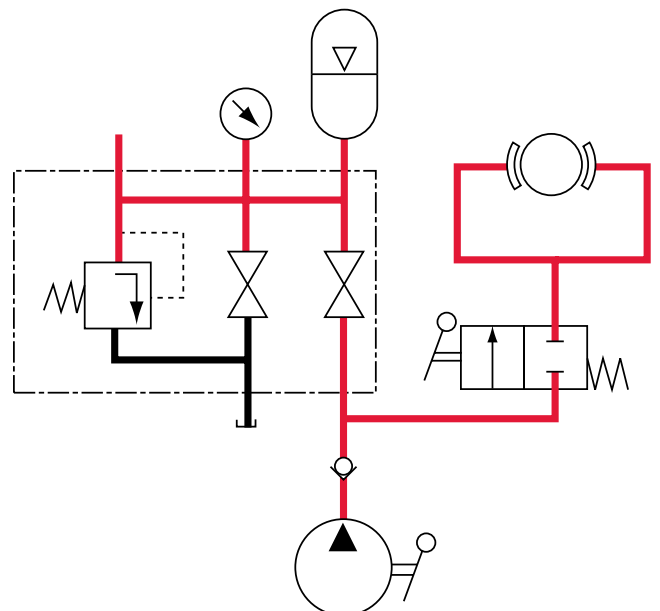
Spring Element

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.



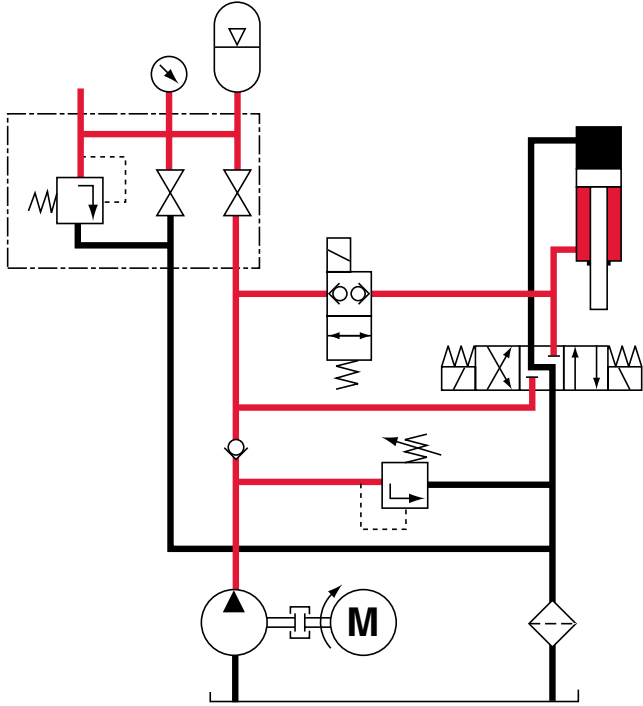
Emergency Brakes

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



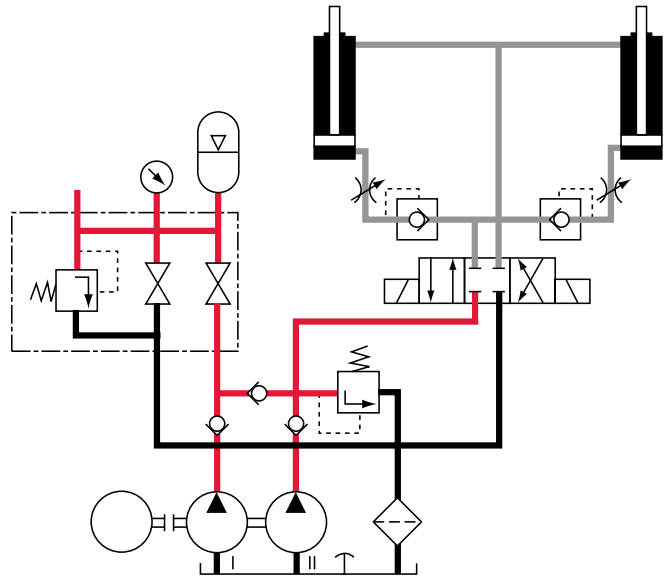
Emergency Operation of a Hydraulic Cylinder

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



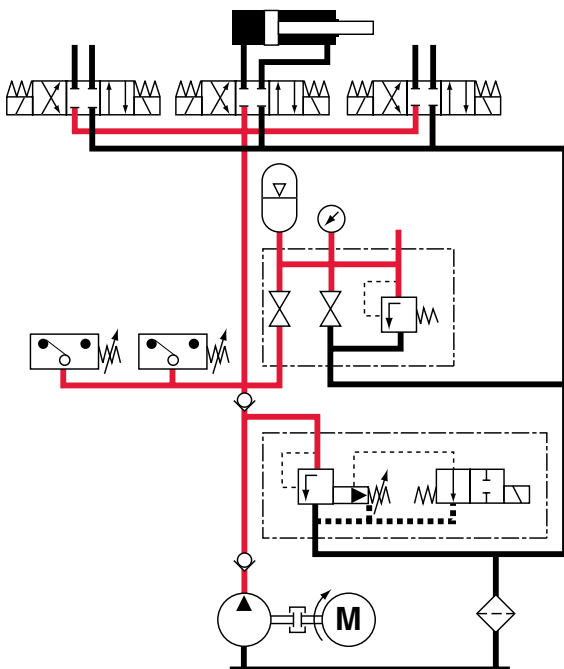
Energy Storage and Shortening of Stroke Time

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



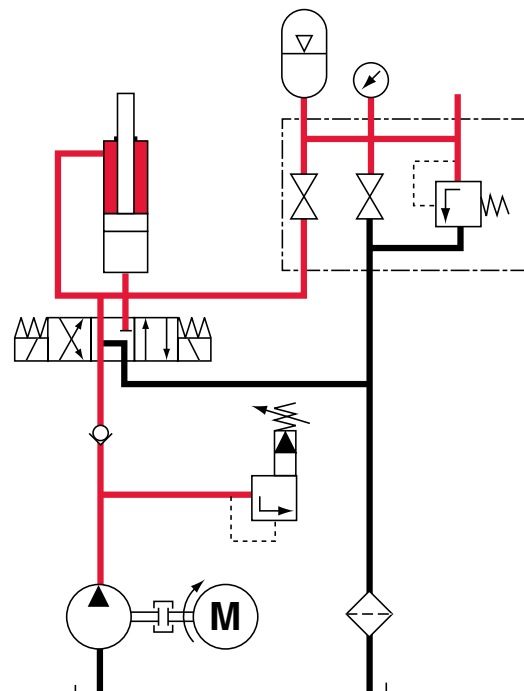
Energy Storage in an Injection Molding Machine

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

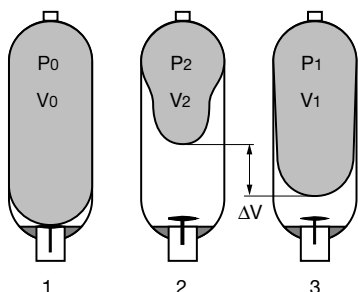
The accumulator is charged to a pre-determined pressure. The pump is switched off. Now the accumulator makes up for the leakage of the system until the minimum pressure is reached and the pump is switched on again.



Operation

Bladder

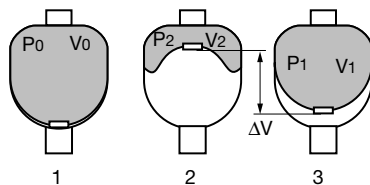
- 1 The bladder is precharged with nitrogen. This causes the fluid valve to close, preventing the bladder from extruding out of the fluid port.
- 2 Accumulator at maximum working pressure. The difference in volume (ΔV) between the maximum and the minimum working pressure corresponds to the effective 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

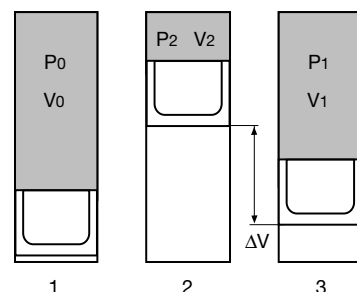
- 1 The diaphragm is precharged with nitrogen. This causes the poppet to close, preventing the diaphragm from extruding out of the fluid port.
- 2 Accumulator at maximum working pressure. The difference in volume (ΔV) between the maximum and the minimum working pressure corresponds to the effective fluid 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 isothermally, 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:

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

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

for adiabatic change of condition:

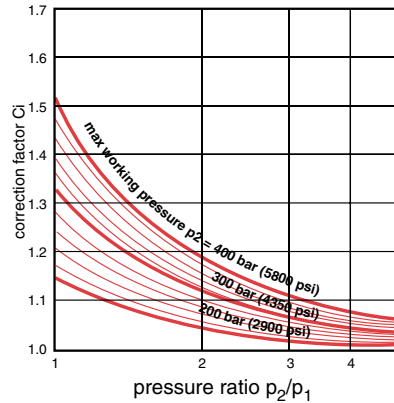
$$V_{0,real} = C_a \times V_{0,ideal} \text{ or}$$

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

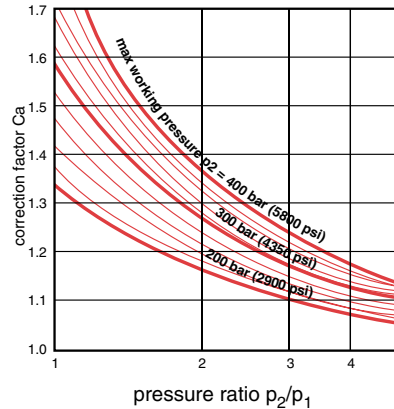
1 An estimate of the accumulator size and a selection of precharge pressure can be calculated similar to the sample shown. For more accurate sizing and design assistance, please contact HYDAC.

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

$\Delta V = 1.35$ gallons

maximum operating temperature

$T_2 = 120^\circ\text{F}$

minimum operating temperature

$T_1 = 75^\circ\text{F}$

Required:

- necessary accumulator size, taking into account the real gas behavior
- gas precharge pressure p_0 at 68°F (T_0)
- 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.

- Determination of required gas volume:

a) gas precharge pressure at T_2 :

$$p_{0,T_2} = 0.9 \times p_1 = 0.9 \times 1500 = 1350 \text{ psi}$$

b) gas precharge pressure at T_1 :

$$p_0 = p_{0,T_2} \times \left(\frac{T_1 + 460}{T_2 + 460}\right) = 1350 \text{ psi} \times \left(\frac{75 + 460}{120 + 460}\right) \approx 1245 \text{ psi}$$

c) ideal gas volume:

$$V_{0,ideal} = \frac{\Delta V}{\left(\frac{P_0(T_1)}{P_1}\right)^{0.714} - \left(\frac{P_0(T_1)}{P_2}\right)^{0.714}} = \frac{1.35}{\left(\frac{1245}{1500}\right)^{0.714} - \left(\frac{1245}{3000}\right)^{0.714}} = 3.95 \text{ gallons}$$

d) correction factor from diagram:

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

e) real gas volume:

$$V_{0,real} = C_a \times V_{0,ideal} = 1.16 \times 3.95 = 4.6 \text{ gal.}$$

- Determination of gas precharge pressure p_0 at 68°F:

$$p_{0,T_0} = p_{0,T_2} \times \left(\frac{T_0 + 460}{T_2 + 460}\right) = 1350 \text{ psi} \times \left(\frac{68 + 460}{120 + 460}\right) \approx 1230 \text{ psi}$$

- Selected: Size 20 (5 gallon)

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

Precharged to 1230 psi at 68°F

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:

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

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

$$\Delta V (l) = x \cdot q$$

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

V_0 = required gas volume

ΔV = fluctuating fluid volume

$q(l)$ = stroke volume per cylinder

$\hat{p} - p_m = \check{p} - p_m$ = amplitude of pressure fluctuations

X = residual pulsations

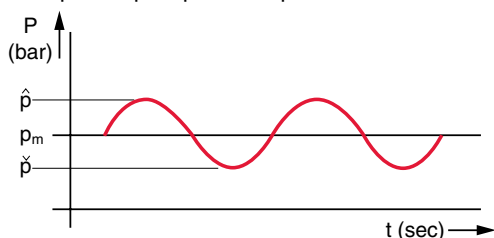
\hat{p} = max. working pressure

\check{p} = min. working pressure

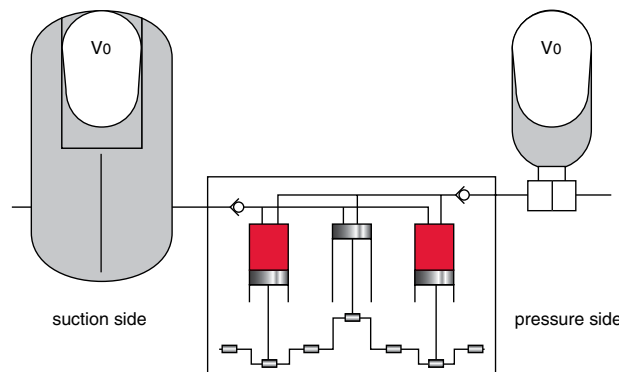
p_m = pump flow rate or pressure in the suction line

= 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



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



Types of Pump	z	
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 $\pm 0.5\%$

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)

Accumulator Sizing Bladder, Diaphragm, and Piston

Name _____	Title _____
Company _____	E-mail _____
Address _____	
Phone _____	State _____ Zip _____
Phone _____	Fax _____

Please attach any special requirements or drawings to the fax or e-mail.

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 = <input type="text"/>	E1 = <input type="text"/>	A1 = <input type="text"/>
QV2 = <input type="text"/>	E2 = <input type="text"/>	A2 = <input type="text"/>
QV3 = <input type="text"/>	E3 = <input type="text"/>	A3 = <input type="text"/>
QV4 = <input type="text"/>	E4 = <input type="text"/>	A4 = <input type="text"/>
QV5 = <input type="text"/>	E5 = <input type="text"/>	A5 = <input type="text"/>

Fluid

Required Mounting Orientation

Country of Final Installation (for country codes please see page 2)

Required Quantity

Annual Usage _____ Target Price _____ Competitor _____ Quantity _____

Additional Remarks

Accumulator Sizing Shock Applications

Name _____	Title _____	
Company _____	E-mail _____	
Address _____		
Phone _____	State _____	Zip _____
Phone _____	Fax _____	

Please attach any special requirements or drawings to the fax or e-mail.

What is the source of the shock? (i.e. valve closing, pump start, or other - please describe)

At the instance the shock occurs what is the...

Flow rate: _____ GPM
 Normal Operating Pressure: _____ PSI ; Maximum Spike Pressure: _____ PSI
 The system's maximum allowable design pressure: _____ PSI
 Information is required on all piping from the shock source to the anticipated location of the shock absorber (*accumulator*).
 Please continue to answer the following:
 Total Number of pipes: _____ (up to 10 pipes)

Starting at the shock source, please answer the following:

Pipe	Inner Diameter (inches)	Length (feet)	Pipe	Inner Diameter (inches)	Length (feet)
1	<input type="text"/>	<input type="text"/>	6	<input type="text"/>	<input type="text"/>
2	<input type="text"/>	<input type="text"/>	7	<input type="text"/>	<input type="text"/>
3	<input type="text"/>	<input type="text"/>	8	<input type="text"/>	<input type="text"/>
4	<input type="text"/>	<input type="text"/>	9	<input type="text"/>	<input type="text"/>
5	<input type="text"/>	<input type="text"/>	10	<input type="text"/>	<input type="text"/>

If the vertical height from the shock source to the anticipated location of the shock absorber is greater than 10 feet please state this distance.

Vertical Height: _____ feet

Fluid

Required Mounting Orientation

Country of Final Installation (for country codes please see page 2)

Required Quantity

Annual Usage _____ Target Price _____ Competitor _____ Quantity _____

Additional Remarks

Accumulator Sizing Pulsation Dampening

Name _____	Title _____
Company _____	E-mail _____
Address _____	
Phone _____	State _____ Zip _____
Phone _____	Fax _____

Please attach any special requirements or drawings to the fax or e-mail.

What type of pump is causing the pulsation?

Please name or describe (ie piston pump, gear pump, etc.)

What is the...

Flow rate: _____ GPM

Pump: _____ RPM

Pump Piston Diameter: _____ (inches)

Pump Piston Stroke: _____ (inches)

Number of Rotating Elements: _____ (3 piston, 13 tooth gear, etc)

Operating Pressure: _____ psi

The system's maximum allowable pressure: _____ psi

Line Size where pulsation dampener will be fitted into: _____
(The I.D. of the line is what is really required)

Note: A pulsation dampener should be always be installed as close to the pulsation source as possible to optimize its performance. A pulsation dampener should never be placed greater than 10 ft away from the pulsation source.

Fluid

Required Mounting Orientation

Country of Final Installation (for country codes please see page 2)

Required Quantity

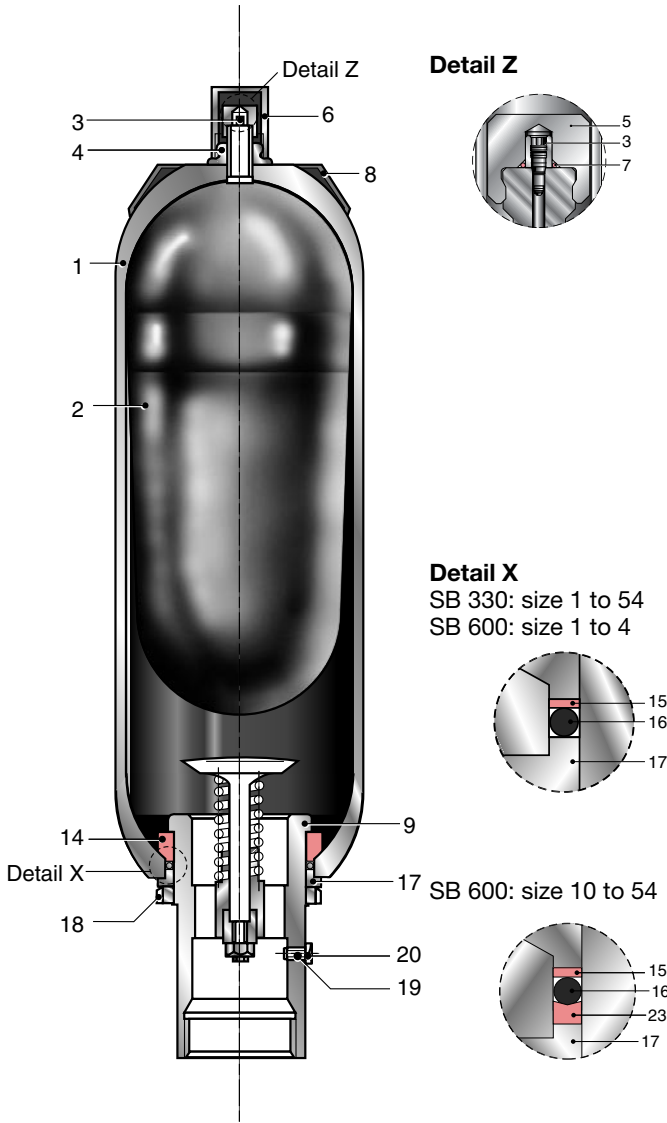
Annual Usage _____ Target Price _____ Competitor _____ Quantity _____

Additional Remarks

Spare Parts

Bladder Accumulators

Bottom Repairable SB330, SB300H, SB 600



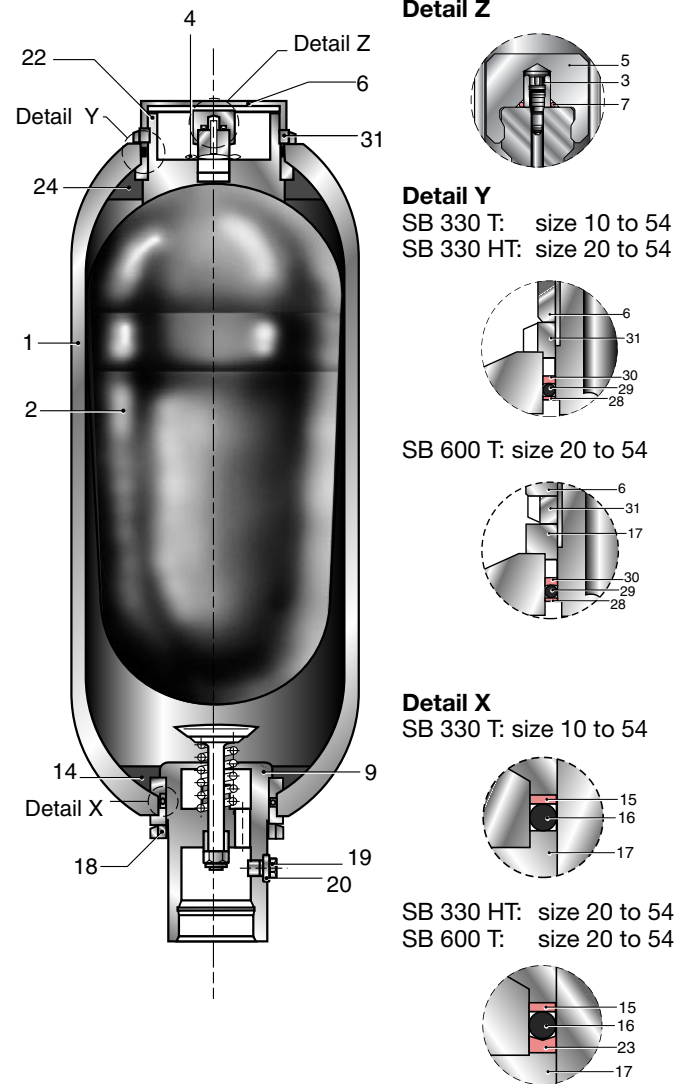
Repair Kits consist of items

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



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

Parts Legend

Gas Side

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

Seal Kits Bladder Accumulators

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

Bottom Repairable - Buna N*

Size	3000 PSI		5000 PSI	
	Fluid Port Seal Kit	Repair Kit	Fluid Port Seal Kit	Repair Kit
1 (1 qt.)	02054031	02054034	02054032	02054455
4 (1 gal.)	02054032	02054035	02054032	02054035
6 (1.5gal.)	02054032	02054677	N/A	N/A
10 (2.5 gal.)	02054033	02054036	02054283	02054279
20 (5 gal.)	02054033	02054037	02054283	02054280
32 (10 gal.)	02054033	02054038	02054283	02054281
42 (11 gal.)	02054033	02075963	N/A	N/A
54 (15 gal.)	02054033	02054039	02054283	02054282

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

Tools Bladder Accumulators

Item	Part Number
Pull Rod	00172054
Gas Valve Torque Wrench	02080987
Gas Valve Core Tool	00616886
Spanner Wrenches:	
1 Qt. -	02054547
1-15 Gal -	02054545
High Flow and Top Repairable	02054548

Gas Valve Torque Wrench



Gas Valve Core Tool



Spanner Wrench



Pull Rod: comes complete with fittings for both HYDAC gas valve types, and 3 extension segments to accommodate accumulators up to 54 liter

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

Competitive Crossover Bladder Accumulators



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-100-6	BA002B3T1A1
1 gal	02054004	A131003	0-531-113-640	841720	1-100-6	BA01B3T1A1
2.5 gal	02054005	A2.531003	0-531-114-640	849760	2.5-100-6	BA02B3T1A1
5 gal	02054006	A531003	0-531-115-640	849392	5-100-6	BA05B3T1A1
10 gal	02054007	A1031003	0-531-115-650	850670	10-100-6	BA10B3T1A1
15 gal	02054008	A1531003	0-531-116-6401	849910	15-100-6	BA15B3T1A1

Repair Kits¹⁰ Replacement Bladder

Size	HYDAC	Accum Inc.	Bosch ²	Greer	Oil Air	Parker
1 qt 5/8" Gas Valve	02054655	AI-1QT-3KT3	N/A	7029283	A1QT-3003	08506930023
1 qt 7/8" Gas Valve (HYDAC standard)	02054034	AI-1QT-3KT	9-534-232-0243	702928	A1QT-300	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	9-534-232-0291	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-5-100-6	BA05T3T1A1
10 gal	02054001	A10TR31003	9-530-230-095	851590	TR-10-100-6	BA10T3T1A1
15 gal	02054002	A15TR31003	9-530-230-1051	852480	TR-15-100-6	BA15T3T1A1

Repair Kits¹⁰ Replacement Bladder

Size	HYDAC	Accum Inc. ⁴	Bosch ^{2,4}	Greer	Oil Air	Parker
2.5 gal	02054036	AI-2.5-3KT	N/A	702970	A2.5-2-300	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	9-534-232-0291	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	BA01B5T01A1
2.5 gal	02054276	A2.5TR510036	N/A	851150	G-2.5-5-100-6	BA02B5T01A1
5 gal	02054275	A5TR510036	N/A	855360	G-5-5-100-6	BA05B5T01A1
10 gal	02054277	A10TR510036	N/A	850680	G-10-5-100-6	BA10B5T01A1
15 gal	02054278	A15TR510036	N/A	855370	G-15-5-100-6	BA15B5T01A1

Repair Kits¹⁰ Replacement Bladder

Size	HYDAC	Accum Inc. ⁹	Bosch ^{2,4}	Greer	Oil Air	Parker
1 qt	020544557	N/A	N/A	704040	N/A	N/A
1 gal	020540357	N/A	N/A	704060	N/A	N/A
2.5 gal	020542798	AI-2.5-5-3KT	N/A	704080	AG-2.5-5-300	08619050258
5 gal	020542808	AI-5-5-3KT	N/A	704100	AG-5-5-300	08619050508
10 gal	020542818	AI-10-5-3KT	N/A	704120	AG-10-5-300	08619051008
15 gal	020542828	AI-15-5-3KT	N/A	704140	AG-15-5-300	08619051508

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

Seal Kits & Replacement Pistons

Piston Accumulators

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

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

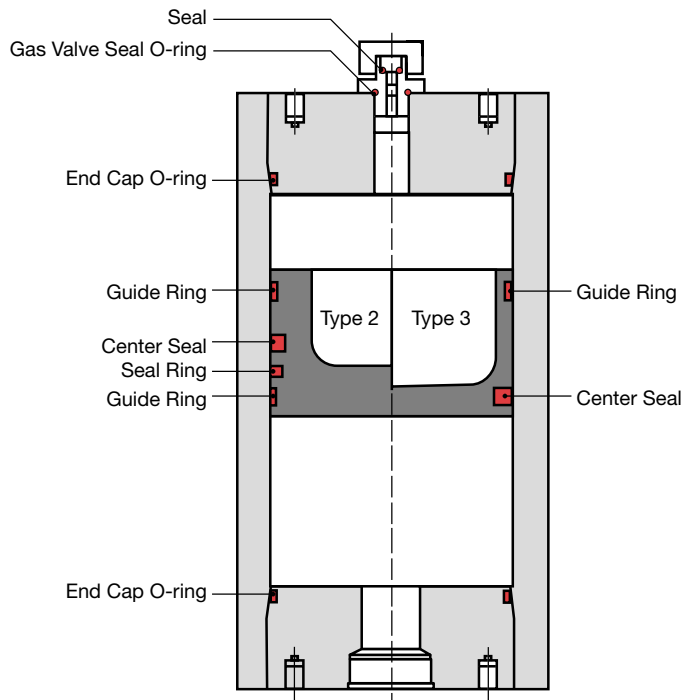
Piston Type Diameter

Piston Seal Kits

Diameter	Type 2 (NBR)	Type 3 (PUR)
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
31 (310 mm)	03016200	—
35 (355 mm)	00363272	—

Replacement Pistons - w/ Seals

Diameter	Type 2 (NBR)	Type 3 (PUR)
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
31 (310 mm)	03004987	—
35 (355 mm)	00356382	—



Tools

Piston Accumulators

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:

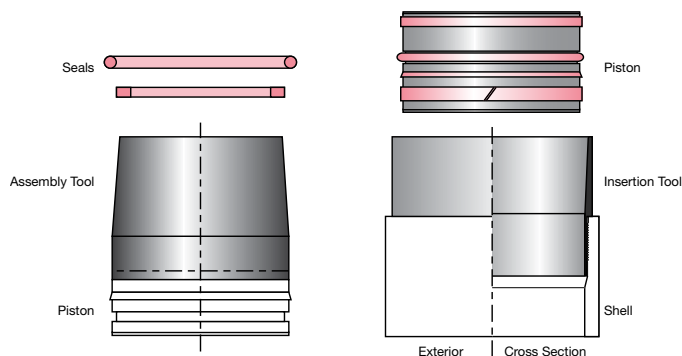
a tapered shroud that protects the seals from the threaded portion of the shell, and provides even seal compression and piston alignment when inserting the piston into the shell.

Tools

Diameter	Seal Assembly	Piston Insertion
08 (80 mm)	00359537	00359614
10 (100 mm)	00352198	00290056
15 (150 mm)	02124157	02124161
18 (180 mm)	00350148	00290049
25 (250 mm)	00290035	00290046
31 (310 mm)	02127304	02127305
35 (355 mm)	00354147	00290985

For items not listed please contact HYDAC.

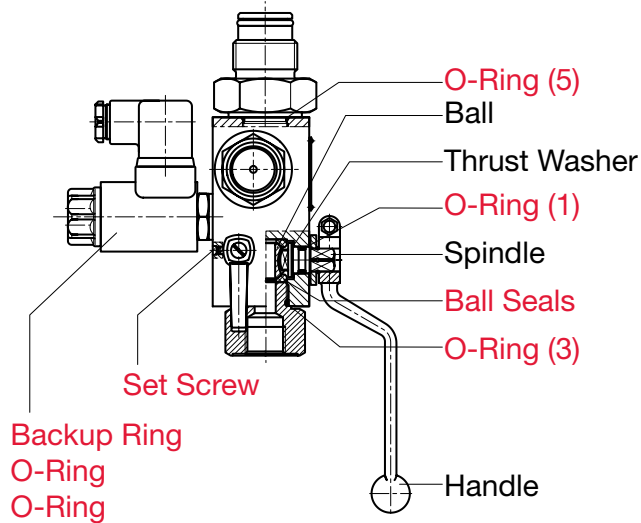
WARNING: Only qualified persons should perform maintenance on any type of accumulator. Complete maintenance instructions are available - Contact HYDAC.



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

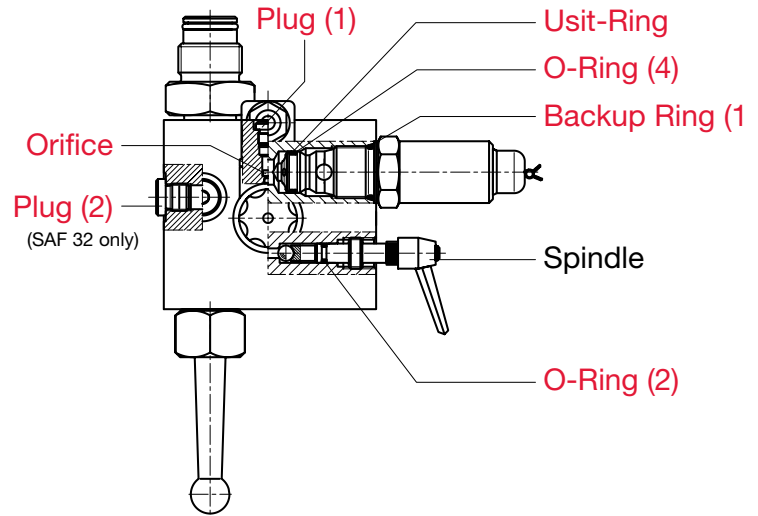
Repair Kits

Series	Part Number
SAF 10...	03154715 (FPM)
SAF 20...	03154716 (FPM)
SAF 32...	03154717 (FPM)



Seal Kit (includes parts marked in red)

Series	Part Number
SAF 10...	03154712 (FPM)
SAF 20...	03154713 (FPM)
SAF 32...	03154714 (FPM)



Dimensions for Spare Parts

Item	SAF 10...	SAF 20...	SAF 32...
O-Ring (1)	10 x 2	15 x 2.5	20 x 3
O-Ring (2)	-	6 x 2	-
O-Ring (3)	21 x 2	34 x 2.5	53 x 2.5
O-Ring (4)	19 x 3	26 x 3	26 x 3
O-Ring (5)	29.7 x 2.8	29.7 x 2.8	37.2 x 3
Usit-ring	17.4 x 24 x 1.5	24.7 x 31.5 x 2	24.7 x 31.5 x 2
Backup Ring (1)	20.3 x 25 x 1	27.3 x 32 x 1	27.3 x 32 x 1
Plug (1)	7/16-20UNF	3/4-16UNF	3/4-16UNF
Plug (2)	N/A	N/A	G1/8

O-ring dimensions are in mm

Manual Bleed Valve

Consists of Spindle, Handle, Ball, O-Ring, and Set Screw

Part No.	02115649 (FPM)
----------	----------------

Solenoid

2-way solenoid operated bleed valve (without coil)	Old 2SV5	New WSM
Normally Open (for SAF...E16Y)	N/A	03055295
Normally Closed (for SAF...E16Z)	N/A	03055276

Coil Kit for 2-way solenoid operated bleed valve	Old 2SV5	New WSM
24 V DC	00715003	02083644
110 V AC	00715033	02083645

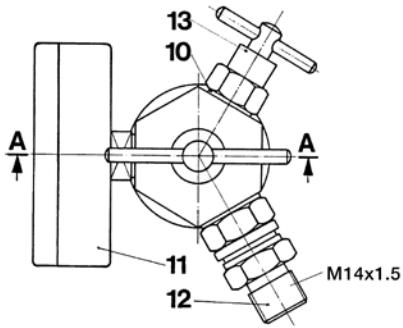
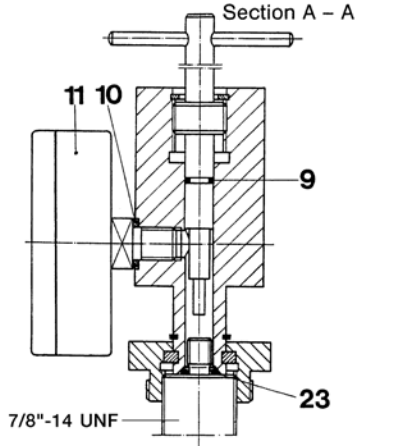
Note: 2SV5 coils and WSM coils are not interchangeable.

When replacing a 2SV5 with a WSM you must also replace the coil with the WSM design.

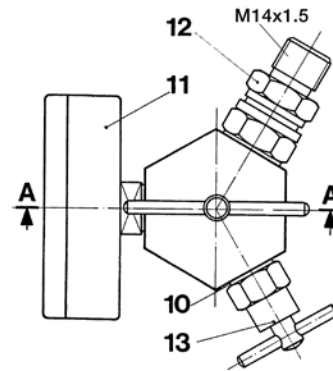
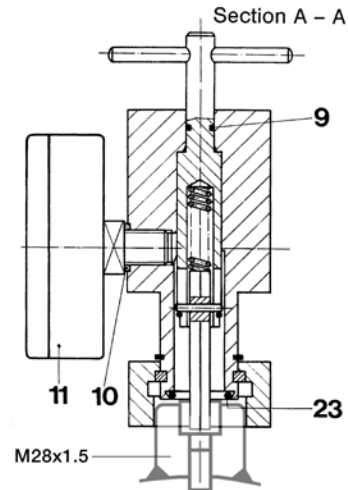
Charging & Gauging Units

Spare Parts

FPS Unit



FPK Unit



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 - FPS	00626488
	O-Ring - FPK	00601049
-	2.5m Hose	00236514
-	4m Hose	00236515
-	10m Hose	00373405
-	ADAPTER G4	02068737
-	ADAPTER A3 (FPK/SB)	00291533

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

HYDAC Accumulators

Bladder, Piston, Diaphragm.

HYDAC is the only worldwide manufacturer producing all types of hydraulic accumulators – Bladder, Piston, Diaphragm Accumulators, and Hydraulic Dampeners. Not only does **HYDAC** supply the most comprehensive Hydraulic Accumulator range, but also the best technical solution for every application. HYDAC Accumulators are supplied with pressure vessel certifications to the laws governing the appropriate country of installation.

Bladder

Nominal Volume

- 1 quart to 15 gallons

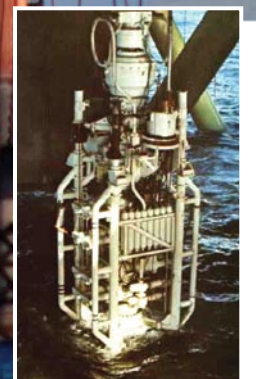
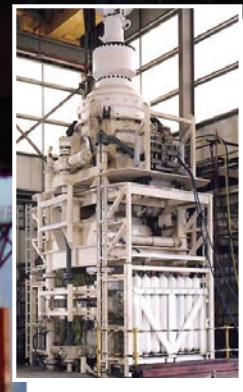
MAWP

- 3000, 5000, 6000,
6500, 7000, 10,000 psi

Available Options

- Stainless Steel
Fluid Ports & Gas Valves
- 3 Coat Epoxy Paint
- ASME Certified
- PED “CE” Certified
- DNV
- ABS
- CRN

*For more information
on these bladders see page 46.*





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