1. DESCRIPTION

INTRODUCTION

Fluids are practically incompressible and cannot therefore store pressure energy. The compressibility of a gas (nitrogen) is utilized in hydropneumatic accumulators for storing fluids. HYDAC bladder accumulators are designed on this principle, using nitrogen as the compressible medium. 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.
HYDAC bladder accumulators can be used in a wide variety of applications some of which are listed below:

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

Plastic injection molding machine

Typically, the flow demand during a cycle varies greatly (see fig. 1). By utilizing HYDAC bladder accumulators, pump size can be reduced, thus saving energy while improving cycle rate.

Crude oil piston pump

A HYDAC bladder accumulator with back-up nitrogen bottle supplies fluid to a hydrostatic secondary control motor. The motor in turn drives the piston pump rod through its acceleration profile on its upward stroke.

Hydropuls® - resonance fatigue testing machine (Carl Schenck AG)

This fatigue-testing machine is used to establish metallurgical limits. HYDAC high flow bladder accumulators provide fluid volume over a relatively low pressure range for cycling at a frequency of 30 Hz. This ensures uniform loading on the test sample.
Putzmeister® Concrete Pumper
The HYDAC bladder accumulator provides flow to the cylinder switching circuit.

Coal Crusher
The coal is crushed hydraulically by hammers in a rotary motion. The hammers have a tendency to oscillate up and down due to the unevenness of the coal being fed into the crushing bed. HYDAC bladder accumulators are installed to prevent pressure shocks and reduce the oscillations of the hammers; the accumulators provide hydro-pneumatic suspension.

Loading Fuel Tankers
Any sudden change in the steady state condition of flow (e.g. when the shut-off valve is closed at the end of a long pipeline) causes an increase in pressure which may be many times that of the normal working pressure.

When installed near the shut-off valve, HYDAC bladder accumulators absorb the motion energy of the fluid, allowing the pressure to rise slowly to a permissible level. Pipelines and valves are therefore protected from pressure surges.
3. TECHNICAL DATA

OPERATION

Describing the operation of bladder accumulators:

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 ($\Delta V$) 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 bladder from chafing the valve on each cycle. Thus, $p_0$ should always be lower than $p_1$.

$$\Delta V = V_1 - V_2$$

$\Delta V$ = Volume of fluid available between the working pressures $p_2$ and $p_1$.

$p_0$ = gas precharge

$p_1$ = minimum working pressure

$p_2$ = maximum working pressure

$V_0$ = effective gas volume of the accumulator

$V_1$ = gas volume at $p_1$

$V_2$ = gas volume at $p_2$

$T_0$ = temperature at precharging

$T_1$ = minimum operating temperature

$T_2$ = maximum operating temperature

Recommended Gas Precharge Pressure

- for energy storage: $p_0 = 0.9 \times p_1$
- $p_1$ = minimum working pressure
- for shock absorption: $p_0 = (0.6$ to $0.9) \times p_m$
  $p_m$ = median working pressure at free flow
- for pulsation dampening: $p_0 = (0.6$ to $0.8) \times p_m$
  $p_m$ = median working pressure

TECHNICAL SPECIFICATION

Maximum working pressure

Please refer to tables on pages 10, 12 and 14.

In other countries the maximum working pressure may be different.

Maximum allowable pressure ration

Ration of maximum working pressure ($P_2$) to gas precharge pressure ($P_0$).

$p_2 : p_0 \leq 4 : 1$

Nominal volume (size)

Please refer to tables on pages 10, 12 and 14.

Effective gas volume ($V_0$)

Please refer to the tables on pages 10, 12 and 14.

Effective fluid volume ($\Delta V$)

Volume of fluid available between the working pressures $p_2$ and $p_1$.

Fluids

Mineral oil, hydraulic oil, water, water glycol and water emulsions. For other fluids, please contact HYDAC.

Operating temperature range

Selection of the shell material and elastomer depends on the operating temperature range of the unit. For selection, please refer to pages 8 and 9.

Flow rates

The maximum allowable flow rate depends on the accumulator size. For selection, please refer to pages 10 and 12.

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 7.

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

$celsius$

$$p_{0,T_0} = p_{0,T_2} \times \left( \frac{T_0 + 273}{T_2 + 273} \right)$$

$T_0$ = 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 FOR SIZING ACCUMULATORS

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

The following applies for ideal gases:

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

where the time related change of state is represented by the polytropic exponent “n”. For slow expansion and compression processes which occur almost isothermically, the polytropic exponent can be set at \( n = 1 \).

For rapid processes, the adiabatic change of state can be calculated using \( n = k = 1.4 \) (for nitrogen as a diatomic gas)\(^1\).

For pressures above 3000 psi the real gas behavior deviates considerably from the ideal one, which reduces the effective fluid volume \( \Delta V \). 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

1. **Polytropic**:

\[ V_0 = \frac{\Delta V}{(\frac{p_0}{p_1})^{1/n} - (\frac{p_0}{p_2})^{1/n}} \]

2. **Isothermal** (\( n = 1 \)):

\[ V_0 = \frac{\Delta V}{(\frac{p_0}{p_1}) - (\frac{p_0}{p_2})} \]

3. **Adiabatic** (\( n = k = 1.4 \)):

\[ V_0 = \frac{\Delta V}{(\frac{p_0}{p_1})^{0.714} - (\frac{p_0}{p_2})^{0.714}} \]

### Correction factors to take into account the real gas behavior

- **Isothermal change of condition**:

\[ V_{0,\text{real}} = C_i \times V_{0,\text{ideal}} \]

\[ \Delta V_{0,\text{real}} = \Delta V_{\text{ideal}} \]

- **Adiabatic change of condition**:

\[ V_{0,\text{real}} = C_a \times V_{0,\text{ideal}} \]

\[ \Delta V_{\text{real}} = \Delta V_{\text{ideal}} \]

\(^1\) 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.  

### 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 \( T_2 = 120°F \)
- minimum operating temperature \( T_1 = 75°F \)

1. **Determination of required gas volume:**

   - \( p_0, T_2 = 0.9 \times p_1 \)
   - \( = 0.9 \times 1500 = 1350 \text{ psi} \)

   - \( p_0, T_1 = \frac{p_0, T_2}{(\frac{T_2}{T_1})^{0.714}} \)
   - \( = \frac{1350}{(\frac{120}{75})^{0.714}} \approx 1245 \text{ psi} \)

   - \( V_{0,\text{ideal}} = \left( \frac{p_0, T_1}{p_1} \right)^{0.714} - \left( \frac{p_0, T_1}{p_2} \right)^{0.714} \)
   - \( = \left( \frac{1245}{1500} \right)^{0.714} - \left( \frac{1245}{3000} \right)^{0.714} \)
   - \( = 3.95 \text{ gallons} \)

2. **Correction factor from diagram:**

   - \( \frac{p_2}{p_1} = 2 - C_a = 1.16 \)

3. **Real gas volume:**

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

4. **Determination of gas precharge pressure \( p_0 \) at 68°F:**

   - \( p_0, T_0 = p_0, T_2 \times \left( \frac{T_2 + 460}{T_0 + 460} \right) \)
   - \( = 1350 \times \left( \frac{120 + 460}{68 + 460} \right) \)
   - \( = 1230 \text{ psi} \)

5. **Selected:** Size 20 (5 gallon) Model: SB 330 -20A1 / 112S - 210C Precharged to 1230 psi at 68°F
4. INSTALLATION REQUIREMENTS

General Suggestions

WARNING!

Hydraulic accumulators are pressurized vessels and only qualified technicians should perform repairs. Never weld, braze or perform any type of mechanical work on the accumulator shell. **When handling an accumulator never lift it by the gas valve.** Always drain the fluid completely from the accumulator before performing any work, such as recommended repairs (see Maintenance Instructions) or connecting pressure gauges. Precharge new or repaired accumulators with dry nitrogen to the proper gas precharge pressure \( (p_0) \).

For more complete details, please refer to HYDAC Operating and Installation Instructions. HYDAC suggests a thorough inspection including a pressure test every 5 to 10 years depending upon the application. **Country of Installation**

Pressure vessel codes vary depending upon the country of installation. In the United States and Canada pressure vessels are governed by the ASME pressure vessel code. HYDAC manufactures according to these standards. For installations in countries outside of the United States, please consult HYDAC for the appropriate certifications*. The country of installation codes shown below are required for ordering: please refer to page 9.

Argentina S
Australia F
Austria D
Brazil K
Canada S/S1
Chile S
China A9
Finland L
France B
Germany A
Great Britain (UK) K
Italy M
Japan P
Mexico E
Russia A6
Sweden R
USA S
others upon request

---

### Elastomer Compatibility Table

In order to maximize system performance it is important to match your system fluid and its temperature range with the appropriate elastomer compound. The table below illustrates the most common ones. For special requirements, please consult HYDAC.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Operating Temperature Range</th>
<th>Some Typical Fluids</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBR (BUNA N)</td>
<td>5°F to 180°F</td>
<td>mineral oils</td>
</tr>
<tr>
<td></td>
<td>32°F to 180°F</td>
<td>water and water-glycols</td>
</tr>
<tr>
<td>LT-NBR (low temp. NBR)</td>
<td>-40°F to 180°F</td>
<td>mineral oils</td>
</tr>
<tr>
<td>ECO (HYDRIN)</td>
<td>-20°F to 250°F</td>
<td>mineral oils</td>
</tr>
<tr>
<td>IIR (BUTYL)</td>
<td>-20°F to 200°F</td>
<td>phosphate esters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>brake fluids</td>
</tr>
<tr>
<td>FPM (VITON)</td>
<td>5°F to 300°F</td>
<td>chlorinated hydrocarbons</td>
</tr>
</tbody>
</table>

Notes:
1. The operating temperature range does vary with fluid types, please consult HYDAC for more specific fluid data.
2. The above typical fluids are some examples of the most common fluids, please consult HYDAC for specific data.
3. For temperatures below - 40°F and above 200°F, please consult HYDAC for maximum allowable working pressures of the pressure vessels.
4. For other applications not listed, please consult HYDAC.

* The European Community (EC) has the Pressure Equipment Directive (PED) that is being phased in. Contact HYDAC for details.
5. Model Code: Bladder Accumulators

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

**Special design (if required)**
- H = High Flow
- T = Top Repairable
- HT = High Flow / Top Repairable

**Size (see tables)**

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

**Gas port**
- 1 = Standard model, HYDAC gas valve version 4 (8V1 - ISO 4570)
- 2 = Transfer barrier model

**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 (304)
- 3 Stainless steel (316)
- 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)*
- 4 Stainless steel (316)
- 6 Low temperature carbon steel (<-40°F)

**Bladder compound**
- 2 NBR (Buna N)
- 3 ECO (Hydrin)
- 4 IIR (Butyl)
- 5 LT-NBR (low temperature Buna)
- 6 FPM (Viton)
- 7 Others

**Country of Installation**
- S = USA
- Others on request

**Maximum working pressure**
- 210 = 3000 psi
- 345 = 5000 psi

**Fluid port connection**
- Threaded: A = BSP (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)

(Not all combinations available)

### SB 330 (maximum working pressure 3000 psi)

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<thead>
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<td>9.1</td>
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### SB 600 (maximum working pressure 5000 psi)

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<td>1 7/8-12 UN</td>
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<td>9.1</td>
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<td>1 7/8-12 UN</td>
<td>N/A 240</td>
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1) For SAE thread only
2) Maximum discharge flow rate recommended for vertically mounted accumulators

### Split Flange Connection (optional):

**Split Flange Connection (size 10 to 54)**

<table>
<thead>
<tr>
<th>Series</th>
<th>B in (mm)</th>
<th>ØE in (mm)</th>
<th>Connection</th>
<th>Q² gpm</th>
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<td>SAE 2&quot;-3000 psi (code 61)</td>
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<td>SB 330T³</td>
<td>(104)</td>
<td>(71.4)</td>
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<tr>
<td>SB 600</td>
<td>5.5</td>
<td>2.5</td>
<td>SAE 1 1/2&quot;-6000 psi (code 62)</td>
<td>240</td>
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<tr>
<td>SB 600T³</td>
<td>(140)</td>
<td>(63.5)</td>
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</tr>
</tbody>
</table>

3) size 20 to 54 only
**Spare Parts:** Accumulators SB 330, SB 330 H, and SB 660

**Detail X**
- SB 330: size 1 to 54
- SB 660: size 1 to 4

**Detail Z**
- SB 330: size 10
- SB 600: size 10 to 54

**Item** | **Description:**
--- | ---
1 | Shell
2 | Bladder
3 | Gas Valve Core
4 | Lock Nut
5 | Valve Seal Cap
6 | Valve Protection Cap
7 | O-ring
8 | Name Plate
9 | Fluid Port
14 | Anti-extrusion Ring
15 | Flat Ring
16 | O-ring
17 | Spacer Ring
18 | Lock Nut
19 | Vent Screw
20 | Seal Ring
23 | Back-up Ring

**Repair Kit Consists Of:**
- 2 Bladder
- 3 Gas Valve Core
- 4 Fluid Port Lock Nut *(SB 600 only)*
- 5 Valve Seal Cap
- 7 O-Ring
- 15 Flat Ring
- 16 O-Ring
- 23 Back-up Ring *(where applicable)*

**Seal Kit Consists Of:**
- 15 Flat Ring
- 16 O-Ring
- 23 Back-up Ring *(where applicable)*
7. Top Repairable and High Flow Bladder Accumulators: SB 330 T, SB 330 H, SB 330 HT (3000 psi), and SB 600 T (5000 psi)

**SB 330 T, SB 330 HT, SB 600 T**

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**SB 330 H (maximum working pressure 3000 psi)**

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</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>5</td>
<td>1125</td>
<td>161 (73)</td>
<td>35.7 (907)</td>
<td>5.3 (135)</td>
<td>1.3 (33)</td>
<td>9.1 (231)</td>
<td>3.8 (97)</td>
<td>2 1/2-12 UN</td>
<td>N/A</td>
<td>480</td>
<td></td>
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<tr>
<td>32</td>
<td>10</td>
<td>2080</td>
<td>247 (112)</td>
<td>56.9 (1420)</td>
<td>5.3 (135)</td>
<td>1.3 (33)</td>
<td>9.1 (231)</td>
<td>3.8 (97)</td>
<td>2 1/2-12 UN</td>
<td>N/A</td>
<td>480</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>15</td>
<td>3205</td>
<td>352 (160)</td>
<td>79.5 (2020)</td>
<td>5.3 (135)</td>
<td>1.3 (33)</td>
<td>9.1 (231)</td>
<td>3.8 (97)</td>
<td>2 1/2-12 UN</td>
<td>N/A</td>
<td>480</td>
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<td></td>
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</tbody>
</table>

**SB 600 T (maximum working pressure 5000 psi)**

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</thead>
<tbody>
<tr>
<td>20</td>
<td>5</td>
<td>1125</td>
<td>172 (78)</td>
<td>33.5 (851)</td>
<td>3.1 (80)</td>
<td>1.6 (40)</td>
<td>9.1 (231)</td>
<td>3.0 (76)</td>
<td>1 7/8-12 UN</td>
<td>N/A</td>
<td>240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>10</td>
<td>2080</td>
<td>260 (118)</td>
<td>53.7 (1364)</td>
<td>3.1 (80)</td>
<td>1.6 (40)</td>
<td>9.1 (231)</td>
<td>3.0 (76)</td>
<td>1 7/8-12 UN</td>
<td>N/A</td>
<td>240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>15</td>
<td>3205</td>
<td>380 (172)</td>
<td>77.3 (1964)</td>
<td>3.1 (80)</td>
<td>1.6 (40)</td>
<td>9.1 (231)</td>
<td>3.0 (76)</td>
<td>1 7/8-12 UN</td>
<td>N/A</td>
<td>240</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) SAE split flange connections for SB 330 T see page 10.
2) For SAE thread only.
3) Maximum discharge flow rate recommended for vertically accumulators.
**Spare Parts**: SB 330 T, SB 330 HT, and SB 600 T

**Item Description:**
1. Shell
2. Bladder
3. Gas Valve Core
4. Lock Nut
5. Valve Seal Cap
6. Valve Protection Cap
7. O-ring

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

**Gas Side**
22. Gas Port Adapter
24. Anti-extrusion Ring
28. Flat Ring
29. O-ring
30. Back-up Ring
31. Lock Nut

**SB 330 T, SB 600 T Repair Kit consists of:**
2. Bladder
3. Gas Valve Core
5. Valve Seal Cap
7. O-ring
15. Flat Ring
16. O-ring
28. Flat Ring
29. O-ring
30. Back-up Ring

**SB 330 HT Repair Kit consists of:**
2. Bladder
3. Gas Valve Core
5. Valve Seal Cap
7. O-ring
15. Flat Ring
16. O-ring
28. Flat Ring
29. O-ring
30. Back-up Ring

**Seal Kit Consists of:**

**SB330T:**
15. Flat Ring
16. O-ring
28. Flat Ring
29. O-ring
30. Back-up Ring

**SB330HT:**
15. Flat Ring\(^1\)
16. O-ring\(^1\)
23. Back-up Ring\(^1\)

**SB600T:**
15. Flat Ring\(^1\)
16. O-ring\(^1\)
23. Back-up Ring\(^1\)

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1) These parts can be used on either the gas side or the fluid side, if both sides are being re-sealed two kits are required.
8. SPECIAL BLADDER ACCUMULATORS

HIGH PRESSURE BLADDER ACCUMULATORS
SB 800, SB 1000

The HYDAC high pressure bladder accumulators work on the same principles as our standard bladder accumulators. HYDAC offers them in standard carbon or stainless steel.

**SB 800**
*maximum working pressure 11,600 psi*

<table>
<thead>
<tr>
<th>Size</th>
<th>1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Volume - in³</td>
<td>90</td>
</tr>
<tr>
<td>Weight - lbs (kg)</td>
<td>68.4 (31)</td>
</tr>
</tbody>
</table>

**SB 1000**
*maximum working pressure 14,500 psi*

<table>
<thead>
<tr>
<th>Size</th>
<th>1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Volume - in³</td>
<td>90</td>
</tr>
<tr>
<td>Weight - lbs (kg)</td>
<td>190 (86)</td>
</tr>
</tbody>
</table>

Note: dimensions shown in mm.

---

LOW PRESSURE BLADDER ACCUMULATORS

HYDAC offers low pressure bladder accumulators. Please consult HYDAC for details.

STAINLESS STEEL BLADDER ACCUMULATORS

HYDAC offers stainless steel bladder accumulators. Please consult HYDAC for details.

---

Dimensions: SB 800

Note: dimensions shown in mm.

Dimensions: SB 1000

Note: dimensions shown in mm.
TRANSFER BARRIER
TYPE BLADDER
ACCUMULATORS
SB 600: Size 20 to 54

With a small differential between minimum and maximum working pressure, the nitrogen in the accumulator can only be compressed slightly. As a result, the effective portion of accumulator volume is correspondingly small. When sizing so-called “back-up” type accumulators, the same principle is used as for individual accumulators, where \( V_0 \) represents the total volume of accumulator and nitrogen bottles.

It should be noted, however, that on back-up accumulators, the accumulator should only be charged to 75 % of its fluid capacity to keep the bladder from being over compressed.

The gas precharge pressure can be higher than 0.9 times the min. working pressure, so that when discharged to min. working pressure \( p_1 \), a residual fluid volume \( \Delta V_R \) of approx. 10% of the accumulator volume remains.

The calculation must be iterative. After each stage, check whether the effective volume \( \Delta V' \) is sufficient to take up the fluid volume during isothermal charging, from gas precharge pressure to working pressure.

Checking the effective volume on a back-up version.

\[
\Delta V' = V_0^{\text{(total)}} \left( \frac{p_0}{p_1} - \frac{p_0}{p_2} \right)
\]

\[
\Delta V' \leq 0.75 \times V_0^{\text{(accum.)}}
\]

Please consult HYDAC for more details.
Other Products from HYDAC's Accumulator Line

Diaphragm Accumulators
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. Two styles are available weld (non-repairable) and threaded (repairable). Both are suited for energy storage and shock applications.
Nominal volume 5 in³ to 1 gal.
Max. working pressure 3000, 4700, and up to 10,000 psi
Flow rate up to 40 gpm

Request catalog # 02071831

Piston Accumulators
A wide range of piston accumulators is available. Piston position monitoring is available using proximity switches, extending piston rod or ultrasonic techniques. Auxiliary gas bottles are frequently used with piston accumulators to provide the required gas volume.
Nominal volume 1 qt. to 100 gal.
Max. working pressure 3000, 5000, and up to 15000 psi
Flow Rate up to 2000 gpm

Request catalog # 02068597

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. mounting components are used mainly for the following: to fix the accumulator into its position, to carry the weight of the accumulator, and to counteract the forces exerted by the hydraulic lines. 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.

Request catalog # 02071834

Charging & Gauging
To maintain system performance, HYDAC recommends a regular check of the gas precharge pressure. 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. By means of a charging and gauging unit, hydro-pneumatics accumulators are precharged with dry nitrogen or their existing gas precharge pressure is checked. For these purposes, a charging and gauging unit is connected to a commercially available nitrogen bottle via a flexible hose. The charging and gauging units incorporate a gauge, check valve in the charging connection, manual bleed valve and T-handle.

Request catalog # 02071833