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http://www.accumulator.co.jp/
1. Functions & Effects

- **Energy Storage (Power Compensator)**
  This is a typical application of an accumulator where it stores energy from an external pressure source during idle time and discharges it as needed. In other words, it is used for reduction of pump and motor sizes, as an auxiliary power source in case of emergency, and/or to augment the output of the pump during high speed operation of actuator and hydraulic starter of internal combustion engines.

- **Water Hammer and Surge Pressure Absorber (Shock Dampener)**
  If a high pressure, high flow pipe line was shut suddenly, a huge pressure surge occurs, or, if an external mechanical shock was introduced to an actuator, vibration to fluid occurs, causing damages to machinery and equipment. The accumulator will dampen these fluid and mechanical shocks.

- **Pump Pulsation Dampener (Pulsation dampener)**
  Pulsation pressure of high pressure piston pumps, such as single, double, or triple actings, causes difficulties in various controls of hydraulic pressure systems. These pulsation pressure and knocking phenomenon that will occur, due to small feeding by cylinder, can be eliminated by an accumulator.

- **Leakage Compensator**
  An accumulator will minimize pressure reduction due to leakage when an accumulator was held at a set position for a long period of time or when something is being clamped.

- **Thermal Change Compensator**
  An accumulator will compensate for rising pressure in a closed line that is exposed to hot weather or lowering pressure due to fluid contraction in a cold area.

- **Hydraulic Balancer**
  Because the gas pressure in an accumulator will act as a weight for raising or lowering of machine tool heads or T.V. camera pedestal, they can be operated with minimum cylinder friction.

- **Hydro-Pneumatic Shock Absorbers**
  An accumulator serves as a spring for absorbing shocks between the body and wheels of a vehicle. In addition, it can be used as a pneumatic spring for various kinds of reduction rolls. It has less fatigue and greater shock absorption than a spring.

- **Transfer Barrier**
  An accumulator transfers or sends pressure occurring at one side of the fluid to the other without mixing heterogeneous fluid. With this method the accumulator acts as a compressor of gas or transport of corrosive fluid. The pressure change in an accumulator, which is caused by storage and discharge of fluid, can be minimized by enlarging the gas chamber and operating at low pressure difference.

- **Fluid Supplier**
  An accumulator can be used for supply of lubricant or as a portable lubricator.

---

The hydro-pneumatic accumulator is a pressurized fluid storage vessel that utilizes compression of gas and by the expansion power of the compressed gas the pressurized fluid stored in the accumulator is discharged. The bladder type accumulator uses a soft rubber bag to separate the compressed gas and non-compressed fluid and is charged with gas. It has many functions, in addition to storing pressure.
2. Accumulator Volume Calculation

**COMMON SYMBOL**

- \( \Delta V \) : Available Discharge Volume of Acc. (Liter)
- \( P_A \) : Normal Pressure (MPa \cdot A)
- \( P_M \) : Max. Permissible Pressure (MPa \cdot A)
- \( P_X \) : Mean Operating Pressure (MPa \cdot A)
- \( P_B \) : Max. Permissible Pressure (MPa \cdot A)
- \( W \) : Mass of Fluid in Line (kg)
- \( v \) : Flow Velocity (m/sec)
- \( q \) : Pump Displacement per Revolution (Liter/rev)
- \( F_1 \) : Pump Coefficient (See Graph Next)
- \( n \) : Polytropic Exponent at Discharging (Per Graph Below)
- \( m \) : Polytropic Exponent at Storage. (Value of "n" − 0.2)
- \( V_1 \) : Accumulator Gas Volume (Liter)
- \( P_1 \) : Precharge Pressure (MPa \cdot A)
- \( P_2 \) : Min. Operating Pressure (MPa \cdot A)
- \( P_3 \) : Max. Operating Pressure (MPa \cdot A)
- \( n \) : Polytropic Exponent at Discharging (Per Graph Below)
- \( m \) : Polytropic Exponent at Storage. (Value of "n" − 0.2)
- \( V_1 \) : Accumulator Gas Volume (Liter)
- \( g \) : Acceleration of Gravity, 9.8m/sec²

**CALCULATION FORMULA**

**Energy Storage**

\[
V_1 = \frac{\Delta V \times P_2 \times \left( \frac{P_1}{P_2} \right)^{\frac{n}{m}}}{P_1 \left\{ \left( \frac{P_1}{P_2} \right)^{\frac{1}{m}} - 1 \right\}}
\]

**Surge Absorption**

\[
V_1 = \frac{W \times v^2 \times (n - 1)}{200 \times g \times P_1 \left( \left( \frac{P_n}{P_A} \right)^{\frac{1}{m}} - 1 \right)}
\]

**Pulsation Dampening**

\[
V_1 = \frac{q \times F_1 \left( \frac{P_X}{P_1} \right)}{1 - \left( \frac{P_X}{P_M} \right)^{\frac{1}{n}}}
\]

**LIMITATION**

1. The relationship between higher or lower pressure is 0.25 \( \times (P_3 \text{ or } P_B \text{ or } P_M) \leq P_1 \leq 0.9 \times (P_2 \text{ or } P_A \text{ or } P_X).
2. In case of \( n < m \) in energy storage, make the value of "n" as "m" (but, it is over 1).

**Note:**

- In the case of Isothermal Change, \( n=1 \) and \( m=1 \)
- For \( n \), please put a numerical value of less than 1(sec.) from the graph next.
Polypotropic Change and Exponent... Graph to obtain a polypotropic exponent from time change and average pressure.

(Example) If the time change is 5 sec. and the average pressure is 5 MPa, polypotropic exponent is \( n = 1.41 \).

1. If the discharge time from \( P_3 \) to \( P_2 \) is 5 seconds and the average pressure is 5 MPa, \( n = 1.41 \).
2. If the storage time from \( P_2 \) to \( P_3 \) is 5 seconds and the average pressure is 5 MPa, \( m = 1.21 \).
Operate a 500 kN press of which ram diameter is 200mm. Stroke 115 mm at 1.5 sec. There is a 2 min. idle time for removing the work. If this is done with a pump and motor only, what will their sizes be? If an accumulator is used, what will their sizes be? The comparison of two cases are shown in Table 1 below.

If an accumulator was used … There are two approaches. One is that since the pressure drops as the bladder type accumulator discharges fluid, select a larger bore of cylinder, another is increase the pressure and put the minimum required pressure at the end of discharge. Let us work on the latter example. If an accumulator that withstands 21.5 MPaG and a pump that is capable of producing the pressure of 21.5 MPaG were used at the same time,

\[ V_1 = \frac{\Delta V \times P_2 \left( \frac{P_3}{P_2} \right)^{\frac{1}{n}}}{P_1 \left( \frac{P_3}{P_2} \right)^{\frac{1}{m}} - 1} \]

Note: On the pressure, convert (MPaG + 0.1) into MPaA. Refer to following item f at P1.

\[ V_1 = \frac{3.7 \times 16.1 \left( \frac{21.6}{16.1} \right)^{\frac{1}{1.35}}}{13.4 \left( \frac{21.6}{16.1} \right)^{\frac{1}{1.85}} - 1} = 32.5 \text{ Liter} \]

Flow rate to accumulator = \( \frac{3.7 \text{ Liter}}{2 \text{ min}} = 1.9 \text{ Liter/min} \)

Motor = \( \frac{1.9 \text{ Liter/min} \times 21.5 \text{ MPaG}}{61.2 \times 0.82} = 0.82 \text{ kw} \equiv 1.1 \text{ kw} \)

If an accumulator was used, the pressure will increase 1.35 times, however, the sizes of a pump and a motor becomes smaller, 1/79 and 1/50 respectively.
a. The model shall be G230 or T230 (Ref. to INDEX 5 and 6) as the pressure is 21.5 MPaG.

b. At gas volume of 32.5 Liter, the accumulator model is 30 Liter (Ref. to "Gas Volume" in INDEX 5 and 6).

c. As the flow rate required per minute is 149 Liter/min, it is acceptable as refer to the maximum allowable discharge flow of non-stamped standard type (Ref. to INDEX 5 and 6).

d. If the fluid is the standard mineral oil (or water glycol) and the temperature is 80 °C or less, refer to INDEX 3 for bladder material 20. (Ref. to INDEX 3)

e. If piping is done with flange connections, it will be OPF-B32 (requires a mating flange). (Ref. to INDEX 12).

Therefore, Model: G or T230-30-20-OPF-B32 (requires a mating flange).

f. With respect to the filling pressure $P_1$, if it is 90% or less than the minimum operating pressure $P_2$, the higher it is the greater discharge amount $\Delta V$ becomes. However, if the temperature of gas charging time rises and the pressure goes over 90%, it will lead to shortening of the bladder life, therefore, a caution is required. If gas was charged at the ambient temperature of 26 °C and the oil temperature during operation of it is 50 °C.

$$P_1 = \frac{\text{Absolute temperature at precharging}}{\text{Max. absolute temperature}} \times 0.9 \times P_2 = \frac{273 + 26}{273 + 50} \times 0.9 \times 16.1 = 13.4 \text{ MPaA}$$

$$\Delta V = 3.7 \text{ Liter can be archived at } P_1 = 13.3 \text{ MPaG}$$
Exercise 2, Pulsation Dampening:

Assume that the average working pressure is 5 MPaG, maximum allowable pressure is raised 3% of the average working pressure (5.15 MPaG), pump is one stage, 62rpm, and its displacement is 32 liter/min. and $P_i = 3$ MPaG,

$$F_i = 0.6, \quad n = 1.51$$

$$V_i = \frac{q \cdot F_i \cdot \left(\frac{P_x}{P_i}\right)}{1 - \left(\frac{P_x}{P_m}\right)^n} = \frac{32}{62} \times 0.6 \times \left(\frac{5.1}{3.1}\right) = 26.8 \text{ Liter}$$

Therefore, by using an accumulator, of which gas volume is 26.8 liter it is possible to dampen the pulsation by plus/minus 3% of average working pressure.

Further, you can determine the displacement per revolution from the pump plunger size and stroke.

a. Refer to Exercise 1 for accumulator model selection.

b. Refer to INDEX 4 for the effect of pulsation dampening.
Exercise 3, Surge Absorption:

Assume that we are going to reduce caused by sudden closure of a valve installed at the end of a pipe which overall length (L) is 700m, 8B X Sch40 (216.3 mm X 8.2 mm) JIS Standard, and is operated at normal line pressure of 0.53 MPaG, and fluid volume Q = 4,500 liter /min.

\[ V_1 = \frac{W \times \nu^2 \times (n - 1)}{200 \times g \times P_1 \left\{ \left( \frac{P_{1A}}{P_{nA}} \right)^{\frac{n-1}{n}} - 1 \right\} } \]

\[ V_1 : \text{Accumulator gas volume, Liter} \]
\[ W : \text{Fluid mass within the line, kg} \]

\[ W = \frac{\pi}{4} \cdot d^2 \cdot L \cdot \gamma = \frac{\pi}{4} \times 200^2 \times 700 \times 0.9 \times 10^{-3} = 19792 \text{ kg} \]

\[ d : \text{I.D. of the pipe, (mm)} \]
\[ \gamma : \text{Fluid specific gravity, (kg/cm}^2) \]

\[ \nu : \text{Velocity of fluid, (m/sec)} \]
\[ \nu = 21.23 \frac{Q}{d^2} = 21.23 \times 4,500/200^2 = 2.4 \text{ m/sec} \]

\[ g : \text{Acceleration of gravity, 9.8 m/sec}^2 \]
\[ P_{nA} : \text{Normal pressure, 0.53 MPaG = 0.63 MPaA} \]
\[ P_{1A} : \text{Maximum allowable pressure = 1.23 MPaA} \]
\[ P_{1} : \text{Precharge pressure, MPaA} \]
\[ \text{From } P_{1} \leq 0.9P_{nA}, \text{ it becomes 0.53 MPaA} \]
\[ n : \text{Politropic coefficient 1.405} \]

\[ V_1 = \frac{19792 \times 2.4 \times (1.405 - 1)}{200 \times 9.8 \times 0.53 \left\{ \left( \frac{1.23}{0.63} \right)^{0.2883} - 1 \right\} } = 209 \text{ Liter} \]

Therefore, install an accumulator which size is 209 liters near the valve installed at the end of the pipe. Refer to Exercise 1 for a selection of accumulator models.
3. Explanation of Model Symbols


S7 … Cleanliness class of NAS. Class 7, 8, or 9 for use of servo circuitry, etc. If not specified, a standard will apply.
PV … Accumulator Preventor. G.T Series for a standard accumulator of 20 liters and over. (Ref. INDEX 13)

MT … Safety device for gas port.
60M … Glycerol filled pressure gauge for gas port.
CG … Coreless type gas port (Ref. INDEX 11-1)

Nominal dia. of flange.
Flange connection. (Ref. INDEX 12) If not specified, a standard gas valve will be provided.

Rubber materials

<table>
<thead>
<tr>
<th>Types</th>
<th>Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrile rubber (NBR)</td>
<td>Low Temperature</td>
</tr>
<tr>
<td>10</td>
<td>– 25 to +80 °C</td>
</tr>
<tr>
<td>Nitrile rubber (NBR)</td>
<td>Mineral oil, water glycol</td>
</tr>
<tr>
<td>20</td>
<td>– 10 to +80 °C</td>
</tr>
<tr>
<td>Epichlorohydrine (CHC)</td>
<td>Gasoline, etc., Aromatic material</td>
</tr>
<tr>
<td>30</td>
<td>– 10 to +90 °C</td>
</tr>
<tr>
<td>Butyl rubber (IIR)</td>
<td>Phosphate ester</td>
</tr>
<tr>
<td>40</td>
<td>– 10 to +90 °C</td>
</tr>
<tr>
<td>Fluorine rubber (FKM)</td>
<td>Chemical material</td>
</tr>
<tr>
<td>28</td>
<td>– 5 to +120 °C</td>
</tr>
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</table>

Surface treatment (or material)

<table>
<thead>
<tr>
<th>Surface treatment (or material)</th>
<th>Surface treatment (or material)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parkerizing</td>
<td>Water glycol, mineral oil</td>
</tr>
<tr>
<td>Nickel plating</td>
<td>Water hydr. Shell/Nickel plating, Connection / Stainless steel</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>Others Both shell &amp; connection / Stainless steel, Ref. to INDEX 10</td>
</tr>
</tbody>
</table>

Series of accumulator

<table>
<thead>
<tr>
<th>Type</th>
<th>Type</th>
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</thead>
<tbody>
<tr>
<td>Damper series</td>
<td>In-line type</td>
</tr>
<tr>
<td>General series</td>
<td>Standard type</td>
</tr>
<tr>
<td>Minorator Series</td>
<td>Small capacity type</td>
</tr>
<tr>
<td>Twin Open Series</td>
<td>Open top type</td>
</tr>
</tbody>
</table>

Nominal capacity of accumulator (Liter)
Maximum working pressure (kgf/cm²)

If not specified, a standard gas valve will be provided.
### 4. MINIORATOR M-Series

<table>
<thead>
<tr>
<th>Spec.</th>
<th>Model</th>
<th>M210</th>
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<tbody>
<tr>
<td>Max. W.P</td>
<td>20.6 MPa</td>
<td></td>
</tr>
<tr>
<td>Precharge</td>
<td>N₂ gas</td>
<td></td>
</tr>
<tr>
<td>Precharge pressure limits</td>
<td>max. 9/10 of min. operating pressure min. 1/4 of max. operating pressure</td>
<td></td>
</tr>
<tr>
<td>Installation</td>
<td>Vertically (oil port downward)</td>
<td></td>
</tr>
<tr>
<td>Surface treatment</td>
<td>Oil service : parkerizing Water service, etc. : nickel plating</td>
<td></td>
</tr>
</tbody>
</table>

### Model symbols
- **M210**
- **1**
- **20**

#### Materials
- Rubber
- Nominal capacity of accumulator (Liter)
- Max. working pressure
- Series

#### Dimensions

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>M210</td>
<td>0.1</td>
<td>0.115</td>
<td>2</td>
<td>232</td>
<td>74</td>
<td>60.5</td>
<td>85</td>
<td>–</td>
<td>Rc1/4</td>
<td>62</td>
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<tr>
<td></td>
<td>0.3</td>
<td>0.29</td>
<td>5</td>
<td>286</td>
<td>94</td>
<td>76.3</td>
<td>85</td>
<td>35</td>
<td>Rc3/4</td>
<td>92</td>
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<tr>
<td></td>
<td>0.5</td>
<td>0.5</td>
<td>6.3</td>
<td>376</td>
<td>94</td>
<td>76.3</td>
<td>85</td>
<td>35</td>
<td>Rc3/4</td>
<td>92</td>
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<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>12.5</td>
<td>398</td>
<td>124</td>
<td>107.9</td>
<td>85</td>
<td>10</td>
<td>Rc3/4</td>
<td>260</td>
</tr>
</tbody>
</table>

*Maximum allowable discharge flow is the limit where the stopper will start chattering due to discharge of pressurized fluid.

Maximum allowable discharge flow is for the case of mineral oil VG46.

### Examples of pulsation dampening effect

- **(A) Without ACC.**
  - 0.5 liter bladder type ACC.

- **(B) With ACC.**
  - 0.5 liter bladder type ACC.

Data on the effects of pulsation dampening by different structure of accumulators is available upon request.
### 5. GENERAL SERIES  G-Series

#### Model symbols

- **G 230** – 10 H – 20

<table>
<thead>
<tr>
<th>Spec.</th>
<th>Model</th>
<th>G175</th>
<th>G230</th>
<th>G300</th>
<th>G350</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. W.P.</td>
<td>17.2 MPa</td>
<td>22.6 MPa</td>
<td>29.5 MPa</td>
<td>34.4 MPa</td>
<td></td>
</tr>
</tbody>
</table>

- Precharge

  - N\textsubscript{2} gas

- Precharge pressure limits

  - max. 9/10 of min. operating pressure
  - min. 1/4 of max. operating pressure

- Installation

  - Vertically (oil port downward)

- Surface treatment

  - Oil service: parkerizing
  - Water service, etc.: nickel plating

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Max. W.P. (MPa)</th>
<th>Nominal capacity of accumulator (lit.)</th>
<th>Max. Working Pressure (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td><strong>A</strong></td>
<td><strong>B</strong></td>
<td><strong>C</strong></td>
</tr>
<tr>
<td>G175 -1</td>
<td>1.2</td>
<td>9</td>
<td>391</td>
</tr>
<tr>
<td>-2.5</td>
<td>2.4</td>
<td>11</td>
<td>577</td>
</tr>
<tr>
<td>-4</td>
<td>3.7</td>
<td>18</td>
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<td>-5</td>
<td>4.7</td>
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<td>-50</td>
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<td>-10H</td>
<td>9.9</td>
<td>70</td>
<td>653</td>
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<tr>
<td>-30H</td>
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<td>-50H</td>
<td>48.1</td>
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<td>1945</td>
</tr>
<tr>
<td>-60H</td>
<td>58.7</td>
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<td>2311</td>
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<td>G300 -1</td>
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<td>1.2</td>
<td>10</td>
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<td>-2.5</td>
<td>2.4</td>
<td>20</td>
<td>577</td>
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<td>3.6</td>
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<td>-5</td>
<td>4.6</td>
<td>22</td>
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<td>10.1</td>
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- Rubber Materials
- Hi-Flow TYPE
- Nominal capacity of accumulator (lit.)
- Max. working pressure
- Series

* Refer to INDEX 13 for flange connection.

Maximum allowable discharge flow is for the case of mineral oil VG46.
6. TWIN OPEN SERIES  T-Series

**Features:**
- A large opening is provided on the top for ease of maintenance.
- Because the bladder is a fully enclosed type, it is easy for the degree of deformation and offers a longer life.
- Because the bladder is not configured with a seal, no special maintenance skill is required.
- Maintenance can be easily done either from the top or bottom.
- Because the shell has no threaded, there is no problem such as impossibility of disassembly and no probability of damaging the bladder at the time of maintenance.

**Model symbols:**

<table>
<thead>
<tr>
<th>Model</th>
<th>Hi-Flow TYPE</th>
<th>Nominal capacity of accumulator (Liter)</th>
<th>Max. working pressure (MPa)</th>
<th>Nominal capacity of accumulator (Liter)</th>
<th>Max. working pressure (MPa)</th>
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</table>

**Model Symbols:**

- **Model:**
  - T 175 – 10 H – 20
  - T 230 – 10 H – 20
  - T 350 – 10 H – 20

- **Rubber Materials**
  - 10. (NBR) Low Temperature
  - 20. (NBR) Mineral oil
  - 30. (CHC) Aromatic Material
  - 40. (IR) Phosphate Esters
  - 28. (FKM) Chemical Material

- **Series**
  - Hi-Flow TYPE
  - Nominal capacity of accumulator (Liter)
  - Max. working pressure

---

**Refer to INDEX 12 for flange connection.**
7. In-Line Type Accumulator D-Series

Features:

- Because the fluid flows on the surface of the bladder, the bladder absorbs high frequency pulsations.
- Very effective for reduction of water hammer, surge pressure and noise.
- Fluid does not sojourn within the accumulator.
- Because the bladder is configured with no seal, no special maintenance skill is required.

Model symbols:

D 215 – 02 – 20

- Rubber Materials
  - 20. (NBR) Mineral oil
  - 40. (IIR) Phosphate Esters
  - 28. (FKM) Chemical Material
- Nominal capacity of accumulator (Liter)
- Max. working pressure
- Series

### Features:

- Model symbols:
  - D 215 – 02 – 20

- Model symbols explain:
  - Rubber Materials:
    - 20. (NBR) Mineral oil
    - 40. (IIR) Phosphate Esters
    - 28. (FKM) Chemical Material
  - Nominal capacity of accumulator (Liter)
  - Max. working pressure
  - Series

- Examples of pulsation dampening effect:
  - (A) Without ACC.
  - (B) With ACC.
8. Screen Type Accumulator  P-Type

Screen type accumulator has a plate with many small orifices to allow fluid to pass through that is used in lieu of a poppet valve placed at the fluid port of G.T. Series accumulator. This accumulator can be used at the maximum precharged gas pressure of 0.75 MPa and particularly it is used when the fluid pressure is less than the precharged gas pressure or when the fluid pressure drops to the atmospheric pressure. In the case of a G.T. Series accumulator, if it was used under the same conditions, the bottom part of the bladder sometimes will be damaged by the poppet valve, however, the Screen Type Accumulator will prevent such occurrence and is widely used for surge absorption in low pressure water lines, pipe lines of petrochemical industry, etc.

Model symbols:

G 30 – 10 P – 20

- For a bushing connection, specify Re diameter.
- For a flange connection, specify the standard and nominal

Rubber Materials

10. (NBR) Low Temperature
20. (NBR) Mineral oil
30. (CHC) Aromatic Material
40. (IIR) Phosphate Esters
28. (FKM) Chemical Material

P-Screen type
Nominal capacity of accumulator (Liter)
30-Max. working pressure, 3.0 MPa
Series
If the Twin Open Series is required, indicate "T".

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<th>Mass kg</th>
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<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Max Allowable discharge flow Liter/min</th>
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*Maximum allowable flow rate is the value at the pressure difference of 1.18 MPa.
*Maximum allowable flow rate is for the case of mineral oil VG46 (28 °C).
Transfer Barrier Accumulators are used for transfer of pressure between different types of fluids, for example, oil and water, clean oil and contaminated oil, liquid and gas, etc. There is a perforated tube inside of the bladder and it prevents the bladder from being damaged due to the fluid's direct contact with the interior of the bladder. Applications are, for example, attaining water pressure by oil pressure, supply oil to compressor bearings, etc.

Model symbols:

- **T** Series Transfer Barrier
- **B-** Transfer Barrier Type
- Nominal capacity of accumulator (Liter)
- Max. working capacity
- Series
- If the General Series is required, indicate "G".

### Dimensions and Specifications

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<th>Gas volume</th>
<th>Mass</th>
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</table>

- For a bushing connection, Rc3/4 is provide as standard for both gas and oil port sides.
- For a flange connection, specify the standard and nominal diameter of it.
- If the General Series is required, indicate “G”.

If the mineral oil VG46 flows at 200 L/min through the perforated tube, there will be a pressure loss of approximately 0.08 MPa.

* Use within the bladder compression ratio of maximum (0.2P ≥ P ≥ 0.9P) or (V ≥ 0.2V1, V ≤ 0.9V1).

Reference dimension ASME 150lb 1-1/2BRF
Recently accumulators are being used in systems, other than oil hydraulic systems, such as water and special fluid (for example, high purity washing water, oil hydraulic fluid that requires high cleanliness, drinking water, chemical fluid). For such applications, a stainless steel accumulator is most appropriate.

**Features:**
- Use stainless steel that has high anti-corrosiveness such as SUS304, SUS316L, etc.
- Excellent for maintaining a high level of cleanliness in lubricating and hydraulic systems.
- The shell is made in accordance with JISB8358 and is seamless.
- Titanium (TB480H) bladder type accumulators are also available.

**Model symbols:**

- **G S 70 – 50 – 20**

  - For flange connection, specify the standard and nominal diameter of flange.
  - 10. (NBR) Low Temperature
  - 20. (NBR) Mineral oil
  - 30. (CHC) Aromatic Material
  - 40. (IIR) Phosphate Esters
  - 28. (FKM) Chemical Material

**Nominal capacity of accumulator (Liter)**

- Max. working pressure
- S-Stainless Steel Accumulator

**Features:**
- Use stainless steel that has high anti-corrosiveness such as SUS304, SUS316L, etc.
- Excellent for maintaining a high level of cleanliness in lubricating and hydraulic systems.
- The shell is made in accordance with JISB8358 and is seamless.
- Titanium (TB480H) bladder type accumulators are also available.

**Rubber Materials**

- 10. (NBR) Low Temperature
- 20. (NBR) Mineral oil
- 30. (CHC) Aromatic Material
- 40. (IIR) Phosphate Esters
- 28. (FKM) Chemical Material

**Max. working pressure**

- S-Stainless Steel Accumulator

**Dimension**

- **Max. W.P.**
- **Gas volume**
- **Max.**
- **Mass**

**Model**

- **M** - Minorator Series
- **G** - General Series
- **T** - Twin Open Series

**Table:**

<table>
<thead>
<tr>
<th>Model</th>
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<th>Gas volume</th>
<th>Max.</th>
<th>Mass</th>
<th>Dimension</th>
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</table>

*1: Reference to INDEX 4.
*E" and "F" shown in the above are standard units. Should you require ones of other standards, such as ANSI, API, JPI, DIN, or of specific material, please specify.
*Please discuss with us your desired allowable flow rate.
1. Coreless type gas port (safety device with pressure gauge)

Model symbols:

- Max. scale of pressure gauge
- Safety unit
- Coreless type gas port
- Glycerol filled pressure gauge
- Melting type safety unit (Not required for 10 liters or more as it comes as a standard.)

Rubber Materials
Nominal capacity of accumulator (Liter)
Max. working pressure
Series

Note: If our coreless type gas port was used, a charging valve is not required. Only a hose assembly is required.

Connecting to accumulator, 7/8" -14UNF
2. Charging Hose Assembly :

- Charging Valve (VR type)
  - Model symbols:
  - Charging Valve
  - Charging Hose Assembly
  - VR16M → TS 150 X 4
  - Length
  - Leave blank if it is standard (2m).
  - Enter the no. of length you desire.
  - Indicate the rated pressure, - 150, 400
  - Type of hose
  - Max. scale of pressure gauge - (indicated in MPa.)
    (Pressure gauge is AT 1/4 X ø60)
  - VR type : the Type that uses a metal touch coreless valve for the gas valve.
  - Note: If charging gas is less than 1 MPaG, please indicate.

- Charging Hose Assembly (TS type)
  - Connection to accumulator
Melting plug is a safety device that will protect the accumulator.

- **Features:**
  - Sure safety device as there are no moving parts.
  - No damage due to mal-gas charging, etc., because gas supply valve seat and the safety device are independently provided.
  - Even if the fuse is melted due to fire, no melted piece will be thrown out because of the protection of a valve guard.
  - A new safety device is provided when a bladder is changed.
  - Safe against external shocks, etc.
  - Because the safety device is incorporated in the valve stem (standard part), no extra space is required.

In order to find a temperature \( T \) to melt within \( 1.1 \times P_3 \) at the time of fire, assuming that the max. operating pressure is \( P_3 \) and probable maximum precharge pressure \( P_1 \) is \( P_1 = 0.8P_3 \) as shown in the Fig. on the right, and the temperature is expected to be 0 degrees °C, it becomes

\[
T = 273 \text{ °K} (0 \text{ °C}) \times \frac{1.1P_3}{0.8P_3} = 375.4 \text{ °K} = 102.4 \text{ °C}
\]

Based on this, we set the melting temperature of our fusible metal at 105 plus/minus 5 degrees °C as a standard.

In the event the temperature is much higher, under certain operating conditions, it may lose the significance of the safety unit. Further, if the temperature is much lower, the fusible metal may melt as a result of temporary temperature rise that is still less than abnormal.
12. OIL PORT FLANGE OPF Series

If you choose a flange connection for the accumulator, we recommend that you choose the flange from the following.

For 1 to 60 liter accumulators

For high flow (H type) and 40 to 220 liter accumulators

Model symbols:

G 230 – 10 – 20 – OPF – B20 (Require a mating flange.)

When you place an order combined with the accumulator, please indicate the accumulator model followed by the model of oil port flange, nominal diameter (with or without a mating flange). If there is no indication the accumulator is supplied with the Rc 3/4 bushing.

Rubber material: Nominal capacity of accumulator (Liter)

Maximum working pressure: Accumulator series.

- Please indicate if you will require a mating flange or not.

For 1 to 60 liter accumulators

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Nominal capacity</th>
<th>Model</th>
<th>Nominal dia.</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>d1</th>
<th>d2</th>
<th>T</th>
<th>G</th>
<th>H</th>
<th>Mating flange</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.6 MPa</td>
<td>1 – 5</td>
<td>OPF-A</td>
<td>15(1/2B)</td>
<td>88</td>
<td>45</td>
<td>28</td>
<td>16</td>
<td>22.2</td>
<td>25</td>
<td>M12</td>
<td>G25</td>
<td>NHA15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20(3/4B)</td>
<td>88</td>
<td>45</td>
<td>28</td>
<td>20</td>
<td>27.7</td>
<td>22</td>
<td>M10</td>
<td>G30</td>
<td>SHA20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25(1B)</td>
<td>88</td>
<td>48</td>
<td>28</td>
<td>24</td>
<td>34.5</td>
<td>28</td>
<td>M12</td>
<td>G35</td>
<td>SSA25</td>
<td>B2291</td>
</tr>
<tr>
<td></td>
<td>10 – 60</td>
<td>OPF-B</td>
<td>15(1/2B)</td>
<td>88</td>
<td>45</td>
<td>28</td>
<td>16</td>
<td>22.2</td>
<td>25</td>
<td>M12</td>
<td>G25</td>
<td>NHA15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20(3/4B)</td>
<td>88</td>
<td>45</td>
<td>28</td>
<td>20</td>
<td>27.7</td>
<td>22</td>
<td>M10</td>
<td>G30</td>
<td>SHA20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25(1B)</td>
<td>88</td>
<td>48</td>
<td>28</td>
<td>25</td>
<td>34.5</td>
<td>28</td>
<td>M12</td>
<td>G35</td>
<td>SSA25</td>
<td>B2291</td>
</tr>
<tr>
<td></td>
<td>34.4 MPa</td>
<td>OPF-C</td>
<td>15(1/2B)</td>
<td>88</td>
<td>45</td>
<td>28</td>
<td>16</td>
<td>22.2</td>
<td>25</td>
<td>M12</td>
<td>G25</td>
<td>NFA15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20(3/4B)</td>
<td>88</td>
<td>48</td>
<td>28</td>
<td>20</td>
<td>27.7</td>
<td>22</td>
<td>M10</td>
<td>G30</td>
<td>NFA20</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>25(1B)</td>
<td>88</td>
<td>56</td>
<td>32</td>
<td>24</td>
<td>34.5</td>
<td>31</td>
<td>M16</td>
<td>G35</td>
<td>NFA25</td>
<td>B2291</td>
</tr>
<tr>
<td></td>
<td>10 – 60</td>
<td>OPF-D</td>
<td>15(1/2B)</td>
<td>88</td>
<td>45</td>
<td>28</td>
<td>16</td>
<td>22.2</td>
<td>25</td>
<td>M12</td>
<td>G25</td>
<td>NFA15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20(3/4B)</td>
<td>88</td>
<td>48</td>
<td>28</td>
<td>20</td>
<td>27.7</td>
<td>25</td>
<td>M12</td>
<td>G30</td>
<td>NFA20</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>25(1B)</td>
<td>88</td>
<td>56</td>
<td>32</td>
<td>25</td>
<td>34.5</td>
<td>31</td>
<td>M16</td>
<td>G35</td>
<td>NFA25</td>
<td>B2291</td>
</tr>
</tbody>
</table>

For high flow (H type) and 40 to 220 liter accumulators

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Nominal volume</th>
<th>Model</th>
<th>Nominal dia.</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>d1</th>
<th>d2</th>
<th>T</th>
<th>e</th>
<th>G</th>
<th>H</th>
<th>Mating flange</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.6 MPa</td>
<td>10H – 60H and 40 – 230</td>
<td>OPF-S</td>
<td>32(1/4B)</td>
<td>Ø118</td>
<td>56</td>
<td>44</td>
<td>31.5</td>
<td>43.2</td>
<td>28</td>
<td>16</td>
<td>G40</td>
<td>M12</td>
<td>SSA32</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40(1/2B)</td>
<td>Ø140</td>
<td>65</td>
<td>44</td>
<td>37.5</td>
<td>49.1</td>
<td>38</td>
<td>18</td>
<td>G50</td>
<td>M16</td>
<td>SSA40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50(2B)</td>
<td>Ø144</td>
<td>73</td>
<td>44</td>
<td>47.5</td>
<td>61.1</td>
<td>36</td>
<td>20</td>
<td>G80</td>
<td>M16</td>
<td>SSA50</td>
<td>B2291</td>
</tr>
<tr>
<td></td>
<td>34.4 MPa</td>
<td>OPF-J</td>
<td>32(1/4B)</td>
<td>*176</td>
<td>116</td>
<td>45</td>
<td>32</td>
<td>43.2</td>
<td>44</td>
<td>18</td>
<td>G65</td>
<td>M27</td>
<td>NHAFA32J</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40(1/2B)</td>
<td>*176</td>
<td>116</td>
<td>45</td>
<td>40</td>
<td>49.1</td>
<td>44</td>
<td>20</td>
<td>G65</td>
<td>M27</td>
<td>NHAFA40J</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>50(2B)</td>
<td>*176</td>
<td>116</td>
<td>45</td>
<td>50</td>
<td>61.1</td>
<td>44</td>
<td>23</td>
<td>G65</td>
<td>M27</td>
<td>NHAFA50J</td>
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<td></td>
<td></td>
<td></td>
<td>65(2/4B)</td>
<td>*176</td>
<td>116</td>
<td>45</td>
<td>56</td>
<td>77.1</td>
<td>44</td>
<td>28</td>
<td>G65</td>
<td>M27</td>
<td>NHAFA63J</td>
<td>B2291</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>80(3B)</td>
<td>*176</td>
<td>116</td>
<td>45</td>
<td>56</td>
<td>90.0</td>
<td>44</td>
<td>31</td>
<td>G65</td>
<td>M27</td>
<td>NHAFA80J</td>
<td></td>
</tr>
</tbody>
</table>

*Please indicate if you will require a mating flange or not.

Press Model Nominal dia. Nominal volume Mating flange Standard

Press Model Nominal dia. Nominal capacity Mating flange Standard

Nakamura in-house standard

Nakamura in-house standard

Nakamura in-house standard
The 12th Invention Award!

A bladder type accumulator discharges the fluid by the expansion force of gas that is charged within the bladder. If it repeats compression and expansion for a long period of time, the charged gas penetrates the bladder's rubber member and goes into the fluid. As a result, the gas volume decreases, causing the bladder to become overly compressed, deformed and damaged.

The accumulator with a sensor was developed in order to avoid such phenomenon.

N\(_2\) gas precharge pressure normal range: \(0.25P_1 \leq P_1 \leq 0.9P_2\).

N\(_2\) gas precharge pressure abnormal detection: \(0.25P_3 > P_1\).

\((P_1 : N\(_2\) gas precharge pressure, P\(_2\) : Minimum operating pressure, P\(_3\) : Maximum operating pressure)\)

**Principle of operation**

- **Features:**
  - This is to detect a change in the volume of bladder in an accumulator electrically and is aimed at preventive maintenance to detect abnormality during the operation of a hydraulic unit.
  - This is to detect and prevent bladder damages from occurring due to reduction of gas pressure.
  - This can be used as a fluid pressure system alarm for malfunction of the hydraulic circuit, abnormal high pressure, etc.
  - This can be used as a warning lamp or buzzer on the shop floor or in a control room, or for switching or stopping a fluid pressure circuit at any time because this detects abnormality by electrical signals.

**The following can be supplied with the standard accumulators of 20 liters or more.**

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>Accumulator with a preventer</th>
<th>Accumulator without a preventer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Can be relieved from regular inspection.</td>
<td>1) A regular inspection of once a month is necessary.</td>
<td></td>
</tr>
<tr>
<td>2) Can conclude N(_2) pressure and condition of bladder compression during operation of a subsystem.</td>
<td>2) Measure N(_2) pressure after stopping a unit and making the pressure of fluid pressure line zero.</td>
<td></td>
</tr>
<tr>
<td>3) Can make central control possible as it will send signals to a control room. Simple warning control.</td>
<td>3) Inspect one unit at a time with a pressure gauge.</td>
<td></td>
</tr>
<tr>
<td>4) Replenish N(_2) by the motion of Preventer.</td>
<td>4) Fill up N(_2) at each inspection.</td>
<td></td>
</tr>
</tbody>
</table>

**Preventive maintenance**

- 1) Bladder damage due to lack of N\(_2\) gas pressure will be eliminated.
- 2) Arrangement for spare parts can be done beforehand.
- 3) Unexpected sudden unit seizure due to bladder damages will be eliminated.

- 1) Over 90% of bladder damages are caused by lack of N\(_2\) gas pressure. Because the hydraulic pressure is constant, if N\(_2\) gas pressure drops, the compression ratio of gas and fluid pressures becomes 1/4 or more causing a severe bend on a bladder and ultimately pushing the upper part of bladder against the gas supply port causing puncture damage.
- 2) Spare parts arrangement will be after finding the bladder is damaged.
- 3) Unexpected sudden system stoppage will occur.
The piston type accumulator with a sensor has a position sensor within an accumulator so that it will permit sensing the position of a piston within an accumulator continuously by an electric signal in order to correspond to hydraulic systems that are more and more electronically controlled.

**Features:**
- It allows detecting the position of the piston of the accumulator continuously.
- By detecting the position of a piston it is possible to find easily the available displacement and forecast the time of maintenance inspection. Also, the sensor has a long life because it is placed at a non-pressurized area, having no abnormal force.
- The output signal is analog (voltage, current), the position of piston can easily be found by a tester, etc. (Example 1.)
- The output signal can be displayed on a digital counter or used for a high level of control system by programming it in a computer. (Example 2.)
- A higher level of control is possible by using it with a pressure transducer. Piston type accumulator with a sensor.
- It can be incorporated in all piston type accumulators manufactured by Nakamura Koki Co., Ltd. (Refer to INDEX 15.)
Our piston type accumulators have been in manufacture since 1967 with our own technology. In 1970 we supplied ones of 150 liters to Nippon Steel Corporation, Ohita factory, for their slab continuous casting machines and since then they have been widely used by many customers and applications such as the Japanese Defense, power plants, hydraulic controls, etc.

Features:
- Because low friction packings are used, there is very little movement frictions.
- There is no limitation in the ratio between precharged N2 gas pressure and hydraulic pressure.
- Large gas volume sizes and / or more hi-pressure types can be supplied.

Model symbols:
**PA 230 – 20 – 20 – LS**

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Max. W.P. MPa</th>
<th>Gas volume Liter</th>
<th>Mass kg</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Max Allowable Flow Rate Liter / min</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA230 - 20</td>
<td>20.6 MPa</td>
<td>20</td>
<td>160</td>
<td>957</td>
<td>2</td>
<td>241.8</td>
<td>36</td>
<td>990</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 40</td>
<td>40</td>
<td>40</td>
<td>220</td>
<td>1562</td>
<td>87</td>
<td>241.8</td>
<td>36</td>
<td>990</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 60</td>
<td>60</td>
<td>60</td>
<td>490</td>
<td>1310</td>
<td>16</td>
<td>355.6</td>
<td>36</td>
<td>2200</td>
<td></td>
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<tr>
<td>- 100</td>
<td>100</td>
<td>100</td>
<td>605</td>
<td>1860</td>
<td>16</td>
<td>355.6</td>
<td>36</td>
<td>2200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please specify the diameter of piping. Standard unit comes with ø27.7 (3/4 inch).

With a sensor
Seal Materials 20. (NBR) Mineral oil
28. (FKM) Chemical Material
Nominal capacity of accumulator (Liter)
Max. working pressure
Piston type accumulator

Please advise the fluid you will use beforehand.
One with an ASME stamp can also be supplied.
16. HYDRO-LUNG  BAB Series

Features:

- Pollution control of the hydraulic fluid
- Prevention from vaporization of the water glycol type hydraulic fluid

Selection of the type

1. Calculate the max. displacement of the hydraulic fluid in the oil reservoir:
   
   \[ V_k = \frac{\pi}{4} d^2 s \cdot 10^{-6} \]

   \( V_k \) : max. displacement of the hydraulic fluid (L)
   \( d \) : piston rod diameter (mm)
   \( s \) : cylinder stroke (mm)

2. Calculate the max. flow rate when the max. displacement is done:

   \[ Q_0 = \frac{V_k}{T_c} \cdot 60 \]

   \( Q_0 \) : max. flow rate (L/min)
   \( T_c \) : operating time of cylinder (sec)

3. Confirmate the max. flow rate

   \[ Q_0 \leq Q \]

   \( Q \) : max. allowable flow rate (L/min)

As a result, when \( Q_0 \) is less than \( Q \), it is needed to select a hydro-lung which maximum displacement is adequate to \( V_k \) (see the dimension table at the right side). But if \( Q_0 \) is more than \( Q \) it is better to increase the number of hydro-lungs.

As the example of hydro-lung use (fig.1), due to working a hydraulic cylinder, the piston-rod-volume starts to change the oil-level. Then a hydro-lung acts as a buffer between the increase and decrease of an air chamber space in an oil-reservoir. In other words, when the oil-level rises the rubber bag of a hydro-lung expands and as the oil-level falls it contracts.

Equipped with the breather, a hydro-lung is useful for the furious fluctuation of the oil content due to hydraulic fluid supply or an equipment exchange, etc. As the oil-level falls, the vacuum valve (2) absorbs air through the filter (3) after the rubber bag of a hydro-lung contracts. On the contrary, when the oil-level rises or the pressure in an air chamber rises, air is exhausted from relief valve (1) to outside after the rubber bag expands.

In addition, hydro-lung can prevent the oil-reservoir from pollution since inside of the oil-reservoir is isolated from outside.

<table>
<thead>
<tr>
<th>Model</th>
<th>Max. Volume (Liter)</th>
<th>Max. allowable flow rate ((Q, \text{L/min}))</th>
<th>A mm</th>
<th>B mm</th>
<th>C mm</th>
<th>D mm</th>
<th>Mass kg</th>
<th>Max. W.P. MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAB 1</td>
<td>0.8</td>
<td>47.1</td>
<td>167</td>
<td>384</td>
<td>217</td>
<td>114.3</td>
<td>6</td>
<td>0.03 MPa</td>
</tr>
<tr>
<td>BAB 2.5</td>
<td>1.6</td>
<td>47.1</td>
<td>355</td>
<td>572</td>
<td>217</td>
<td>114.3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>BAB 4</td>
<td>2.4</td>
<td>47.1</td>
<td>225</td>
<td>442</td>
<td>217</td>
<td>165.2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>BAB 10</td>
<td>6.0</td>
<td>152.6</td>
<td>376</td>
<td>635</td>
<td>259</td>
<td>216.3</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>BAB 20</td>
<td>11.7</td>
<td>152.6</td>
<td>666</td>
<td>925</td>
<td>259</td>
<td>216.3</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>BAB 30</td>
<td>21.0</td>
<td>152.6</td>
<td>1187</td>
<td>1446</td>
<td>259</td>
<td>216.3</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>BAB 50</td>
<td>32.0</td>
<td>152.6</td>
<td>1673</td>
<td>1932</td>
<td>259</td>
<td>216.3</td>
<td>52</td>
<td></td>
</tr>
</tbody>
</table>
We have developed a hydraulic high pressure booster that offers more energy savings than traditional ones by utilizing our piston type accumulators that have a long application history and high reliability that we are proud of.

- **Features:**
  - It is compact compared to the traditional compressors and easy to transport.
  - Low noise.
  - Electrical consumption is small.
  - Cooling water is not required.
  - Simple maintenance as the structure is simple.
  - The cost is very low compared with the traditional high pressure compressor.

### Model symbols:

**HYB 10 – ES 2 – 24 – 7.5 x 220V**

- **Power source voltage**
- **Electric motor output (kw)**
- **Maximum N2 gas generating pressure (MPa)**
  - (Max. W.P. of Hyd. pump Minus 1.5)
- **Design number**
- **Type**
  - ES: Electrical control type
  - EX: Anti-explosion electrical control type
- **Booster (Compressor) volume (Liter)**
- **Hydraulically driven booster unit**

### Specification examples of applications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Type</th>
<th>ES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor output/cycle</td>
<td>kw/Hz</td>
<td>7.5/60</td>
</tr>
<tr>
<td>Maximum N2 gas pressure</td>
<td>MPa</td>
<td>24</td>
</tr>
<tr>
<td>Outer dimensions (W<em>L</em>H)</td>
<td>Mm</td>
<td>750×1160×1590</td>
</tr>
<tr>
<td>Mass</td>
<td>Kg</td>
<td>600</td>
</tr>
<tr>
<td><strong>Hydraulic Pump</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum working pressure</td>
<td>MPa</td>
<td>25.5</td>
</tr>
<tr>
<td>Output Capacity</td>
<td>liter/min.</td>
<td>10.6</td>
</tr>
<tr>
<td>Revolution</td>
<td>rev./min.</td>
<td>1800</td>
</tr>
<tr>
<td><strong>Compressor</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>–</td>
<td>Reciprocal Type</td>
</tr>
<tr>
<td>Volume</td>
<td>liter</td>
<td>10</td>
</tr>
</tbody>
</table>
1. We have been supplying FHN series to many customers as accumulator stop valves since 1985 and are proud of supplying them in large quantities and their high reliabilities.

**Features:**
- Designed compact with few parts.
- Can be directly connected to an accumulator.
- With its balancing structure and a bearing, it is possible to open/close even at high pressure.
- It can be used as both stop and throttle valves.
- No chattering at throttling because the valve stem is a thread connection to the main valve.
- It is possible to change a bladder without removing an accumulator from a unit by using an ACC joint. (Ref. to INDEX 18-2)

**Model symbols:**
- **FHN 32**
  - S : Flange connection
  - 20 : (NBR) Mineral oil
  - N : None
  - F1 1/4B : With a weld type mating flange
  - K : Bite type fitting for steel pipe
  - S7 : Weld type fitting

**Parts for connection to drain:**
- N : None
- K : Bite type fitting
- W : Weld type fitting

**Parts for connection to a main line:**
- N : None
- F1-1/4B : With a weld type mating flange

**Parts for connection to an accumulator:**
- N : None
- In case of FHN32L.

-Seal Materials:
- 20 : (NBR) Mineral oil
- 28 : (FKM) Chemical Material

**Cleanliness class of NAS:**
- N : None

Maximum working pressure 34.4 MPa:

**Dimensions:**
- Model: FHN32S, FHN65S, FHN32L
- D : Approx. 32
- øD : 9.6
- øD + 4 : 14.3

**Circuit diagram:**
- To drain port (G1/4)
- To main port

**Connection by OPF-E and OPF-H are special type flanges.**
**Piping connection to a drain port is as shown at the right. Either a bite type fitting or a welded fitting can be offered. Please specify.**
2. Example of application:

Note: This figure shows application of In Line block for connection to main piping but standard type is provided with attached flange.
We supply accumulator stands where several accumulators are put together on a stand, in addition to supplying accumulators by themselves. We also design and manufacture accumulator stands that are equipped with accumulator stop valves, pressure gauges, pressure switches, boosters for gas charging, and other hydraulic components.

The accumulator stand comes with adjusting bolts, therefore, it is possible to change the bladders without removing shells from the stand by using a crane or lifter or inspecting accumulators. The H dimension shown the case of main line being 1-1/2 inches and the throttle valve is 32 mm.
The accumulator is a pressure vessel containing pressurized fluid in it. Read the operation manual and well understand its content before using the vessel. To prevent injury to persons or damage to the accumulator, observe the safety precautions below.

1. Selecting an accumulator

Accumulators are pressure vessels which are controlled under laws and regulations according to their place of use, pressure, and capacity. When selecting an accumulator, be aware of such regulations.

Select an accumulator which is compatible with its usage conditions, such as operating pressure, amount of work oil to be pressurized, operating temperature, type of fluid to be charged in the accumulator, environmental considerations, and applicable regulations. If a wrong accumulator were selected, it could not only fail to perform to expectations but also adversely affect interconnected machines.

2. Installing an accumulator

Do not attempt to weld anything to or drill a hole in an accumulator. Such an act would jeopardize its safety and could cause it to explode.

Secure an accumulator to the frame or wall with a band or other suitable means. If such a support were neglected, vibration (due to normal operation or earthquake) would excessively stress the accumulator, and could eventually loosen its fasteners.

Do not subject an accumulator to external heat. Put up a heat shield around the accumulator if it is near a heat source or exposed to direct sunlight. If an accumulator were heated from outside, the fluid inside could build up a dangerously high pressure.

As a safety measure, provide a pressure control valve in the piping system at a location near and directly connected to the accumulator so that its maximum allowable pressure will never be exceeded.

3. Charging an accumulator with nitrogen gas (precharging)

Only use nitrogen gas as the fluid precharged in an accumulator. Never use oxygen or flammable gas because it could cause a fire or explosion.

While no regulatory qualification is required (in Japan) for a person to charge an accumulator with nitrogen gas, it is important for personal safety that the person be trained for handling high-pressure gases. When charging an accumulator with nitrogen gas, use a charging assembly which is compatible with the accumulator.

4. Using a charging assembly

A charging assembly is used for precharging, replenishing, or pressure calibration. Attach a charging assembly to an accumulator only before use, and always remove it from the accumulator after use. A charging assembly as permanently attached to an accumulator could increase the possibility of gas leak or damage to its instruments.

5. Using an accumulator

Ensure that an accumulator is used at pressures not exceeding its maximum working pressure (design pressure). Excessive pressure could cause the accumulator to explode.

Do not leave an accumulator charged only with pressurized fluid but not with work oil for more than two weeks. Otherwise, the bladder rubber could permanently stick to the inside surface of the shell.

6. Maintaining an accumulator

To ensure maximum performance of an accumulator and the integrity of its bladder, check and adjust an accumulator right after precharging, one week after the precharging, and every three months thereafter.

When measuring the pressure of the fluid in an accumulator, the pressure inside the work oil circuit must be equal to the pressure of the outside atmosphere.

7. Disassembling, reassembling, or discarding an accumulator

Reduce the pressure inside the work oil circuit to the pressure of the atmosphere and completely discharge the fluid from the accumulator before attempting to disassemble it. If you attempted to disassemble it with some pressure inside, you could be injured by the pressure.

Before discharging the fluid from an accumulator, ensure that the area is well ventilated. Otherwise, there could be a danger of oxygen deficiency. Also ensure that there is no person or objects that could be easily flown away in the direction in which the fluid is to be discharged. Otherwise, the high-pressure jet of the discharged fluid could injure a person or damage objects.

After disassembling an accumulator, check and ensure that there is no significantly corroded, scratched, or deformed part in it before reassembling it. Any degraded part used undetected could endanger the safety of the accumulator.

If a T-series accumulator is disassembled and its bladder is removed off through the top portion, discharge away any fluid remaining at the bottom before replacing a new bladder. Otherwise, the new bladder could be deformed and damaged by the buoyancy from the remaining fluid.

When discarding an accumulator, first release both work oil and fluid pressures to the atmosphere, and then disassemble it and take necessary measures to make it unusable.

Note: The WARNING or CAUTION statements with the word WARNING, or CAUTION indicated by the asterisk (*) above are also marked on an accumulator in the form of a label.
We have been supplying many products with nurtured technology and quality since 1962 when we first introduced bladder type accumulators in Japan.

For any questions pertaining to selection of economical volume, applicable laws, etc., please do not hesitate to contact us.

Products we offer

- Bladder type accumulators
- Diaphragm type accumulators
- Hydro Lung
- Accumulators with sensors
- O-rings and other packings
- Piston type accumulators
- Accumulator stop valve
- Nitrogen gas boosters for charging gas
- In-line type accumulators

We reserve the right to change the contents of this brochure without any prior notice.