Piston Accumulators

AP Series 250 and 350 bar
Benefits

360mm Bore AP Series Accumulator with Flange Port

1, 2 & 3 Shell and Caps
For maximum seal life, heat generated within the accumulator during rapid cycling must be dissipated quickly and efficiently. Compact, rugged steel shell and end caps permit rapid heat dissipation, while the bore of the accumulator is micro-finished to maximise seal life.

180mm and 250mm bore accumulators feature threaded caps to minimize downtime and simplify maintenance of the accumulator, permitting quick and easy installation of seals. 360mm bore units (illustrated) use a screwed ring (3) to retain the gas and oil caps, reducing the mass of parts handled during maintenance and providing additional protection for the gas valve.

4. Piston
Rapid response in high cycling applications is assured by Parker’s lightweight piston design. The dished profile of the aluminium piston gives extra gas capacity while maintaining stability in the bore, and permits a greater usable volume of fluid.

5 & 6 Piston Sealing
Rapid cycling, with piston speeds up to 8m/s, places extreme demands on piston seals. Parker’s AP Series accumulators employ seals with different performance characteristics for the oil and gas sides of the piston, selected to suit the differing operating conditions encountered.

The AP Series multi-element sealing system holds full pressure throughout long idle periods between cycles, providing dependable, full pressure storage of hydraulic energy. It ensures safe, reliable absorption of pressure peaks and helps to prevent the failure modes associated with bladder accumulator designs.

7. PTFE Bearing Rings
To reduce wear and extend service life, filled PTFE bearing rings are fitted, eliminating metal-to-metal contact between the piston and bore, and protecting the piston seals from fluidborne contaminants. Their low coefficient of friction minimizes heat build-up within the piston and shell.

8. Safety Bleed Groove
A bleed groove in the gas cap progressively releases unrelieved gas pressure in the accumulator as the gas cap is unscrewed. **Note:** to avoid the risk of damage or injury, an accumulator must always be discharged before disassembly.

9. Gas Valve
All AP Series piston accumulators are fitted as standard with a robust, mechanically opened/closed poppet-type gas valve rated at 350 bar. To avoid the risk of damage or injury, an accumulator must be discharged before disassembling but, for added safety, the gas valve vents progressively as it is unscrewed.

10. Gas Valve Protector
To prevent accidental – and potentially hazardous – damage to the gas valve, 180mm and 250mm bore AP Series accumulators are fitted with a steel gas valve protector. The gas valve on 360mm bore models (illustrated) is recessed within the shell to reduce the risk to the valve from external impact.

11. Ports
To provide the required flow rate and simplify system design, a range of port types and sizes is available. BSPP ports are fitted as standard; metric flanged ports to ISO 6162 and ISO 6164 are available as an option.
Applications

Ideal for die casting and plastic injection moulding

AP Series Piston Accumulators

Parker’s AP Series accumulators are a premium specification product designed for use in high performance applications such as die casting and plastic injection moulding, where large volumes of fluid have to be displaced at high speed. Special multi-element sealing systems have been developed to combine good servo application and load holding properties with the wear characteristics required to withstand continuous use at piston speeds of up to 8m/s.

A wide range of bore/stroke combinations enables an accumulator with the required volume to be selected in a size that will optimise the use of available space, while metric mountings and a choice of port styles simplify connection. Parker offers a full range of clamps to provide secure mounting.

Main Features

Actual Bore Sizes & Maximum Flow Rates

<table>
<thead>
<tr>
<th>Model</th>
<th>Actual Bore ø (mm)</th>
<th>Max. Recommended Flow Rate* (l/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP180</td>
<td>180</td>
<td>12,000</td>
</tr>
<tr>
<td>AP250</td>
<td>250</td>
<td>23,000</td>
</tr>
<tr>
<td>AP360</td>
<td>360</td>
<td>45,000</td>
</tr>
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</table>

Bore Size, Pressures & Temperature Range

<table>
<thead>
<tr>
<th>Bore Size (mm)</th>
<th>Max. Working Pressure (bar)</th>
<th>Volume (Litres)</th>
<th>Material Working Temperature Range °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>AP180</td>
<td>250/350</td>
<td>6</td>
<td>80</td>
</tr>
<tr>
<td>AP250</td>
<td>250/350</td>
<td>30</td>
<td>150</td>
</tr>
<tr>
<td>AP360</td>
<td>250/350</td>
<td>100</td>
<td>300</td>
</tr>
</tbody>
</table>

Materials

- Shell – high strength steel
- End caps – steel
- Pistons – lightweight aluminium alloy
- Cap end seals – NBR (standard): other compounds to suit application
- Piston bearing rings – filled PTFE
- Piston seals – filled PTFE (standard): other compounds to suit application
- Gas valve assembly – stainless steel
- Gas valve protector – steel
- Paint finish – black primer, suitable for epoxy paint finishes (standard) – other finishes on request

Custom Designs

For unique applications and hostile environments, different designs, materials and coatings can be supplied. Please contact our engineering department to discuss custom solutions to individual application requirements.
250 and 350 Bar Pressure Ranges
AP Series industrial accumulators are available in two different pressure ratings, to suit maximum working pressures of 250 and 350 bar. The same premium quality design and technical features guarantee optimum performance and service life from every AP Series accumulator model, while differing wall thicknesses allow the designer to specify precisely the right performance envelope for the application.

Available Options
A wide variety of options are available for AP Series accumulators, including:
- Port styles and sizes
- Seal compounds
- High flow gas ports for use with remote gas storage bottles
- Water service versions
- Safety fuses
- Mounting systems
- Precharge/piston position sensors
- Certifications to suit different market requirements

Water Service
AP Series piston accumulators are available for use with water as the fluid medium. Modifications include plating of all working surfaces. Please consult the factory for details.

Operating Temperatures, Seals and Fluids
Standard and optional seal combinations for AP Series accumulators are shown below. Other seals are also available for use in exceptional conditions – please consult the factory with details of the application. The shells of Parker’s AP Series accumulators are CE approved for operation at temperatures between -25°C and +150°C.

Filtration
For maximum component life, the system should be protected from contamination by effective filtration. Fluid cleanliness should be in accordance with ISO 4406. The quality of filters should be in accordance with the appropriate ISO standards.

The rating of the filter media depends on the system components and the application. The minimum required for hydraulic systems should be class 19/15 to ISO 4406, which equates to 25μ (β10≥75) to ISO 4572.

Safety
Charging must be carried out by qualified personnel. Before taking any readings or pressurizing with nitrogen, the accumulator must be isolated from the hydraulic system and the fluid side discharged in order to depressurize it. Use only nitrogen (N₂) to pressurize the accumulator.

Danger of Explosion – Never Charge with Oxygen
The types of nitrogen permitted are: type S (99.8% pure); type R (99.99% pure); type U (99.993% pure).

Approvals

<table>
<thead>
<tr>
<th>Approvals</th>
<th>AP180</th>
<th>AP250</th>
<th>AP360</th>
</tr>
</thead>
<tbody>
<tr>
<td>PED 2014/68/EU</td>
<td>•</td>
<td>•</td>
<td>•</td>
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</tbody>
</table>

Mounting
The optimum mounting orientation is vertical however angled and horizontal mountings are permissible if the hydraulic fluid is kept clean; high levels of contaminants in the fluid can result in uneven or accelerated seal wear.

Seals, Fluids and Temperature Ranges

<table>
<thead>
<tr>
<th>Code</th>
<th>Seal Type</th>
<th>&quot;Min Temp&quot;</th>
<th>&quot;Max Temp&quot;</th>
<th>&quot;Fluid Type&quot;</th>
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</thead>
<tbody>
<tr>
<td>K</td>
<td>&quot;NBR (Nitrile)&quot;</td>
<td>-30°C</td>
<td>75°C</td>
<td>General purpose, petroleum-based fluids</td>
</tr>
<tr>
<td>E</td>
<td>&quot;FPM (Fluorocarbon elastomer)&quot;</td>
<td>-25°C</td>
<td>150°C</td>
<td>High temperature and/or synthetic fluids</td>
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<tr>
<td>D</td>
<td>&quot;EPDM (Ethylene Propylene)&quot;</td>
<td>-25°C</td>
<td>120°C</td>
<td>Phosphate-esters</td>
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<tr>
<td>H</td>
<td>&quot;HNBR (Hydrogenated Nitrile)&quot;</td>
<td>-30°C</td>
<td>130°C</td>
<td>Most oil-based and biodegradable fluids</td>
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<td>J</td>
<td>&quot;NBR &quot;Nitrile and filled PTFE&quot;</td>
<td>-30°C</td>
<td>75°C</td>
<td>Water glycol, high water content fluids</td>
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<tr>
<td>Q</td>
<td>&quot;LT-NBR (Low Temperature Nitrile)&quot;</td>
<td>-45°C</td>
<td>71°C</td>
<td>General purpose fluids at low temperatures</td>
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</tbody>
</table>
Dimensions - 250 bar & 350 bar

250 Bar and 350 Bar
AP Series
180mm and 250mm Bore
with CE Approval

250 Bar and 350 Bar
AP Series
250mm and 360mm Bore
with CE Approval

250 Bar and 350 Bar AP Series
180mm and 250mm Bore
with CE Approval

250 Bar and 350 Bar AP Series
250mm and 360mm Bore
with CE Approval

250 and 350 Bar Models, Capacities and Dimensions

<table>
<thead>
<tr>
<th>Model</th>
<th>Code</th>
<th>Bore ø</th>
<th>Fluid Volume Litres</th>
<th>A mm</th>
<th>B mm</th>
<th>C mm</th>
<th>D BSPP</th>
<th>E mm</th>
<th>F mm</th>
<th>G mm</th>
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</tbody>
</table>

*Flange mounting surface on AP360 Series extends 2mm beyond shell.
Gas Valves
The standard gas charging valve fitted to AP Series 250 and 350 bar piston accumulators is a cored-type gas valve, rated at 350 bar. A mechanically opened and closed poppet-type gas valve cartridge, also rated at 350 bar, is available as an option.

Both types of charging valve may be used with the Charging and Gauging Kit illustrated on page 7.

Piston Accumulator Seal Kits
Seal kits are available for all AP Series accumulator models. When ordering seal kits, please supply the complete model number from the identification plate and specify the fluid type and the temperature at which the accumulator is to be used. Installation and maintenance are described in Bulletin 1240-M1.

The seal kits listed below contain a piston with the appropriate seals ready fitted, to minimize the risk of damage during assembly. Seal kits contain items 5, 6, 7, 8, 9, 10 and 12.

Seal Kits
Seal Kit Part Numbers with piston seals assembled (remove the WP for a Seal Kit without piston seal assembled)

<table>
<thead>
<tr>
<th>Model</th>
<th>Seal Material + Filled PTFE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nitrile NBR</td>
</tr>
<tr>
<td>API80</td>
<td>PK180APKWP</td>
</tr>
<tr>
<td>AP250</td>
<td>PK250APKWP</td>
</tr>
<tr>
<td>AP360</td>
<td>PK360APKWP</td>
</tr>
</tbody>
</table>
Introduction and Features

Piston Accumulators
AP Series

'U' Bolts for Piston Accumulators

Model | Pressure Rating | Part No. | A (mm) | B (mm) | C (mm) | D (mm) | E (mm)
--- | --- | --- | --- | --- | --- | --- | ---
AP180 | 250 | PE1093-5 | M16 x 2 | 210 | 226 | 180 | 95
AP180 | 350 | PE1093-8 | M16 x 2 | 224 | 240 | 185 | 115
AP250 | 250 | PE1093-6 | M20 x 2.5 | 286 | 306 | 240 | 135
AP250 | 350 | PE1093-9 | M20 x 2.5 | 312 | 332 | 256 | 150
AP360 | 250 | PE1093-10 | M27 x 3 | 408 | 435 | 290 | 175
AP360 | 350 | PE1093-11 | M27 x 3 | 438 | 465 | 300 | 190

Note: 'U' bolts should never be mounted more than 75mm from the end of the accumulator to avoid deformation of the shell.

Charging and Gauging

The charging and gauging assemblies listed in the table are suitable for use with both the standard cored-type gas valve and the optional poppet type. Each kit contains a UCA assembly incorporating a gas valve, bleed valve and gas chuck, and a 3m long charging hose with standard nitrogen bottle fittings. The kit includes 25 bar and 250 bar pressure gauges, to permit easy monitoring of the gas precharge.

<table>
<thead>
<tr>
<th>Territory</th>
<th>Gas Bottle Fitting</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>5/8 BSP (male)</td>
<td>UCA 02</td>
</tr>
<tr>
<td>France</td>
<td>W 21.7 x 1/14” (female)</td>
<td>UCA 04</td>
</tr>
<tr>
<td>Germany</td>
<td>W 24.32 x 1/14” (female)</td>
<td>UCA 01</td>
</tr>
<tr>
<td>Italy</td>
<td>W 21.7 x 1/14” (male)</td>
<td>UCA 05</td>
</tr>
<tr>
<td>US</td>
<td>0.960 x 1/14” (male)</td>
<td>UCA 03</td>
</tr>
<tr>
<td>Universal</td>
<td>All available fittings (includes all fittings above)</td>
<td>UCA UNI</td>
</tr>
</tbody>
</table>

All dimensions are in millimetres unless otherwise stated.

Please note:
Resistant parts cannot be supplied as spares (tubes/end caps)
Hydraulic and Gas Ports

The BSPP ports shown are supplied as standard at the fluid ends of AP Series 250 bar accumulators, and at the gas ends of these accumulators when ordered for use with gas bottles. A range of optional threaded and flanged ports is also available, as shown below. All ports are specified by adding the relevant code to the accumulator model number.

Optional Flanged Ports

<table>
<thead>
<tr>
<th>Bore Ø</th>
<th>ISO Port Style</th>
<th>DN10</th>
<th>DN13</th>
<th>DN19</th>
<th>DN25</th>
<th>DN32</th>
<th>DN38</th>
<th>DN51</th>
<th>DN56</th>
<th>DN63</th>
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<tr>
<td>180</td>
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<td></td>
<td>ISO 6164</td>
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</table>

Optional Flanged Ports

AP Series Piston Accumulators are available with metric flange ports to ISO 6162/3000 psi and ISO 6164/6000 psi as shown in the tables. Inch pattern flange ports and flange ports for higher pressure operation are also available, please consult the factory for details.

ISO 6162/3000 psi

<table>
<thead>
<tr>
<th>Flange Size</th>
<th>From Model</th>
<th>A</th>
<th>B ± 0.25</th>
<th>C ± 0.25</th>
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ISO 6164/6000 psi

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# How to order

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<th>Model</th>
<th>Type of Construction</th>
<th>Options</th>
<th>Capacity</th>
<th>Working Pressure</th>
<th>Design Number</th>
<th>Seal Type</th>
<th>Port Size</th>
<th>Gas Port</th>
<th>Pre-Charge</th>
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<td>E</td>
<td>M</td>
<td>080</td>
<td>L</td>
<td>2</td>
<td>K</td>
<td>RF</td>
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### Code Attributes

- **Series**: AP
- **Model**: 250
- **Type of Construction**: E
- **Options**: M
- **Capacity**: 080
- **Working Pressure**: L
- **Design Number**: 2
- **Seal Type**: K
- **Port Size**: RF
- **Gas Port**: S
- **Pre-Charge**: /010

### Code Details

- **Bore Size (nominal)**
  - 180: 180 mm bore
  - 250: 250 mm bore
  - 360: 360 mm bore

- **Approval Type**: According to PED 2014/68/EU
  (From 07/2016 PED 97/23/EC becomes PED 2014/68/EU)

- **Valve Options**
  - M: Poppet-type gas valve
  - L: Poppet-type gas valve + water service
  - P: Poppet-type gas valve + safety fuse
  - R: Poppet-type gas valve + water service + safety fuse

- **Maximum Working Pressure**
  - L: 250 bar
  - H: 350 bar

- **Port**
  - Metric mounting + BSPP port (standard)
  - Specials (Parker assigned number)

---

Please see Seals table on page 4

Please see Fluid Port tables on page 8

---

### Gas Port

**Specification** (where no valve supplied)

- Other approvals are available to order - please consult the factory.
- Where a gas port is specified, no gas valve will be supplied.
- For other pressure ratings, please consult the factory.

### Hydraulic and Gas Port Modifications

For accumulators with non-standard ports, specify special gas and/or hydraulic ports and use the appropriate port code from page 8. A typical model number for an accumulator with ISO 6149 hydraulic and gas ports would be: A - 3 - T - M - 0690 - D - 2 - K - YE/YE

### Pre-Charge

- 010: 10 bar
- 020: 20 bar
Sizing an Accumulator

Accumulator Sizing Software
Parker Olaer has developed very sophisticated simulation software to optimize accumulator sizing recommendations. The behaviour of accumulators used in applications such as pulsation dampening, surge alleviation, thermal expansion and energy storage can be simulated. Our software can be downloaded from our website www.parker.com/ACDE.

You may also contact your local Parker Olaer office for sizing assistance.

Calculating Accumulator Size
Accurate calculation of accumulator size requires many factors to be considered – the working volume of fluid, ambient and maximum operating temperatures, the working pressure range etc. In addition, correction factors must be applied to allow for temperature compensation between the ambient and gas temperatures, and the consequent effect on precharge pressure in the accumulator. Where the working cycle is sufficiently rapid that no heat transfer takes place, the process is termed *adiabatic*. Conversely, where the process takes place at a constant temperature, it is termed *isothermal*.

Accumulator Sizing Charts
The charts shown opposite are used to estimate the size of piston accumulator required to provide a given volume of fluid discharge from the accumulator.

The curves are based on the following formula:

\[
\Delta V = 0.855 \times V_0 \left(\frac{P_2}{P_1}\right)^n \left(\frac{P_2}{P_1}\right)^f - 1
\]

Where:
- \(\Delta V\) = volume of fluid discharged
- \(V_0\) = Accumulator size
- \(n\) = discharge coefficient
- \(f\) = charge coefficient
- \(P_2\) = maximum system pressure
- \(P_1\) = minimum system pressure

It is assumed that the gas precharge pressure = 0.9 \(P_1\).

Piston Accumulators
AP Series

Isothermal and Adiabatic Operation
In constructing the curves, the following factors have been assumed.

For isothermal operation eg: slow charge and discharge time, \(f\) and \(n = 1\)

For adiabatic operation, eg: fast charge and discharge time, \(f\) and \(n = 1.8\)

Note: The charts provide an estimate of the volume of accumulator required to store and release a given volume of fluid under specified conditions. In practice, the true charge and discharge coefficients will depend on the application, and may cause significant variations from the chart results. If in doubt, please contact our engineering department for a more detailed calculation.

Where the ratio \(P_2 / P_1\) exceeds 1.9, a fatigue analysis is necessary. Please contact our engineering department for further information.

How to Use the Sizing Chart
These charts are used to find accumulator size \(V_0\) when the required output \(\Delta V\) is known.

Example
Refer to the red lines in the charts opposite.
\(\Delta V = 6\) litres \(P_2 = 170\) bar \(P_1 = 100\) bar

Step 1
As the accumulator output \(\Delta V\) is known, choose the appropriate pair of charts from the two sets shown opposite. For outputs up to 50 litres use charts A and B, and for outputs above 50 litres use charts C and D. In this case, as the required output is 6 litres, charts A and B should be used.

Step 2
Calculate \(P_2 / P_1\) by dividing the maximum system pressure by the minimum pressure required to make the machine function.
In this case, 170/100 = 1.7

Step 3
Using chart A, locate 1.7 on the X-axis and draw a vertical line to the top of the chart.

Step 4
Depending on the cycle time, select the appropriate curve on chart A. For fast cycle times, use the adiabatic curve; for slow cycle times, the isothermal curve should be used. In this case, use the adiabatic curve. (\(n\) and \(f = 1.8\))

Step 5
On chart A, identify the point at which the vertical line drawn in step 3 crosses the chosen curve (in this case adiabatic) and draw a horizontal line across to the right hand end of chart B.

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You may also contact your local Parker Olaer office for sizing assistance.

Calculating Accumulator Size
Accurate calculation of accumulator size requires many factors to be considered – the working volume of fluid, ambient and maximum operating temperatures, the working pressure range etc. In addition, correction factors must be applied to allow for temperature compensation between the ambient and gas temperatures, and the consequent effect on precharge pressure in the accumulator. Where the working cycle is sufficiently rapid that no heat transfer takes place, the process is termed *adiabatic*. Conversely, where the process takes place at a constant temperature, it is termed *isothermal*.

Accumulator Sizing Charts
The charts shown opposite are used to estimate the size of piston accumulator required to provide a given volume of fluid discharge from the accumulator.

The curves are based on the following formula:

\[
\Delta V = 0.855 \times V_0 \left(\frac{P_2}{P_1}\right)^n \left(\frac{P_2}{P_1}\right)^f - 1
\]

Where:
- \(\Delta V\) = volume of fluid discharged
- \(V_0\) = Accumulator size
- \(n\) = discharge coefficient
- \(f\) = charge coefficient
- \(P_2\) = maximum system pressure
- \(P_1\) = minimum system pressure

It is assumed that the gas precharge pressure = 0.9 \(P_1\).
**Sizing an Accumulator**

**Piston Accumulators**  
**AP Series**

**Step 6**  
Using the lower X-axis on chart B, locate the required accumulator output (ΔV), in this case 6 litres. Draw a vertical line to the top of the chart.

**Step 7**  
Locate the point where the vertical line drawn in step 6 crosses the horizontal line drawn in step 5. Locate the first curve to the right of this intersection.

**Accumulator Sizing Chart ∆V = 0.1 to 50 Litres**

**Chart 1**

**Chart 2**

**Chart 3**

**Chart 4**

**Step 8**  
Follow the curve selected in step 7 up to the top X-axis (V₀) and read off the required accumulator size, in this case 30 litres. Always round up to the next largest size available; for this example, therefore, a 38 litres accumulator should be selected.

**Summary**

Pre-charge: 90% of 100 bar = 90 bar  
Adiabatic / Isothermal: Adiabatic  
Accumulator selected: A6ES2310L2K
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TH – Thailand, Bangkok
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