Lighthaulics® Composite Hydraulic Cylinders

For working pressures up to 380 bar
Composite hydraulics from Parker. Technology you can trust.

High pressure hydraulic products require high strength structural components. Traditionally, high strength steels have been used for typical mobile and industrial applications, while more expensive lower density alloys were used where reduced weight was critical. The introduction of carbon fibre composite materials opened up new possibilities for the design of lightweight, high strength components.

Early composite designs used the composite material as a reinforcement to lightened steel components. However, the weight savings were modest and designs were still limited by the strength of the remaining metallic elements.

With more than fifteen years of experience in the development of composite materials, Parker has engineered hydraulic cylinders and accumulators with fully composite barrels which offer dramatic weight savings combined with exceptional burst and fatigue strengths. Tested over millions of cycles, our standard range of cylinders is designed for operating pressures up to 380 bar. We also offer custom designs, with working pressures up to 700 bar available to order.

- Carbon fibre, glass fibre, aramid fibre, epoxy resins
- Filament winding, prepreg winding
- Analytical & numerical design methods for anisotropic materials
- Purpose-built test equipment
- Continuous research & development

▲ Artemis II racing yacht
Fitted with Parker composite canting keel cylinders, Artemis II set a new record for Open 60 class in the 2010 Sevenstar Race around Britain and Ireland.

▲ Leading edge technology
Parker’s advanced composite products and technology are the result of an enduring commitment to R&D. Continuous investment in state-of-the-art production technologies guarantees manufacturing capacity and ensures consistent product performance. Our unique formulation and proven filament winding process enhance impact resistance and prevent delamination.
**Higher performance**

Composite hydraulic cylinders deliver weight savings of up to 60%, saving energy and increasing productivity

Lighter, stronger, faster, greener …

**Weight savings of up to 60%**
- Cutting axle load saves energy and permits greater payload
- Allows extra features where total weight is limited
- Superior acceleration improves productivity through faster cycle times

**Saving space**
- Minimizing stabilizer envelope simplifies set-up and repositioning
- Maximizing horizontal reach delivers greater versatility and higher productivity

**Cleaner and greener**
- Cutting fuel/electricity consumption reduces operating costs and raises efficiency
- Energy savings benefit the environment

**Delivering in the toughest conditions**
- Corrosion resistance of composite material cuts maintenance time and cost

Image courtesy of Putzmeister America Inc.

Images courtesy of Vestas Wind Systems A/S
A step change in technology

Parker’s Lightraulics® composites technology dramatically cuts the weight of high performance hydraulic components. Our composite cylinders use special carbon fibre rovings and epoxy resins as the matrix, enabling us to customise the material properties through different combinations of fibres and matrix material. As a result, material properties can be adjusted to achieve a load-optimized structure which reflects the differing forces encountered locally within a component while also meeting the specific demands of the application.

Unique construction
In conventional composite designs, a metal liner carries the axial and hoop loads, and functions as a diffusion barrier. The composite outer layer is simply a supportive overwrap, with the main loads carried by the metal liner. Parker’s weight saving composite inner liner makes metal liners obsolete.

Patented joint technology
One of the greatest challenges when working with composites and metal in high pressure hydraulic applications is to create a strong joint between the two materials. A glued joint will not withstand the high operating pressures, while bolted solutions would damage the structural integrity of the composite material. Parker has developed a patented mechanical connection which overcomes these limitations, combining exceptional weight savings with proven high pressure, high cycling performance.

Tube-cap joint
Parker’s patented design creates a permanent, durable connection between the composite barrel and the aluminium head and cap ends. The structural integrity of this connection has been proven at pressures in excess of 1500 bar.

Lightweight rod gland and seals
The cartridge-type rod gland is threaded into the cylinder head, permitting quick, easy servicing of rod seals, cutting downtime and ensuring high productivity. Both gland and head are machined from high grade aluminium alloy and surface treated to resist corrosion, to deliver high performance under hostile conditions.
Exterior finishes for every application

- Standard – black primed, pure carbon finish for general use.
- Optional – clear coat or painted to customer specification. Other cosmetic finishes on request.
- Optional – abrasion resistant aramid fibre overwrap for harsh conditions.

▼ Composite outer barrel
Unique lightweight design carries the axial loads usually borne by steel barrels, metal liners or tie rods.

▲ Composite inner liner
The integrated lightweight plastic layer acts as a diffusion barrier and carries the hoop loads. The high surface finish significantly reduces seal wear, ensuring a long and productive service life.

▲ Spherical bearings
Standard cylinders feature spherical bearings with an optimized degree of freedom at both mounting points, permitting a smooth distribution of forces. Custom mounting styles are available on request.

▲ Lightweight piston and rod
The low inertia aluminium piston permits rapid cycle times. Wide bearing rings provide stability and resist wear, ensuring long life and high productivity. Larger diameter piston rods are centre drilled to minimise reciprocating mass.

▲ Lightweight cylinder cap
The one-piece cylinder cap and eye are machined from high grade aluminium alloy for superior fatigue performance under high working loads. All aluminium parts are surface treated to resist corrosion, even in aggressive environments.
Performance that goes straight to the bottom line

Reduced weight translates directly into greater productivity, higher payloads and reduced energy consumption

**Weight savings – composite vs. aluminium and steel cylinders** *

![Graph showing weight comparison between composite, aluminium, and steel cylinders.]

*Illustrative figures only. Precise comparisons for a specific application can be supplied on request.

**Test specifications**

**Cylinder**
- Maximum working pressure: 380 bar (5500 psi)
- Piston diameter: 200 mm
- Piston rod diameter: 125 mm
- Stroke: 1600 mm
- Weight approx.: 255 kg (steel equivalent – 425 kg, aluminium – 361 kg)
- Construction: composite barrel with integral plastic liner

**Programme**
- Full pressure cycling: 0.5 million cycles of 20 – 380 bar (300 – 5500 psi)
- Short strokes (‘dithering’): 1 million cycles of short strokes of +/- 5 mm
- Side loading: 0.5 million cycles under continuous side loading
The Composite advantage

- **High strength to weight ratio**
  Sometimes referred to as self-supporting length or breaking length, this is the maximum length of a vertical column of material with fixed cross-section which could support its own weight when suspended from the top. The strength to weight ratio of composite material is typically twice that of steel.

- **High stiffness to weight ratio**
  Specific modulus or specific stiffness is a materials property consisting of the elastic modulus per mass density of a material. This describes the elastic resistance of a material against an applied force under consideration of its own weight. Against this criteria, composite materials outperform metals by a factor of approximately 2.5.

- **Superior fatigue life and manufacturability**
  Parker’s composite products offer superior performance to that of lightweight alloys such as titanium, aluminium and magnesium.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Parker Composite</th>
<th>Aluminium Alloys</th>
<th>Standard Steels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density (g/cm³)</td>
<td>1.6</td>
<td>2.8</td>
<td>7.85</td>
</tr>
<tr>
<td>Tensile strength (MPa)</td>
<td>1000</td>
<td>max 500</td>
<td>max 550</td>
</tr>
<tr>
<td>Fatigue performance</td>
<td>***</td>
<td>*</td>
<td>**</td>
</tr>
</tbody>
</table>

**Technical**

**Product specifications**

- Working pressure: 380 bar (5500 psi)
- Test pressure: 570 bar (8250 psi)
- Stroke length: standard – up to 3000 mm
- Life cycle: rated for 250,000 cycles at 380 bar, tested for 500,000 cycles at 380 bar
- Maximum piston speed: 0.3 m/s
- Tube material: carbon fibre reinforced composite
- Piston material: aluminium
- Piston rod material: hard chrome plated steel
- Mountings: standard – spherical bearings of normal/stainless steel, other mounting styles available to order
- Sealing system:
  - piston seal: thermoplastic polyester elastomer
  - rod seal: polyurethane lip type
  - wiper seal: polyester-based
  - O-rings: polyurethane (PU)
- Temperature range: -20 °C to +80 °C
- Fluid medium: mineral hydraulic oil

The data in this brochure is supplied for illustrative purposes only. The actual performance of cylinders may be influenced by many factors including, for example, bore, stroke, working pressure, temperature and fluid medium. For accurate guidance or customised specifications, please contact lightraulics@parker.com with details of your application.
Specifying your cylinder

Dimensions

<table>
<thead>
<tr>
<th>A Bore Ø</th>
<th>B Rod Ø</th>
<th>C D E F G H I J K L M N O P Q R S T U (BSPP)</th>
<th>U (BSPP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 36</td>
<td></td>
<td>481 98.2 125 94 102 50 120 12 85 55.5 65 40 33 40 40 40 36 G¼ G½</td>
<td>G½</td>
</tr>
<tr>
<td>100 36 56</td>
<td></td>
<td>579 571 153 116 120 63 161 157 13.5 90 60.5 80 50 36 50 50 50 40 G¼ G½ G½</td>
<td>G½</td>
</tr>
<tr>
<td>125 56 70</td>
<td></td>
<td>643 645 186 130 147 70 188 189 13.5 110 80.5 95 60 46 60 60 60 60 52 G¼ G¼ G¼</td>
<td>G¼</td>
</tr>
<tr>
<td>160 63 100</td>
<td></td>
<td>777 757 245 176 184 95 251 266 13.5 115 85.5 115 80 55 80 80 80 80 80 80 63 G¼ G¼ G¼</td>
<td>G¼</td>
</tr>
<tr>
<td>180 90 125</td>
<td></td>
<td>830 801 270 210 203 115 273.5 283.5 16 125 89 125 90 60 90 90 90 90 90 90 68 G¼ G¼ G¼</td>
<td>G¼</td>
</tr>
<tr>
<td>200 125</td>
<td></td>
<td>791 236 298 210 225 115 288 13.5 125 89 125 90 60 90 90 90 90 90 90 90 68 G¼ G¼ G¼</td>
<td>G¼</td>
</tr>
</tbody>
</table>

Performance

<table>
<thead>
<tr>
<th>A Bore Ø</th>
<th>B Rod Ø</th>
<th>Available force (kN)</th>
<th>Minimum stroke</th>
<th>Weight at minimum stroke (kg)</th>
<th>Additional weight per 100 mm stroke (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Compression Tension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 36</td>
<td></td>
<td>191 152</td>
<td>200</td>
<td>15.2</td>
<td>1.20</td>
</tr>
<tr>
<td>100 36 56</td>
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<tr>
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<td>44.9</td>
<td>2.69</td>
</tr>
<tr>
<td>160 63 100</td>
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<td>764 646</td>
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<td>90.0</td>
<td>3.77</td>
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<tr>
<td>180 90 125</td>
<td></td>
<td>967 725</td>
<td>300</td>
<td>133.0</td>
<td>6.62</td>
</tr>
<tr>
<td>200 125</td>
<td></td>
<td>1194 727</td>
<td>400</td>
<td>156.1</td>
<td>8.32</td>
</tr>
</tbody>
</table>

All dimensions are in millimetres unless otherwise stated.
How to order

<table>
<thead>
<tr>
<th>L</th>
<th>C</th>
<th>BA</th>
<th>380</th>
<th>D</th>
<th>200</th>
<th>125</th>
<th>1500</th>
<th>00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Product</td>
<td>Series</td>
<td>Pressure bar</td>
<td>Operation</td>
<td>Piston Ø mm</td>
<td>Rod Ø mm</td>
<td>Stroke mm</td>
<td>Factory use</td>
</tr>
<tr>
<td>Lightweight</td>
<td>Cylinder</td>
<td>Standard</td>
<td>eg: 380</td>
<td>Double acting</td>
<td>eg: 200</td>
<td>eg: 125</td>
<td>eg: 1500</td>
<td>–</td>
</tr>
</tbody>
</table>

Maintaining peak performance

Parker’s unique composite cylinder technology delivers continuous high performance over hundreds of thousands of cycles.

To maintain that performance and to protect your investment, we offer a maintenance and overhaul service in our own factory, to the same exacting standards as the original manufacturing process. Factory refurbished cylinders are covered by the same warranty terms as the original product.

For simple gland maintenance, service kits are also available.

More information

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Faster acceleration, reduced energy demand and shorter cycle times are achieved by using composite hydraulic cylinders to operate an industrial robotic arm.

Composite cylinders provide greater corrosion resistance and increased payload for this sub-sea drilling rig.

Lightweight composite cylinders permit greater boom reach and a reduced stabilizer envelope for mobile concrete pumps.

Working at 250 bar pressure, the low mass of inertia of servo-controlled composite cylinders gives life-like movement to this theme park dragon.

Working offshore, weight is critical. Using lightweight, corrosion-resistant composite cylinders in assembly tools for wind turbines increases the work rate of crews, enhances safety and reduces crane loading.

Aesthetically pleasing and high tech, the light weight and corrosion resistance of composite cylinders are ideally suited to tensioning the backstay rigging of performance yachts.

Reducing axle load through the use of composite materials frees up capacity elsewhere – in this military application, for additional armament.
Lighthraulics® product range

Standard Composite Cylinder Series
- Piston Ø: 80, 100, 125, 160, 180, 200 mm
- Operating pressure: 380 bar (5500 psi)
- Test pressure: 570 bar (8250 psi)

Custom Composite Cylinders
- Piston Ø: up to 250 mm
- Operating pressure: up to 450 bar (6500 psi)
- Stroke: up to 2500 mm
- Protective overwraps
- Alternative sealing systems
- Integrated valves, feedback sensor systems, heating elements etc.

Custom Sub-Sea Housings
- Ambient/external pressure up to 300 bar (4350 psi)
  Example:
  - Ambient pressure: 300 bar (4350 psi)
  - Internal diameter of barrel: 326 mm
  - Length: 1800 mm
  - Weight: 120 kg

Custom Composite Piston Accumulators
- Operating pressure: up to 420 bar (6100 psi)
- Volume: up to 45 litres
- Weight – composite, 15 litres volume = 26 kg
  – steel, 15 litres volume = approx. 100 kg

WARNING – USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

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