High Performance Cylinder
for Testing Technology

Technical Information

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Field of Application

In component and material testing facilities of research and development departments as well as in structural testing facilities of numerous industrial sectors, the materials, components and structural elements to be tested are exposed to mechanical loads to test their function, suitability for specific applications, degree of wear and life cycle. Apart from electro-mechanical drives, hydraulic drives in the form of linear actuators are used to provide the required mechanical loads in particular with highly dynamic load profiles.

To ensure an excellent control quality of the drive even if highly dynamic motion is required, primarily double-rod cylinders in servo quality with low friction resistances are employed.

The High Performance series with plain bearings is an inexpensive alternative to the conventional and widely used servo cylinders with hydrostatic pocket bearings. With constant, pressure independent frictional values, which are definitely comparable to classic servo cylinders, the modular kit with a forces of 16, 40, 63, 100, 250, 630 and 1000 kN covers a wide range of applications in testing technology.

The price advantage gained due to a more cost-effective sealing and bearing concept when compared to series with pocket bearings, limits the technical usability only marginally. Primarily, the limited capacity of bearing lateral forces transverse to the movement axis, which may be caused e.g. by masses to be moved, own weight (depending on the installation position) and transverse acceleration occurring by interaction with other actuators, has to be taken into account.

System Set-up / Mode of Operation

The High Performance series of cylinders has a modular design. The modular kit providing seven force levels and two pre-defined mounting styles, “base side self-aligning clevis” or “head flange”, in combination with a standardized external or internal thread for connection to the piston rod, allows for a variable configuration of the cylinder, tailored to the mechanical interfaces of the specific application. Further accessories like spherical bearings, cardanic joints and also load cells with adapted spherical bearings, tailored to the mechanical interfaces of the cylinder can be applied.

For both mounting styles, the cylinder can be equipped with an integrated magnetostrictive displacement transducer for position sensing.

In its basic design, the High Performance Cylinder is generally equipped with a connection block forming the connection from the control valve to the two cylinder chambers on the one hand, providing the SAE flange connections for the connection to the pressure oil supply on the other hand and enabling the return flow to the tank.

Furthermore, the connections for the pressure accumulator in the pump port and the damping accumulator in the tank port as well as measuring points equipped with connection couplings for the two cylinder chambers and the pump and tank ports are integrated in the connection block.

The mounting pattern of the control valve is standardized according to ISO 4401. This means that sandwich plates can be used to add additional functions commonly required in testing technology (see page 7).

The coextensive effective areas of the piston in conjunction with the extremely low constant and pressure independent friction ensure good controllability even with highly dynamic motion of the cylinder, which can be used up to a frequency of 50 Hz. The pipe connections as well as the connections from the connection block to the cylinder chambers are designed for flows enabling a cylinder velocity of up to 2 m/s.

Custom variations of the configurations and limitations predefined by the preference series are generally feasible.

Prior consultation with the specialist department is, however, required and a deviation from the indicated delivery times may be involved.

Technical Parameters

- Nominal force levels: 16, 40, 63, 100, 250, 630 and 1.000 kN
- Mounting style: MF3 and MPS
- Nominal pressure: 280 bar
- Working stroke: 50 up to 500 mm
- Typical frequency: up to 50 Hz
- Velocity: 0,01 up to 2 m/s
- Acceleration: up to max. 50 g
- Pressure independent friction lower than 1 % of the nominal cylinder force
- Applications without lateral force respectively lateral force free installation

Features

- Cost-effective amendment to the control cylinder range for highly dynamic test equipment
- Short delivery times due to a predefined modular concept
- Favorable controllability due to pressure independent constant friction
- Connection plate with integrated flange connections for P and T
- Additional functions can be optionally integrated using sandwich plate design
- Optional accessories for load measurement and mechanical link of the actuator
## Cylinder Program for Testing Technology

<table>
<thead>
<tr>
<th></th>
<th>Industrial Cylinder</th>
<th>High Performance Cylinder</th>
<th>Servo Cylinder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sealing concept Rod</td>
<td>Pressure profile</td>
<td>Pressure profile</td>
<td>Pressure profile</td>
</tr>
<tr>
<td>Sealing concept Piston</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bearing concept</td>
<td>Plain bearing</td>
<td>Plain bearing</td>
<td>Hydrostatic pocket bearing</td>
</tr>
<tr>
<td>Nominal pressure</td>
<td>250 / 350 bar depending on model range</td>
<td>280 bar</td>
<td>280 bar</td>
</tr>
<tr>
<td>Seals</td>
<td>pressure loaded</td>
<td>pressure compensated</td>
<td>pressure compensated</td>
</tr>
<tr>
<td>Friction</td>
<td>pressure dependent, lateral force dependent</td>
<td>pressure independent, lateral force dependent</td>
<td>pressure independent, lateral force independent</td>
</tr>
<tr>
<td>Lateral force ability</td>
<td>moderate*</td>
<td>≤1 % x nominal force*</td>
<td>high lateral force ability**</td>
</tr>
<tr>
<td>Typical frequency</td>
<td>5 Hz</td>
<td>50 Hz</td>
<td>Servo valve limits</td>
</tr>
<tr>
<td>Max. speed</td>
<td>0.5 m/s</td>
<td>2 m/s</td>
<td>5 m/s</td>
</tr>
</tbody>
</table>

* Depending from rod diameter, stroke length and stroke position.
** According datasheet RE 57310 or individual clarification with specialist department.
## Dimensions – Preferred Product Range

### Mounting Style MP5

<table>
<thead>
<tr>
<th>Nominal force in kN</th>
<th>16</th>
<th>40</th>
<th>63</th>
<th>100</th>
<th>250</th>
<th>630</th>
<th>1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston diameter (mm)</td>
<td>49</td>
<td>66</td>
<td>74</td>
<td>106</td>
<td>148</td>
<td>235</td>
<td>295</td>
</tr>
<tr>
<td>Rod diameter (mm)</td>
<td>40</td>
<td>50</td>
<td>50</td>
<td>80</td>
<td>100</td>
<td>160</td>
<td>200</td>
</tr>
<tr>
<td>A max. (mm)</td>
<td>540 + 2x stroke</td>
<td>590 + 2x stroke</td>
<td>590 + 2x stroke</td>
<td>560 + 2x stroke</td>
<td>660 + 2x stroke</td>
<td>930 + 2x stroke</td>
<td>1080 + 2x stroke</td>
</tr>
<tr>
<td>B max. (mm)</td>
<td>112</td>
<td>122</td>
<td>122</td>
<td>192</td>
<td>216</td>
<td>390</td>
<td>452</td>
</tr>
<tr>
<td>C max. (mm)</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>550</td>
<td>550</td>
<td>600</td>
<td>600</td>
</tr>
<tr>
<td>Piston rod end D</td>
<td>Male thread</td>
<td>M33x2</td>
<td>M42x2</td>
<td>M42x2</td>
<td>M72x3</td>
<td>M90x3</td>
<td>M140x4</td>
</tr>
<tr>
<td>Female thread</td>
<td>M20</td>
<td>M24</td>
<td>M24</td>
<td>8xM12, c.p.: Ø56</td>
<td>8xM16, c.p.: Ø71</td>
<td>8xM24, c.p.: Ø112</td>
<td>12xM24, c.p.: Ø150</td>
</tr>
<tr>
<td>Self-aligning clevis E (mm)</td>
<td>Ø40 -0.012</td>
<td>Ø50 -0.012</td>
<td>Ø50 -0.012</td>
<td>Ø80 -0.015</td>
<td>Ø110 -0.020</td>
<td>Ø160 -0.025</td>
<td>Ø200 -0.030</td>
</tr>
<tr>
<td>Pressure port P</td>
<td>SAE 3/4&quot; 6000 PSI</td>
<td>SAE 3/4&quot; 6000 PSI</td>
<td>SAE 3/4&quot; 6000 PSI</td>
<td>SAE 1 1/4&quot; 6000 PSI</td>
<td>SAE 1 1/4&quot; 6000 PSI</td>
<td>SAE 1 1/2&quot; 6000 PSI</td>
<td>SAE 1 1/2&quot; 6000 PSI</td>
</tr>
<tr>
<td>Tank port T</td>
<td>SAE 1&quot; 3000 PSI</td>
<td>SAE 1&quot; 3000 PSI</td>
<td>SAE 1&quot; 3000 PSI</td>
<td>SAE 1 1/2&quot; 3000 PSI</td>
<td>SAE 1 1/2&quot; 3000 PSI</td>
<td>SAE 2&quot; 3000 PSI</td>
<td>SAE 2&quot; 3000 PSI</td>
</tr>
<tr>
<td>Accumulator size in P (l) *</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>2.0</td>
<td>2.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Accumulator size in T (l) *</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>2.0</td>
<td>2.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Mounting pattern for control valve according to ISO 4401</td>
<td>Size 10</td>
<td>Size 10</td>
<td>Size 10</td>
<td>Size 16</td>
<td>Size 16</td>
<td>Size 32</td>
<td>Size 32</td>
</tr>
</tbody>
</table>

* For delivery accumulators are preloaded with 2 bar on gas side.
Preloading needs to be adjusted according to systems engineering value before initial operation!

Leakage must be drained separately.
## Dimensions – Preferred Product Range

### Mounting Style MF3

<table>
<thead>
<tr>
<th></th>
<th>Nominal force in kN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Piston diameter (mm)</td>
<td>49</td>
</tr>
<tr>
<td>Rod diameter (mm)</td>
<td>40</td>
</tr>
<tr>
<td>A max. (mm)</td>
<td>530 + 2x stroke</td>
</tr>
<tr>
<td>B max. (mm)</td>
<td>112</td>
</tr>
<tr>
<td>C max. (mm)</td>
<td>400</td>
</tr>
<tr>
<td>Piston rod end D</td>
<td>Male thread</td>
</tr>
<tr>
<td></td>
<td>Female thread</td>
</tr>
<tr>
<td>Fit diameter E</td>
<td>Ø120f7</td>
</tr>
<tr>
<td>Mounting bore</td>
<td>10xM10, c.p.: Ø145</td>
</tr>
<tr>
<td>Pressure port P</td>
<td>SAE 3/4&quot; 6000 PSI</td>
</tr>
<tr>
<td>Tank port T</td>
<td>SAE 1&quot; 3000 PSI</td>
</tr>
<tr>
<td>Accumulator size in P (l) *</td>
<td>0,7</td>
</tr>
<tr>
<td>Accumulator size in T (l) *</td>
<td>0,7</td>
</tr>
<tr>
<td>Mounting pattern for control valve according to ISO 4401</td>
<td>Size 10</td>
</tr>
</tbody>
</table>

* For delivery accumulators are preloaded with 2 bar on gas side. Preloading needs to be adjusted according to systems engineering value before initial operation!

Leakage must be drained separately.
**Type Code**

| Code | CG | PHK | MP5 | 74 | 50 | 360 | A | 1X | T | 1 | C | A | U | M | Z | T | D | A | W | W |
|------|----|-----|-----|----|----|-----|---|----|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Mode of operation**
1. CG: Double rod cylinder

**Industry solution**
2. P: Testing Technology

**Application**
2.1. H: Testing technology application, plain bearing style

**Model kit**
2.2. K: Model kit

**Types of mounting**
3. MP5: Self-aligning clevis at base

**Piston diameter**
4. ---: Piston diameter 49 up to 295 mm

**Piston rod diameter**
5. ---: Piston rod diameter 40 up to 200 mm

**Working stroke length (Working stroke = total stroke less front and rear side cushioning area)**
6. ---: Working stroke length 50 up to 500 mm

**Type**
7. A: Head and base screwed in (in the tube)

**Series**
8. 1X: Component series - 10 up to 19 unchanged installation and connection dimensions

**Mounting pattern for control valves according to ISO 4401**
9. P: Size 6
   T: Size 10
   U: Size 16
   V: Size 25
   S: Size 32

**Position of connection block at front head**
10. 1: 0°

**Position of connection block at rear head**
11. 1: 0°

**Piston rod version**
12. C: Hard chromium-plated

**Piston rod end**
13. A: Male thread
   E: Female thread

**End position cushioning**
14. U: Without (no end position cushioning in working stroke)

**Seal system**
15. M: Seal system suitable for mineral oil according to DIN 51524 (HL, HLP)
   V: (FPM)-Seal system suitable for phosphate ester (HFD-R)

**Additional options**
16. Z: Additional options - Fill in the form for more options
   W: Without

**Option - Position measuring system**
17. W: Without *
   T: Position measuring system: magnetostrictive

**Option - Position measuring system (Interface)**
18. W: Without *
   D: Digital SSI

**Option - threaded coupling (measuring point)**
19. W: Without *
   A: Threaded coupling both sides (on the manifold)

**Option - version spherical bearing**
20. W: Without (valid for MF3)
   A: Spherical bearing maintenance-free

**Option - rod extension**
21. W: Without
   Y: Piston rod extension - LY specify in plain text *

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*Not included in preferential series and price list, specific inquiries to be addressed to angebotecl@boschrexroth.de by use of RE 07200.
Optional Additional Functions

Version without additional function with directly attached servo valve without maximum pressure limitation in cylinder chambers A and B.

Version with maximum pressure limitation in cylinder chambers A and B by unloading to the tank. Sandwich plate according to RE 48052 (size 10) and RE 48054 (size 16). *

Version with maximum pressure limitation in cylinder chambers A and B by mutual relief. Sandwich plate according to RE 48052 (size 10) and RE 48054 (size 16). *

Version with maximum pressure limitation with pressure relief function in cylinder chambers A and B by short-circuit of the two working channels. Sandwich plate according to RE 48052 (size 10) and RE 48054 (size 16). *

* Not available for size 25 and 32.

Optional additional functions and variations of the preference series available after consultation with the specialist department.
## Accessories

<table>
<thead>
<tr>
<th>Load cells</th>
<th>Spherical joints for load cells</th>
<th>Mounting elements for hydro cylinders</th>
<th>Backlash free adjustable spherical bearings</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Load Cell Image" /></td>
<td><img src="image" alt="Spherical Joints Image" /></td>
<td><img src="image" alt="Mounting Elements Image" /></td>
<td><img src="image" alt="Backlash Bearings Image" /></td>
</tr>
</tbody>
</table>

### Load Cell

- **Nominal force in kN**:
  - 16 kN: Ø A = 88.9 mm, Ø B = Ø7.1 mm, Ø C = 105 mm, T = 35 mm, Weight = 1.5 kg
  - 40 kN: Ø A = 130.3 mm, Ø B = Ø10.5 mm, Ø C = 154 mm, T = 45 mm, Weight = 5 kg
  - 63 kN: Ø A = 130.3 mm, Ø B = Ø10.5 mm, Ø C = 154 mm, T = 45 mm, Weight = 5 kg
  - 100 kN: Ø A = 130.3 mm, Ø B = Ø10.5 mm, Ø C = 154 mm, T = 45 mm, Weight = 5 kg
  - 250 kN: Ø A = 165.1 mm, Ø B = Ø13.5 mm, Ø C = 204 mm, T = 64 mm, Weight = 11 kg
  - 630 kN: Ø A = 229.0 mm, Ø B = Ø17.5 mm, Ø C = 279 mm, T = 89 mm, Weight = 29 kg
  - 1000 kN: Ø A = 241.3 mm, Ø B = Ø22.0 mm, Ø C = 305 mm, T = 114 mm, Weight = 50 kg

Dimensions according preferred supplier.

### Load Cell – Specification

#### Electrical characteristics
- Grade of accuracy ≤ 0.1 (hysteresis + non-linearity <0.1 %)
- Full bridge 200 ... 1000 Ω
- Amplification 2 mV/V
- 6-wire with plug in connector at load cell

#### Environmental conditions
- Temperature range -10 °C bis +50 °C
- Protection class IP65

#### Mechanical characteristics
- Force limit 150 %
- Dynamic load ± 100 %
- Metrical dimensions
Spherical Joints for Load Cells

<table>
<thead>
<tr>
<th>Nominal force in kN</th>
<th>Ø D</th>
<th>LS</th>
<th>LT</th>
<th>M1</th>
<th>CX (mm)</th>
<th>EP</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>110</td>
<td>83</td>
<td>48</td>
<td>52</td>
<td>40,012</td>
<td>35</td>
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<td>40</td>
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<td>90</td>
<td>55</td>
<td>62</td>
<td>50,012</td>
<td>40</td>
<td>8,5</td>
</tr>
<tr>
<td>63</td>
<td>160</td>
<td>90</td>
<td>55</td>
<td>62</td>
<td>50,012</td>
<td>40</td>
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<td>80,015</td>
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<td>630</td>
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<td>132,5</td>
<td>110,020</td>
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<td>70</td>
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<tr>
<td>1000</td>
<td>370</td>
<td>310</td>
<td>200</td>
<td>185</td>
<td>160,025</td>
<td>110</td>
<td>175</td>
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</tbody>
</table>
Mounting Elements for Hydro Cylinders

- Plain clevis
- Swivel head
- Fork clevis
- Bearing bracket
- Clevis- and eye bracket
- Trunnion bracket
- Bolts

Details see data sheet RE 17042

Backlash free adjustable Spherical Bearings

<table>
<thead>
<tr>
<th>Nominal force</th>
<th>L1</th>
<th>B1</th>
<th>H</th>
<th>α1</th>
<th>α2</th>
<th>β</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>86</td>
<td>86</td>
<td>121</td>
<td>80</td>
<td>90</td>
<td>7</td>
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<td>178</td>
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<td>80</td>
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<td>63</td>
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<td>178</td>
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<td>100</td>
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<td>250</td>
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<td>630</td>
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<tr>
<td>1000</td>
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<td>546</td>
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<td>90</td>
<td>8</td>
<td>442</td>
</tr>
</tbody>
</table>

Attention: All dimensions are reference values only.

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Technical Information | High Performance Cylinder for Testing Technology

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