HAWE Products
Our current product range

Solutions for a World under Pressure
# HAWE product range – Contents

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HAWE Hydraulik produces and develops hydraulic components and solutions for many sectors of the mechanical engineering and plant engineering industries. HAWE also helps to resolve global problems regarding energy, infrastructure, efficient production, nutrition and resources.

With over 65 years’ experience and a focus on constantly incorporating new technologies, HAWE is a responsible partner for you when it comes to conserving resources, reducing costs, making machinery safer and developing innovative ideas. The product range includes constant and variable pumps, hydraulic power packs, valves, sensors and accessories. The modular system is complemented by electronic components which are perfectly coordinated with the hydraulic components and simplify control, signal evaluation and fault detection. All pressurised parts are made from steel, which allows for pressures of up to 700 bar and guarantees that components are durable, safe and compact in mid-pressure ranges.

As a result, HAWE Hydraulik products offer concrete benefits for manufacturers and their customers thanks to the consistent modular design which has been tailored to solutions for a world under pressure. “Solutions for a World under Pressure”
Information about this compact product catalogue

This compact catalogue is structured according to nomenclature and offers an initial overview of the available components and their performance data. Thanks to our approach of consistently designing all components based on a modular system, our components can be easily combined to form space-saving units offering added value.

If your requirements are not covered by the product range shown here, we will also be glad to design bespoke hydraulic solutions.

Your HAWE sales representative or sales partner can provide additional technical documentation, drawings or 3D models for individual components and even complete solutions. They will be glad to assist you with selecting and configuring your system, commissioning and service.

The contact data for the contact partner in your region is attached and can also be found at HAWE Hydraulik SE - Global Website.
HAWE - Intelligent solutions to tackle global problems

Stationary hydraulics

In machine tools, testing machinery and many other industrial applications, tensioning and clamping functions are often actuated using hydraulics. In addition to the high output density and energy-efficient drive concept, the integrated monitoring functions also prove particularly useful during operation.

Compact hydraulic power packs in standby mode, a speed-controlled drive concept and an accumulator charging mode are just some of the methods used to increase system efficiency. What's more, zero-leakage directional seated valves, high pressure and intelligent control by the electronics system open up other application fields such as hydraulic tools and renewable energy.
Mobile hydraulics

HAWE Hydraulik provides manufacturers of mobile machines with components for creating an energy-efficient system to help them comply with established standards and regulations.

Proportional directional spool valves regulate the movement speed of the hydraulic consumers continuously and independently of the load. Load-holding valves reliably secure the position of the load and are an important system element for suppressing unwanted oscillations. Axial piston pumps provide the flow rate required depending on the specific needs. When individual components are supplied from a single source, you can be sure that they have been coordinated with one another and you know how they will interact with one another.

Our Sales and Service representatives will be glad to provide you with professional, local assistance for adapting our products to your specific needs – before, during and after commissioning.
1.1 Hydraulic pumps

- Radial piston pump type R, RG and RZ: 12
- Variable displacement axial piston pump type V30E: 16
- Variable displacement axial piston pump type V30D: 20
- Variable displacement axial piston pump type V80M: 24
- Variable displacement axial piston pump type V60N: 26
- Variable displacement axial piston pump type K60N: 30
- Air-driven hydraulic pump type LP: 32
- Hand pump type H, HE and HD: 34
### Radial piston pumps

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / features</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$V_{\text{max}}$ (cm$^3$/rev)</th>
</tr>
</thead>
</table>
| R, RG, RZ | **Radial piston pump / dual-stage pump**  
- Single pump  
- Motor pump  
- Hydraulic power pack | R 7631: 700 | R 7631: 1.59 |
| | | R, RG 6010: 700 | R, RG 6010: 4.58 |
| | | R, RG 6011: 700 | R, RG 6011: 10.7 |
| | | R, RG 6014: 700 | R, RG 6014: 42.78 |
| | | R, RG 6016: 700 | R, RG 6016: 64.18 |
| | **Features and benefits:**  
- High level of efficiency  
- Compact design  
- Max. 14 separate pressure outlets  
- Available from the modular product range as a hydraulic power pack with valve banks | HP/LP: RZ 7631: 700/200 | HP/LP: RZ 7631: 1.59/7.9 |
| | | RZ 6910: 700/200 | RZ 6910: 4.58/26 |
| | | RZ 6911: 700/200 | RZ 6911: 10.7/89.6 |
| | | RZ 6912: 700/200 | RZ 6912: 21.4/89.6 |
| | | RZ 6914: 700/200 | RZ 6914: 42.8/89.6 |
| | | RZ 6916: 700/200 | RZ 6916: 64.2/89.6 |
### Axial piston pumps

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / features</th>
<th>( p_{\text{max}} ) (bar)</th>
<th>( V_{\text{max}} ) (cm³/rev)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>V30D</strong></td>
<td><strong>Variable displacement axial piston pump</strong></td>
<td>045: 350/420</td>
<td>045: 45</td>
</tr>
<tr>
<td></td>
<td>Single pump</td>
<td>075: 350/420</td>
<td>075: 75</td>
</tr>
<tr>
<td></td>
<td>Pump combination</td>
<td>095: 350/420</td>
<td>095: 95</td>
</tr>
<tr>
<td></td>
<td>Features and benefits:</td>
<td>115: 250/300</td>
<td>115: 115</td>
</tr>
<tr>
<td></td>
<td>– Low-noise emissions</td>
<td>140: 350/420</td>
<td>140: 140</td>
</tr>
<tr>
<td></td>
<td>– Wide controller options</td>
<td>160: 250/300</td>
<td>160: 160</td>
</tr>
<tr>
<td></td>
<td>– Full torque available at the second pump in tandem pump applications</td>
<td>250: 350/420</td>
<td>250: 250</td>
</tr>
<tr>
<td><strong>V30E</strong></td>
<td><strong>Variable displacement axial piston pump</strong></td>
<td>095: 350/420</td>
<td>095: 95</td>
</tr>
<tr>
<td></td>
<td>Single pump</td>
<td>160: 350/420</td>
<td>160: 160</td>
</tr>
<tr>
<td></td>
<td>Pump combination</td>
<td>270: 350/420</td>
<td>270: 270</td>
</tr>
<tr>
<td><strong>V80M</strong></td>
<td><strong>Variable displacement axial piston pump</strong></td>
<td>200: 400/450</td>
<td>200: 202</td>
</tr>
<tr>
<td></td>
<td>Single pump</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pump combination</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>V60N</strong></td>
<td><strong>Variable displacement axial piston pump</strong></td>
<td>060: 350/400</td>
<td>060: 60</td>
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<tr>
<td></td>
<td>Single pump</td>
<td>090: 350/400</td>
<td>090: 90</td>
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<tr>
<td></td>
<td>Pump combination</td>
<td>110: 350/400</td>
<td>110: 110</td>
</tr>
<tr>
<td></td>
<td>Features and benefits:</td>
<td>130: 400/450</td>
<td>130: 130</td>
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<tr>
<td></td>
<td>– Optimized power-to-weight ratio</td>
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<td></td>
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<tr>
<td></td>
<td>– High self-suction speed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Wide controller options</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>K60N</strong></td>
<td><strong>Fixed displacement axial piston pump</strong></td>
<td>012: 400</td>
<td>012: 12.6</td>
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<tr>
<td></td>
<td>Single pump</td>
<td>017: 400</td>
<td>017: 17.0</td>
</tr>
<tr>
<td></td>
<td>Features and benefits:</td>
<td>025: 400</td>
<td>025: 25.4</td>
</tr>
<tr>
<td></td>
<td>– Optimized power-to-weight ratio</td>
<td>034: 400</td>
<td>034: 34.2</td>
</tr>
<tr>
<td></td>
<td>– High rotation speed</td>
<td>047: 400</td>
<td>047: 47.1</td>
</tr>
<tr>
<td></td>
<td>– Different shaft and flange versions</td>
<td>064: 400</td>
<td>064: 63.5</td>
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<tr>
<td></td>
<td></td>
<td>084, 984: 400</td>
<td>084, 984: 83.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>108, 9108: 400</td>
<td>108, 9108: 108</td>
</tr>
</tbody>
</table>
## Air-driven hydraulic pumps

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / features</th>
<th>(p_{\text{max}}) (bar)</th>
<th>(V_{\text{max}}) (cm³/stroke)</th>
</tr>
</thead>
</table>
| LP   | Air-driven hydraulic pump  
- Single pump  
- Hydraulic power pack | 80: 700  
125: 1500  
160: 1500 | 80: 6.00  
125: 28.30  
160: 28.30 |

### Features and benefits:
- High operating pressures
- Suitable for explosion-proof systems and equipment
- No electrical energy
- Hydraulic power packs with direct valve mounting

## Hand pumps

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / features</th>
<th>(p_{\text{max}}) (bar)</th>
<th>(V_{\text{max}}) (cm³/stroke)</th>
</tr>
</thead>
</table>
| H, HE, HD | Hand pump  
- Single-acting  
- Double-acting  
Features and benefits:
- Sturdy design  
- Hand pumps with integrated tank  
- Safety and drain valve | H - 16: 350  
H - 20: 220  
H - 25: 150 | H - 16: 6.00  
H - 20: 9.40  
H - 25: 14.70 |
|         |                   | HE - 3: 800  
HE - 4: 600 | HE - 3: 3.00  
HE - 4: 4.00 |
|         |                   | HD - 13: 350  
HD - 20: 220  
HD - 30: 150 | HD - 13: 13.00  
HD - 20: 20.00  
HD - 30: 30.00 |
Radial piston pumps are a type of hydraulic pump. They consist of valve-controlled pump cylinders that are arranged radially. The radial piston pump type R, RG and RZ has a closed pump housing. Therefore, besides use as a motor pump outside an oil tank, installation in the container of a hydraulic power pack is also possible. The radial piston pump is available with several pressure outlets which enable the same or several different volumetric flows. Type RZ is a classic dual-stage pump consisting of a radial piston pump and a gear pump. The radial piston pump type RG has plain bearings which have a longer storage life. This type is therefore used in extreme operating conditions. Extremely high volumetric flows can be achieved by arranging up to 6 radials in parallel. When the radial piston pump is used in the hydraulic power pack, it is suitable for use as a highly compact control system. Connection blocks and valve banks can be mounted on the cover plate of the hydraulic power packs.

**Features and benefits:**
- High level of efficiency
- Compact design
- Max. 14 separate pressure outlets
- Available from the modular product range as a hydraulic power pack with valve banks

**Intended applications:**
- Press construction
- Jig construction
- Testing and laboratory devices
- Lubricating systems

### Design and order coding example

<table>
<thead>
<tr>
<th>RZ 0,9</th>
<th>/ 2 - 16</th>
</tr>
</thead>
</table>

**Sizes**
- Delivery flow gear pump [lpm]

**Basic type, delivery flow [lpm]**
- Type R (version with roller bearing)
- Type RG (version with plain bearing)
- Type RZ (dual-stage pump)

**Additional versions:**
- With several pressure ports
- With separate ports for the flow of one or two pump elements \(Q_{\text{max}} = 4.4 \text{ lpm}\)
  
  e.g. as control oil supply

### Characteristics

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>Radial piston pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Single pump ; dual-stage pump</td>
</tr>
<tr>
<td>(p_{\text{max}}):</td>
<td>700 bar</td>
</tr>
<tr>
<td>(Q_{\text{max}}):</td>
<td>91.2 l/min</td>
</tr>
<tr>
<td>(V_{g}):</td>
<td>64.18 cm³/rev</td>
</tr>
</tbody>
</table>
Function

Single pump type R and RG

Single pump type RZ
only high-pressure section,
low-pressure section is
installed by customer

Single pump type RZ
High and low-pressure section

Pump with several pressure
outlets (example for an Single
pump)

General parameters and dimensions

Single pump type R and RG

Single pump type RZ
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<table>
<thead>
<tr>
<th>Design</th>
<th>Number of cylinders</th>
<th>Delivery flow Qₚₚᵤ (lpm) and max. pressure pₚₚₐₓ (bar)</th>
<th>Dimensions [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>700 bar</td>
<td>550 bar</td>
<td>450 bar</td>
</tr>
<tr>
<td>7631</td>
<td>2</td>
<td>0.18</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.27</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.46</td>
<td>0.7</td>
</tr>
<tr>
<td>6010/6910</td>
<td>1</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.9</td>
<td>1.5</td>
</tr>
<tr>
<td>6011/6911</td>
<td>5</td>
<td>1.4</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>2.1</td>
<td>3.7</td>
</tr>
<tr>
<td>6012/6912</td>
<td>10</td>
<td>2.7</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>4.0</td>
<td>7.4</td>
</tr>
<tr>
<td>6014/6914</td>
<td>20</td>
<td>6.1</td>
<td>11.0</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>8.0</td>
<td>15.0</td>
</tr>
<tr>
<td>6016/6916</td>
<td>42</td>
<td>12.7</td>
<td>22.0</td>
</tr>
</tbody>
</table>

- The data listed represent only a selection of the various different versions
1) Standard motor, design IM B 35 for motor pumps or IM B 5 for hydraulic power packs

### Gear pump

<table>
<thead>
<tr>
<th>Size</th>
<th>Delivery flow Qₚₚᵤ [lpm] and max. pressure pₚₚₐₓ [bar]</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120 bar</td>
<td>80 bar</td>
<td>40 ... 60 bar</td>
</tr>
<tr>
<td>/1</td>
<td>5,2</td>
<td>8,8</td>
<td>11,3</td>
</tr>
<tr>
<td>/2</td>
<td>12,3</td>
<td>16</td>
<td>37</td>
</tr>
<tr>
<td>/3</td>
<td>24</td>
<td>110</td>
<td>135</td>
</tr>
</tbody>
</table>

- The data listed represent only a selection of the various different versions
Circuit example:

R 4.0/B 50 A 700 - VB 11 DM - HRHR - 1 - G 24 - V 5.5

Associated technical data sheets:
- Radial piston pump type R and RG: D 6010
- Motor pump and hydraulic power pack type R and RG: D 6010 H
- Radial piston pumps with several pressure connections type R, RG: D 6010 D, D 6010 DB
- Radial piston pump type R and RG with one main pressure connection and one or two ancillary pressure connections: D 6010 S

Directly mountable valve banks:
- Type VB: Page 114
- Type BWH(N): Page 120
- Type SWR: Page 76
## Individual pumps

### 1.1 Variable displacement axial piston pump type V30E

Variable displacement axial piston pumps operate according to the bent axis principle. They adjust the geometric output volume from maximum to zero. As a result they vary the flow rate that is provided to the loads.

The axial piston pump type V30E is designed for open circuits in mobile hydraulics and operate according to the swash plate principle. They are available with the option of a thru-shaft for operating additional hydraulic pumps in series.

The sturdy pump is particularly suitable for continuous operation in challenging applications. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

**Features and benefits:**
- Low noise emissions
- Wide controller options
- Full torque available at the second pump in tandem pump applications

**Intended applications:**
- Machines for forestry and agricultural purposes
- Cranes and lifting equipment
- Construction machines

### Design and order coding example

<table>
<thead>
<tr>
<th>V30E</th>
<th>095</th>
<th>R</th>
<th>S</th>
<th>F</th>
<th>N</th>
<th>- 1</th>
<th>- 2</th>
<th>XX</th>
<th>LSP</th>
<th>/120</th>
<th>- 200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Pressur specification [bar]**
- **Torque setting [Nm]**
- **Controllers**: See section "Controller"
- **Release swash plate angle indicator**: With/without swash plate angle indicator
- **Housing version**: With/without thru-shaft
- **Seal material**: NBR (N), EPDM (E), FKM (V, C)
- **Flange version**: Flange ISO 3019-2 (G), Flange SAE J744 (F, W)
- **Shaft version**: Spline shaft DIN 5480 (D), Parallel key (K), Spline shaft SAE J744 (S, U)
- **Rotating direction**: Anti-clockwise (L), clockwise (R)
- **Nominal size**

Nomenclature:
- Axial piston pump
- Variable pump

Design: Single pump
- Multiple pump

**P<sub>max</sub>:**
- System pressure: 350 bar
- Peak pressure: 420 bar

**V<sub>g max</sub>:**
- 270 cm³/rev
**Function**

<table>
<thead>
<tr>
<th>Single pump</th>
<th>Multiple pump</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Controller**

**Pressure controller:**
- Pressure controller (P, Pb)
- Electro-proportional pressure controller (P-PMVPS)

**Flow controller:**
- Load-sensing controller with integrated pressure limitation (LSP, LSPb)
- Load-sensing controller with integrated pressure limitation and electric pump direction switching (LSP-BVPM)
- Electro-hydraulic flow controller with integrated pivoting angle pick-up and control electronics for adjustment of setpoint and actual value (EM.CH)

**Power controller:**
- Power controller (L)
- Power controller (Lf, Lf1)
General parameters and dimensions

1 Drain port
2 Suction port
3 Pressure connection

Parameters

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>V30E - 095</td>
<td>95</td>
<td>350 (420)</td>
<td>296 75 236 36 190 57</td>
<td></td>
</tr>
<tr>
<td>V30E - 160</td>
<td>160</td>
<td>2100</td>
<td>332 75 273 36 212 77</td>
<td></td>
</tr>
<tr>
<td>V30E - 270</td>
<td>270</td>
<td>1800</td>
<td>399 88 326 36 266 129</td>
<td></td>
</tr>
</tbody>
</table>

Ports

<table>
<thead>
<tr>
<th>Pressure connection</th>
<th>Suction port</th>
<th>Drain port</th>
</tr>
</thead>
<tbody>
<tr>
<td>V30E - 095</td>
<td>1/4&quot; SAE J518</td>
<td>2 1/2&quot; SAE J518</td>
</tr>
<tr>
<td>V30E - 160</td>
<td>1/4&quot; SAE J518</td>
<td>2 1/2&quot; SAE J518</td>
</tr>
<tr>
<td>V30E - 270</td>
<td>1/2&quot; SAE J518</td>
<td>3&quot; SAE J518</td>
</tr>
</tbody>
</table>
Circuit example:

V30E-270-LSFN-2-1/03-LSP-320

Associated technical data sheets:
- Variable displacement axial piston pump type V30E: Page 20
- Variable displacement axial piston pump type V60N: Page 26
- Fixed displacement axial piston pump type K60N: Page 30
- Variable displacement axial piston pump type V80M: Page 24

Similar products:
- Variable displacement axial piston pump type V30D: Page 20
- Variable displacement axial piston pump type V60N: Page 26
- Fixed displacement axial piston pump type K60N: Page 30
- Variable displacement axial piston pump type V80M: Page 24

Suitable proportional directional spool valve:
- Type EDL: Page 82
- Type PSL/PSV size 2, 3 and 5: Page 90
- Type PSLF/PSVF size 3, 5 and 7: Page 96

Suitable accessories:
- Proportional amplifier type EV1M3: Page 272
- Proportional amplifier type EV2S: Page 274
- Proportional amplifier type EV1D: Page 272
Individual pumps

1.1 Variable displacement axial piston pump type V30D

Variable displacement axial piston pumps operate according to the bent axis principle. They adjust the geometric output volume from maximum to zero. As a result they vary the flow rate that is provided to the loads.

The axial piston pump type V30D is designed for open circuits in industrial hydraulics and operate according to the swash plate principle. They are available with the option of a thru-shaft for operating additional hydraulic pumps in series.

The sturdy pump is particularly suitable for continuous operation in challenging applications. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

Features and benefits:
- Low-noise emissions
- Wide controller options
- Full torque available at the second pump in tandem pump applications

Intended applications:
- Presses
- Industrial plants
- Marine cranes and winches
- Power pack assembly

Design and order coding example

<table>
<thead>
<tr>
<th>V30D</th>
<th>-</th>
<th>095</th>
<th>R</th>
<th>SF</th>
<th>N</th>
<th>-</th>
<th>1</th>
<th>-</th>
<th>1</th>
<th>-</th>
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<th>-2</th>
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<th>-200</th>
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</tbody>
</table>

- Pressure specification [bar]
- Torque setting [Nm]
- Additional versions e.g. stroke limitation
- Controller See section "Controller"
- Release
- Swash plate angle indicator With/without swash plate angle indicator
- Housing version With/without thru-shaft
- Seal material • NBR (N)
- • EPDM (E)
- • FKM (V)
- Shaft version/flange version • Spline shaft DIN 5480 (D)
- • Spline shaft SAE J744 (S)
- • Parallel key (K)
- Rotating direction Anti-clockwise (L), clockwise (R)
- Nominal size

Basic type
Function

Single pump	Multiple pump

Controller

Pressure controller:
- Pressure controller (N)
- Pressure controller with remote-control port (P, Pb)

Flow controller
- Load-sensing controller (LS)
- Load-sensing controller with integrated pressure limitation (LSN)
- Flow controller for setting a constant, speed-independent volumetric flow (Q, Qb)
- Electro-proportional flow controller with rising characteristic (V)
- Hydraulic-proportional flow controller with rising characteristic (VH)

Power controller:
- Power controller (L)
- Power controller, hydraulically adjustable (Lf1)
### General parameters and dimensions

<table>
<thead>
<tr>
<th>(connection locations for clockwise operation)</th>
</tr>
</thead>
</table>

### Parameters

<table>
<thead>
<tr>
<th>Geom. delivery volume</th>
<th>Nominal pressure</th>
<th>Max rotation speed</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_g ) [cm³/rev]</td>
<td>( \rho_{nom} (\rho_{max}) ) [bar]</td>
<td>( n ) [rpm]</td>
<td>( L )</td>
<td>( L1 )</td>
</tr>
<tr>
<td>V30D - 045</td>
<td>45</td>
<td>350 (420)</td>
<td>2600</td>
<td>268</td>
</tr>
<tr>
<td>V30D - 075</td>
<td>75</td>
<td>300 (360)</td>
<td>2400</td>
<td>310</td>
</tr>
<tr>
<td>V30D - 095</td>
<td>95</td>
<td>350 (420)</td>
<td>2200</td>
<td>341</td>
</tr>
<tr>
<td>V30D - 115</td>
<td>115</td>
<td>250 (300)¹</td>
<td>2000</td>
<td>341</td>
</tr>
<tr>
<td>V30D - 140</td>
<td>140</td>
<td>350 (420)</td>
<td>2200</td>
<td>363</td>
</tr>
<tr>
<td>V30D - 160</td>
<td>160</td>
<td>250 (300)¹</td>
<td>1900</td>
<td>363</td>
</tr>
<tr>
<td>V30D - 250</td>
<td>265</td>
<td>350 (420)</td>
<td>1800</td>
<td>432</td>
</tr>
</tbody>
</table>

¹) Higher pressures are possible with reduced delivery flow

### Ports

<table>
<thead>
<tr>
<th>Pressure connection</th>
<th>Suction port</th>
<th>Drain port</th>
</tr>
</thead>
<tbody>
<tr>
<td>V30D - 045</td>
<td>3/4&quot; SAE J518</td>
<td>1 1/2&quot; SAE J518</td>
</tr>
<tr>
<td>V30D - 075</td>
<td>1&quot; SAE J518</td>
<td>2&quot; SAE J518</td>
</tr>
<tr>
<td>V30D - 095</td>
<td>1 1/4&quot; SAE J518</td>
<td>2&quot; SAE J518</td>
</tr>
<tr>
<td>V30D - 115</td>
<td>1 1/4&quot; SAE J518</td>
<td>2&quot; SAE J518</td>
</tr>
<tr>
<td>V30D - 140</td>
<td>1 1/4&quot; SAE J518</td>
<td>2 1/2&quot; SAE J518</td>
</tr>
<tr>
<td>V30D - 160</td>
<td>1 1/4&quot; SAE J518</td>
<td>2 1/2&quot; SAE J518</td>
</tr>
<tr>
<td>V30D - 250</td>
<td>1 1/2&quot; SAE J518</td>
<td>3&quot; SAE J518</td>
</tr>
</tbody>
</table>
Associated technical data sheets:
- Variable displacement axial piston pump type V30D: D 7960.

Similar products:
- Variable displacement axial piston pump type V30E: Page 16
- Variable displacement axial piston pump type V60N: Page 26
- Fixed displacement axial piston pump type K60N: Page 30
- Variable displacement axial piston pump type V80M: Page 24

Suitable proportional directional spool valve:
- Type EDL: Page 82
- Type PSL/PSV 2, 3 and 5: Page 90
- Type PSLF/PSVF 3, 5 and 7: Page 96

Suitable accessories:
- Proportional amplifier type EV1M3: Page 272
- Proportional amplifier type EV2S: Page 274
- Proportional amplifier type EV1D: Page 272
1.1 Variable displacement axial piston pump type V80M

Variable displacement axial piston pumps operate according to the bent axis principle. They adjust the geometric output volume from maximum to zero. As a result they vary the flow rate that is provided to the loads. The axial piston pump type V80M is designed for open circuits in mobile hydraulics and operate according to the swash plate principle. They are available with the option of a thru-shaft for operating additional hydraulic pumps in series. The sturdy pump is particularly suitable for continuous operation in challenging applications. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

Features and benefits:
- High speed
- High nominal pressure
- Less installation space
- Full torque available at the second pump in tandem pump applications

Intended applications:
- Machines for forestry and agricultural purposes
- Cranes and lifting equipment
- Construction machines

### Design and order coding example

<table>
<thead>
<tr>
<th>V80M</th>
<th>- 200</th>
<th>R</th>
<th>S</th>
<th>F</th>
<th>N</th>
<th>- 1</th>
<th>- 1</th>
<th>XX</th>
<th>/LN</th>
<th>-2</th>
<th>/120</th>
<th>-200</th>
</tr>
</thead>
</table>

- **Pressure specification** [bar]  
- **Torque setting** [Nm]  
- **Controller** See section "Controller"  
- **Release**
  - swash plate angle indicator: With/without swash plate angle indicator  
- **Versions with housing**
  - With/without thru-shaft
  - Seals: NBR (N)  
  - FKM (V)  
- **Flange version**
  - DIN (W)  
  - SAE (F)  
- **Shaft version**
  - Spline shaft (DIN 5480) (D)  
  - Spline shaft and flange SAE (S)  
- **Rotating direction**
  - Counter clockwise (L), clockwise (R)  

### Basic type

#### Function

**Single pump**  
**Multiple pump**
Controller

Pressure controller:
- Pressure controller (N)

Flow controller:
- Load-sensing controller (LSN)

Power controller:
- Power controller (L)

General parameters and dimensions

![Diagram of pump connections](connection locations for clockwise operation)

Parameters

<table>
<thead>
<tr>
<th>Geom. output volume $V_g$ [cm$^3$/rev]</th>
<th>Nominal pressure $p_{nom}$ [bar]</th>
<th>Self-suction speed $n$ [min$^{-1}$]</th>
<th>Ports</th>
<th>$m$ [kg] (with controller)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V80M - 200</td>
<td>200</td>
<td>400 (450)</td>
<td>1800</td>
<td>3&quot;</td>
</tr>
<tr>
<td></td>
<td>G 1</td>
<td>1 1/2&quot;</td>
<td></td>
<td>130 (136)</td>
</tr>
</tbody>
</table>

Circuit example:

![Circuit diagram](Image)

Associated technical data sheets:
- Variable displacement axial piston pump V80M: Page 200
- Similar products:
  - Variable displacement axial piston pump type V30D: Page 20
  - Variable displacement axial piston pump type V30E: Page 16
  - Variable displacement axial piston pump type V60N: Page 26
  - Fixed displacement axial piston pump type K60N: Page 30
- Suitable prop. directional spool valve:
  - Type EDL: Page 82
  - Type PSL/PSV size 2, 3 and 5: Page 90
  - Type PSLF/PSVF size 3, 5 and 7: Page 96
- Suitable accessories:
  - Proportional amplifier type EV1M3: Page 272
  - Proportional amplifier type EV2S: Page 274
  - Proportional amplifier type EV1D: Page 272
Individual pumps

1.1 Variable displacement axial piston pump type V60N

Variable displacement axial piston pumps operate according to the bent axis principle. They adjust the geometric output volume from maximum to zero. As a result they vary the flow rate that is provided to the loads.

The axial piston pump type V60N is designed for open circuits in mobile hydraulics and operate according to the swash plate principle. They are available with the option of a thru-shaft for operating additional hydraulic pumps in series. The pump is fitted above all to the power take-off on commercial vehicle transmissions. The range of pump controllers allows the axial piston pump to be used in a variety of applications.

Features and benefits:
- Optimized power-to-weight ratio
- High self-suction speed
- Wide controller options

Intended applications:
- Municipal trucks
- Cranes and lifting equipment
- Machines for forestry and agricultural purposes
- Truck-mounted concrete pumps

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Axial piston pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Single pump</td>
</tr>
<tr>
<td>Max. stroke limitation</td>
<td>With/without max. stroke limitation</td>
</tr>
<tr>
<td>System pressure</td>
<td>400 bar</td>
</tr>
<tr>
<td>Peak pressure</td>
<td>450 bar</td>
</tr>
<tr>
<td>Vₘₐₓ:</td>
<td>130 cm³/rev</td>
</tr>
</tbody>
</table>

**Design and order coding example**

<table>
<thead>
<tr>
<th>V60N</th>
<th>-110</th>
<th>R</th>
<th>S</th>
<th>F</th>
<th>N</th>
<th>-1 -0</th>
<th>/LSNR</th>
<th>-2</th>
<th>-320</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Pressure specification [bar]**
  - Controller: See section "Controller"
  - Stroke limitation: With/without max. stroke limitation

- **Release**

- **Additional function**
  - Housing version: Axial ports, Radial ports with thru-shaft, Radial ports
  - Seal material: NBR (N), FKM (V)
  - Flange version: Flange ISO 7653-1985 (Y, P), Flange ISO 3019-2 (G), Flange SAE J744 (X, Z, F)
  - Shaft version: ISO 14 parallel key splined shaft (D), Spline shaft DIN 5480 (M), Spline shaft SAE J744 (H, U, T, S, Q)
  - Rotating direction: Anti-clockwise (L), clockwise (R)

- **Nominal size**

- **Basic type**
### Function

#### Controller

<table>
<thead>
<tr>
<th><strong>Pressure controller</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Pressure controller (NR)</td>
</tr>
<tr>
<td>- Electro-proportional pressure controller with rising characteristic (PR)</td>
</tr>
<tr>
<td>- Electro-proportional pressure controller with falling characteristic (P1R)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Flow controller</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Load-sensing controller with integrated pressure limitation (LSNR, LSNRT)</td>
</tr>
<tr>
<td>- Flow controller for setting a constant, speed-independent volumetric flow (QNR)</td>
</tr>
<tr>
<td>- Electro-proportional flow controller with rising characteristic (V)</td>
</tr>
<tr>
<td>- Electro-proportional flow controller with falling characteristic (V1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Power controller</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Power controller (L, /ZL)</td>
</tr>
</tbody>
</table>
General parameters and dimensions

### Parameters

<table>
<thead>
<tr>
<th>Geom. output volume</th>
<th>Nom. pressure</th>
<th>Max. speed</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vg [cm³/rev]</td>
<td>pnom (pmax) [bar]</td>
<td>n [rpm]</td>
<td>L</td>
</tr>
<tr>
<td>V60N - 060</td>
<td>60</td>
<td>350 (400)</td>
<td>2500</td>
<td>254</td>
</tr>
<tr>
<td>V60N - 090</td>
<td>90</td>
<td>2300</td>
<td>278</td>
<td>55</td>
</tr>
<tr>
<td>V60N - 110</td>
<td>110</td>
<td>2200</td>
<td>280</td>
<td>55</td>
</tr>
<tr>
<td>V60N - 130</td>
<td>130</td>
<td>400 (450)</td>
<td>2100</td>
<td>270</td>
</tr>
</tbody>
</table>

### Ports

<table>
<thead>
<tr>
<th>Pressure port P</th>
<th>Suction port S</th>
<th>Drain port D</th>
<th>LS connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>V60N - 060</td>
<td>G 3/4</td>
<td>G 3/4</td>
<td>G 1/4</td>
</tr>
<tr>
<td>V60N - 090</td>
<td>G 1/2” SAE 3518</td>
<td>G 3/4</td>
<td>G 1/4</td>
</tr>
<tr>
<td>V60N - 110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V60N - 130</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Circuit example:

V60N-130 RSFN-1-0-03 / LSNR-2-250

PSV 31/D280-2
- A 2 L 25/25/EA1/2
- A 2 H 40/40/EA1/2 DRH
- A 2 L 25/25/EA1/2
- A 2 H 3/3 A 100 B 100/EA1/2 AL-O-D 4/120-BL-O-D 4/120
- A 2 H 3/3/EA1/2 DRH
- E 18-G 24

PSV 31-1
- A2 L 25/25/EA1/2
- A2 L 25/25/EA1/2
- A2 H 3/3/EA1/2 DRH
- A2 H 3/3/EA1/2 DRH
- E 1 - G24

Associated technical data sheets:
- Variable displacement axial piston pump type V60N: D 7960 N

Similar products:
- Variable displacement axial piston pump type V30D: Page 20
- Variable displacement axial piston pump type V30E: Page 16
- Fixed displacement axial piston pump type K60N: Page 30
- Variable displacement axial piston pump type V80M: Page 24

Suitable prop. directional spool valves:
- Type EDL: Page 82
- Type PSL/PSV size 2, 3 and 5: Page 90
- Type PSLF/PSVF size 3, 5 and 7: Page 96

Suitable accessories:
- Proportional amplifier type EV1M3: Page 272
- Proportional amplifier type EV2S: Page 274
- Proportional amplifier type EV1D: Page 272
1.1 Variable displacement axial piston pump type K60N

Fixed displacement axial piston pumps operate according to the bent axis principle. They have a constant output volume and therefore deliver a constant flow rate at a specific rotation speed.

The axial piston pump type K60N is designed for open circuits in mobile hydraulics and operates based on the bent axis principle. The pump is fitted mainly to the power take-off on commercial vehicle transmissions.

**Features and benefits:**
- Optimized power-to-weight ratio
- High rotation speed
- Different shaft and flange versions

**Intended applications:**
- Machines for forestry and agricultural purposes
- Cranes and lifting equipment
- Truck-mounted concrete pumps
- Municipal trucks

### Design and order coding example

<table>
<thead>
<tr>
<th>K60N - 064 R S F N - S - F12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Additional versions</strong></td>
</tr>
<tr>
<td><strong>Seal material</strong></td>
</tr>
<tr>
<td><strong>Flange version</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Shaft version</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Rotating direction</strong></td>
</tr>
</tbody>
</table>

**Nomenclature:**
- Axial piston pump
- Constant pump

**Design:**
- Single pump

**p_{max}**
- 400 bar

**V_{g \text{max}}**
- 108 cm³/rev
### General parameters and dimensions

![Diagram of K60N - 012 pump](image)

#### Parameters

<table>
<thead>
<tr>
<th>Geom. output volume</th>
<th>Nom. pressure</th>
<th>Self-suction speed</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_g$ [cm³/rev]</td>
<td>$p_{nom}$ (p$_{max}$) [bar]</td>
<td>n [rpm]</td>
<td>L</td>
<td>L1</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------</td>
<td>-------------------</td>
<td>-----------------</td>
<td>-------</td>
</tr>
<tr>
<td>K60N - 012</td>
<td>12.6</td>
<td>400</td>
<td>3300</td>
<td>207</td>
</tr>
<tr>
<td>K60N - 017</td>
<td>17.0</td>
<td>400</td>
<td>3200</td>
<td></td>
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<tr>
<td>K60N - 025</td>
<td>25.4</td>
<td>400</td>
<td>2550</td>
<td>209</td>
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<tr>
<td>K60N - 034</td>
<td>34.2</td>
<td>400</td>
<td>2250</td>
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<tr>
<td>K60N - 040</td>
<td>41.2</td>
<td>400</td>
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<td>246</td>
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<tr>
<td>K60N - 047</td>
<td>47.1</td>
<td>400</td>
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<tr>
<td>K60N - 056</td>
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<td>400</td>
<td>2100</td>
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<tr>
<td>K60N - 064</td>
<td>63.6</td>
<td>400</td>
<td>2050</td>
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<tr>
<td>K60N - 084</td>
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<tr>
<td>K60N - 090</td>
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<tr>
<td>K60N - 108</td>
<td>108.0</td>
<td>400</td>
<td>1700</td>
<td>276</td>
</tr>
<tr>
<td>K60N - 130</td>
<td>130.0</td>
<td>350</td>
<td>1600</td>
<td></td>
</tr>
</tbody>
</table>

### Associated technical data sheets:
- Fixed displacement axial piston pump type K60N: D 7960 K
- Variable displacement axial piston pump type V30D: Page 20
- Variable displacement axial piston pump type V30E: Page 16
- Variable displacement axial piston pump type V60N: Page 26
- Variable displacement axial piston pump type V80M: Page 24
- Axial piston motor type M60N: Page 254

### Suitable prop. directional spool valves:
- Type EDL: Page 82
- Type PSL/PSV size 2, 3 and 5: Page 90
- Type PSLF/PSVF size 3, 5 and 7: Page 96

### Similar products:
- Fixed displacement axial piston pump type K60N: D 7960 K
- Variable displacement axial piston pump type V30D: Page 20
- Variable displacement axial piston pump type V30E: Page 16
- Variable displacement axial piston pump type V60N: Page 26
- Variable displacement axial piston pump type V80M: Page 24
- Axial piston motor type M60N: Page 254

### Suitable load-holding valves:
- Type LHK, LHDV, LHT: Page 198
Air-driven hydraulic power packs are pneumatically driven, reciprocally acting plunger pumps. They operate as pneumatic pressure amplifiers with oscillating movement and automatic stroke reversal control.

The air-driven hydraulic pump type LP can generate up to 1500 bar. It is available as a single pump or as a hydraulic power pack with different tank sizes and valve banks. The delivery flow is dependent on the air pressure set and the flow resistance currently present. It can decay to standstill.

Applications are in laboratory presses, in fixture design, in lubrication systems or in potentially explosive atmospheres.

Features and benefits:
- High operating pressures
- Suitable for explosion-proof systems and equipment
  - No electrical energy
- Hydraulic power packs with direct valve mounting

Intended applications:
- Construction and construction materials machinery
- Fixture design
- Testing and laboratory equipment

**Nomenclature:**
- Air driven hydraulic pumps

**Design:**
- Single pump

**$P_{\text{hydraul}}$:** 1500 bar

**$P_{\text{air}}$:** 10 bar

**$Q_{\text{max}}$:** 12 l/min

**Design and order coding example**

<table>
<thead>
<tr>
<th>LP 125 - 16</th>
<th>E /S 81</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td>Hydraulic pump</td>
</tr>
<tr>
<td></td>
<td>- Ready-to-connect version</td>
</tr>
<tr>
<td></td>
<td>- Individual version for self-installation</td>
</tr>
<tr>
<td><strong>Basic type, size</strong></td>
<td>Type LP, size 80, 125, 160</td>
</tr>
<tr>
<td><strong>Additional elements</strong></td>
<td>Suction parts for hydraulic pumps</td>
</tr>
</tbody>
</table>

**Function**
General parameters and dimensions

<table>
<thead>
<tr>
<th>Basic type and size</th>
<th>p_{max} [bar]</th>
<th>Pressure ratio</th>
<th>Geom. volume per double stroke V_{hydr} [cm³]</th>
<th>Tapped port (air) Pipe diameter for pressure connection (hydr)</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>LP80-</td>
<td>8</td>
<td>700</td>
<td>1 : 200</td>
<td>G 1/4&lt;br&gt;Æ6 mm</td>
<td>119</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>240</td>
<td>1 : 24</td>
<td>6</td>
<td>159</td>
<td>114</td>
</tr>
<tr>
<td>LP125-</td>
<td>8</td>
<td>1500</td>
<td>1 : 243</td>
<td>G 3/8&lt;br&gt;Æ8 mm, Æ10 mm</td>
<td>228</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>160</td>
<td>1 : 16</td>
<td>28.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LP160-</td>
<td>8</td>
<td>1500</td>
<td>1 : 400</td>
<td>G 1/2&lt;br&gt;Æ8 mm, Æ10 mm</td>
<td>228</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>265</td>
<td>1 : 24</td>
<td>28.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Associated technical data sheets:**
- Air-driven hydraulic pump type LP: D 7280
- Hydraulic power pack type LP: D 7280 H

**Valve banks:**
- Type VB: Page 114
- Type BWH(N): Page 120
Individual pumps

1.1 Hand pump type H, HE and HD

Hand pumps are a type of hydraulic pump. They generate a flow rate manually. The hand pump type H and HE is single-acting. It draws in oil in one direction and pumps it in the opposite direction. The hand pump type HD is double-acting. It pumps and draws in the same quantity of oil in the pressure line during the forward and backward movement of the hand lever. The hand pump type H, HE and HD is available for pipe connection and manifold mounting.

The hand pump is particularly suitable as an emergency pump or for test benches.

**Features and benefits:**
- Sturdy design
- Hand pumps with integrated tank
- Safety and drain valve

**Intended applications:**
- Shipbuilding
- Mining machinery
- Fixture design
- Testing and laboratory equipment

**Nomenclature:**
- Piston pump
- Single acting hand pump
- Double acting hand pump
- \( p_{\text{max}} \): 800 bar
- \( V_{\text{max}} \): 30 cm³/stroke

**Design and order coding example**

```
HD 13 AS - K 0,5 - 110
```

- **Pressure setting (bar)**
  - With/without tank
  - Usable volume \( V_{\text{use}} \): 0,35 l and 0,5 l

- **Additional elements**
  - Drain valve (A)
  - Pressure limiting valve (fixed or manually adjustable) (S)

- **Basic type, size**
  - Type H (single-acting, open design),
  - Type HE (single-acting, encapsulated design)
  - Type HD (double-acting, encapsulated design)

- With/without pressure resistant suction port
- Versions for manifold mounting

**Function**

Design with pressure limiting valve and drain valve
### General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>$p_{\text{max}}$ [bar]</th>
<th>$V_{\text{max}}$ [cm³/stroke]</th>
<th>Tapped ports (BSPP)</th>
<th>$m$ [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H..</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H 16</td>
<td>350</td>
<td>6</td>
<td>G 1/4</td>
<td>3.1</td>
</tr>
<tr>
<td>H 20</td>
<td>220</td>
<td>9.4</td>
<td>G 1/4</td>
<td></td>
</tr>
<tr>
<td>H 25</td>
<td>150</td>
<td>14.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HE.. and HD..</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE 3</td>
<td>800</td>
<td>3</td>
<td>G 1/4</td>
<td>4.8</td>
</tr>
<tr>
<td>HD 13</td>
<td>350</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HD 20</td>
<td>220</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HD 30</td>
<td>150</td>
<td>30</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Associated technical data sheets:**
- Manual pump type H, HD and HE: D 7147/1
1.2 Hydraulic Unit

- Compact hydraulic power pack type NPC
- Compact hydraulic power pack type HC and HCW
- Compact hydraulic power pack type KA and KAW
- Compact hydraulic power pack type MPN
- Compact hydraulic power pack type HK, HKF and HKL
- Standard hydraulic power pack type FXU
- Air-driven hydraulic power pack type LP
- Connection block type A, B and C
## Compact hydraulic power packs

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / tank volume (l)</th>
<th>( p_{\text{max}} ) (bar)</th>
<th>( V_{\text{max}} ) (cm(^3)/rev)</th>
</tr>
</thead>
</table>
| NPC          | **Radial piston pump**  
  - With integrated electric motor  
  - Direct current supply  
  - Suitable for short period operation  
  - Fill volume 1.0  
  - Usable volume 0.65  
|              | 11: 750  
  12: 750                                           | 11: 0.46  
  12: 0.46                                           |
| HC, HCW      | **Radial piston or gear pump**  
  - With integrated electric motor  
  - 3-phase or AC version  
  - Suitable for intermittent operation  
  - Vertical approx. 1.16 – 2.5  
  - Usable volume approx. 0.50 – 1.5  
|              | HP/LP:  
  1: 700/180  
  2: 700/180                                           | 1: 0.76  
  2: 1.59                                           |
| KA, KAW      | **Radial piston or gear pump**  
  - With integrated electric motor  
  - 3-phase or AC version  
  - Suitable for intermittent operation  
| KA 2         | Fill volume approx. 3.9 – 11.1  
  Vertical approx. 1.85 – 8.95  
| KA 4         | Fill volume approx. 13 – 31  
  Vertical approx. 5 – 25  
| MP, MPN      | **Radial piston pump and/or gear pump**  
  - With integrated electric motor  
  - Single-circuit or dual-circuit pump  
  - Suitable for intermittent or load/no load operation  
  - Fill volume approx. 17 – 100  
  - Usable volume approx. 10 – 75  
| MP - 1       | HP/LP:  
  MP - 1: 700/220                                           | HP/LP:  
  MP - 1: 0.95/4.76  
  MP - 2: 1.59/26                                           |
| MP - 2       | MP - 2: 700/200                                           | MP - 2: 1.59/26                                           |
| MPN - 4      | MPN - 4: 700/220                                          | MPN - 4: 9.17/60                                          |
| HK, HKF, HKL | **Radial piston pump and/or gear pump**  
  - With integrated electric motor  
  - 3-phase version  
  - Suitable for continuous and intermittent operation  
| HK 2         | Fill volume approx. 2.77  
  Usable volume approx. 0.85  
| HK 3         | Fill volume approx. 4.65 – 6.1  
  Usable volume approx. 1.45 – 2.90  
| HK 4, HKF 4  | Fill volume approx. 5.8 – 15.4  
  Usable volume approx. 1.9 – 11.1  
| HKL 3        | Fill volume approx. 3.7 – 13  
  Usable volume approx. 1.7 – 9.1  
| HK - 2       | HP/LP:  
  HK - 2: 700                                           | HP/LP:  
  HK - 2: 1.59                                           |
| HK - 3       | HK - 3: 700/180                                           | HK - 3: 4.58/4.8                                           |
| HK - 4       | HK - 4: 700/180                                           | HK - 4: 9.17/17.0                                          |
| HKF - 4      | HKF - 4: 700/180                                           | HKF - 4: 9.17/17.0                                          |
| HKL - 3      | HKL - 3: 700/180                                           | HKL - 3: 6.11/14.5                                          |
### Standard hydraulic power packs

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / tank volume (l)</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$V_{\text{max}}$ (cm³/rev)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FXU</strong></td>
<td><strong>Radial piston pump / dual-stage pump</strong></td>
<td>R: 700</td>
<td>R: 64.2</td>
</tr>
<tr>
<td></td>
<td>■ Standard hydraulic power pack</td>
<td>Z: 260</td>
<td>Z: 63</td>
</tr>
<tr>
<td></td>
<td>■ Fill volume approx. 26-650</td>
<td>RZ: 700/200</td>
<td>RZ: 64.2/89.6</td>
</tr>
<tr>
<td><strong>A, B, C</strong></td>
<td><strong>Connection blocks</strong></td>
<td>700</td>
<td>20</td>
</tr>
<tr>
<td>Connection block</td>
<td>■ For connecting to the Hydraulic Unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model A, B, C</td>
<td>■ Pumping Units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ Flange valve for Pipe connection or Valve assembly</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LP</strong></td>
<td><strong>Air-driven hydraulic pump</strong></td>
<td>80: 700</td>
<td>80: 6.00</td>
</tr>
<tr>
<td></td>
<td>■ Single pump</td>
<td>125: 700</td>
<td>125: 28.30</td>
</tr>
<tr>
<td></td>
<td>■ Hydraulic power pack</td>
<td>160: 700</td>
<td>160: 28.30</td>
</tr>
<tr>
<td></td>
<td>■ Fill volume approx. 5.8–33</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>■ Usable volume approx. 3.8–28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.2 Compact hydraulic power pack type NPC

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type NPC is suitable for hydraulic systems with operating mode S2. Type NPC includes a DC motor. The power pack is available in a horizontal or vertical version. Either single-circuit systems or dual-circuit systems can be selected. A radial piston pump or an external gear pump can be used as a hydraulic pump.

The compact hydraulic power pack type NPC is suitable for use as a highly compact control system, since the pressure-limiting valve is integrated and valve banks can be directly mounted.

Features and benefits:
- Very low space requirements and easy to transport
- Supplied with direct current at 12V DC or 24V DC
- Particularly suited to mobile applications and construction site operation
- Long lifetime and excellent reliability achieved by using radial piston pumps
- Environmentally sound thanks to low oil fill volumes and minimum cost of disposal
- Low costs for hydraulic fluid
- Co-ordinated range of valves and accessories from the modular system

Intended applications:
- Riveting
- Brakes for wind power plants
- Hydraulic jigs
- Crimping
- Embossing

Design and order coding example

<table>
<thead>
<tr>
<th>NPC 11</th>
<th>/ 0.87</th>
<th>- 1/170</th>
<th>- R</th>
<th>- G12</th>
<th>BWN 1 - NN - 35 - 1 - G12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valve assembly</td>
<td>BWN1, BWH1, VB01</td>
<td>Can be directly assembled without connection blocks according to D 7470 B/1, D 7302</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor voltage</td>
<td>12V DC or 24V DC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check valve</td>
<td>With/without check valve</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure limiting valve and setting</td>
<td>1 = Fixed, 2 = Manually adjustable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery flow [lpm]</td>
<td>1.36 lpm ($V_{g_{max}} = 0.76 \text{ cm}^3/\text{rev}$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nomenclature:
- Radial piston pump with integrated electric motor (DC)

Design:
- Oil immersed compact hydraulic power pack for short period operation

$P_{max}$: 750 bar

$Q_{max}$: 1.36 lpm ($V_{g_{max}} = 0.76 \text{ cm}^3/\text{rev}$)

Basic type, size
- Type NPC, size 11 and 12
Function

Circuit example:

NPC 11 / 0.87 - 1/170 - R - G 12
Compact hydraulic power pack type NPC
pump delivery flow approx. 0.87 lpm

BWN 1 - NN - 35 - 1 - G 12
Directly mounted valve bank type BWN with two valve sections and pressure switch in P gallery, solenoid voltage 12V DC

General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>Delivery flow</th>
<th>Max. pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q (_{pu}) [lpm]</td>
<td>p(_{max}) [bar]</td>
</tr>
<tr>
<td>NPC 11 (24 V)</td>
<td>0.2 0.31 0.44 0.61 0.87 1.05</td>
<td>750</td>
</tr>
<tr>
<td>NPC 11 (12 V)</td>
<td>0.2 0.31 0.44 0.61 0.87 1.05</td>
<td>750</td>
</tr>
<tr>
<td>NPC 12 (24 V)</td>
<td>0.4 0.65 0.94 1.28 1.71 2.14</td>
<td>750</td>
</tr>
<tr>
<td>NPC 12 (12 V)</td>
<td>0.4 0.65 0.94 1.28 1.71 2.14</td>
<td>750</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- Compact hydraulic power pack type NPC: D 7940
- Directly mountable valve banks:
  - Type VB: Page 114
  - Type BWH, BWN: Page 120
  - Pressure switches type DG: Page 262
  - Electronic pressure transducer type DT: D 5440 T/1, D 5440 T/2
Compact hydraulic power packs

1.2 Compact hydraulic power pack type HC and HCW

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type HC and HCW includes an electric drive which runs in oil. The stator is securely attached to the housing (tank). The compact hydraulic power pack is suitable for hydraulic systems with the operating modes S2 or S3. The heat is dissipated via surface convection so that no external cooler is usually necessary.

A radial piston pump or external gear pump can be used as a hydraulic pump. The compact hydraulic power pack type HC and HCW is suitable as a highly compact control system, since connection blocks and valve banks can be directly mounted.

Features and benefits:
- Long lifetime and high pressures thanks to use of radial piston pumps
- Low oil fill volumes make it environmentally sound thanks to small amount of oil to be disposed of and low costs for hydraulic fluid
- Co-ordinated range of valves and accessories from modular system
- Suitable for vertical and horizontal installation

Intended applications:
- Clamping systems on machine tools and jigs
- Rivets and clinching equipment
- Welding robots

Design and order coding example

<table>
<thead>
<tr>
<th>HC24</th>
<th>/0,6</th>
<th>- A1/400</th>
<th>- BWH1F-HH-1-1-G24</th>
<th>- 400V 50 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor voltage</td>
<td>3 ~ 400V 50 Hz, 3 ~ 460V 60 Hz 1 ~ 230V 50 Hz, 1 ~ 110V 60 Hz (3-phase motor)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional directly mounted directional valve bank</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection block</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump version</td>
<td>Single circuit pump</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radial piston pump H (3-, 5- or 6-cylinders) oder Gear pump Z</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Basic type, size
- Type HC (3-phase motor) and type HCW (single-phase-motor, power reduction of 30 ... 50% depending on size), size 1 to 2, type HCG (direct current motor), size 1
- Lying at low installation Heights (Model HC..L)
- Alternative standing version
- Usable volume Vusable 0.5 l to 1.5 l
- With/without fluid level gauge
- With DC-motor (Type HCG) for short time operation

Nomenclature:
- Radial piston or gear pump with integrated electric motor (three-phase or alternating current design)

Design:
- Oil immersed hydraulic power pack for intermittent service (S3-service)

Pmax:
- Radial piston pump 700 bar
- Gear pump 180 bar

Qmax:
- Radial piston pump 4.4 lpm ($V_g = 1.6 \text{ cm}^3/\text{rev}$)
- Gear pump approx. 3.4 lpm ($V_g = 1.3 \text{ cm}^3/\text{rev}$)

Vusable max: 8 l
**Function**

**Example circuit:**

HC 24/0.64
Pump unit type HC, size 24, pump delivery flow approx. 0.64 lpm
- A1/400
Connection block type A and pressure-limiting valve (400 bar)
- BWH1F - RH1 - 1 - 1 - G 24
Directly mounted valve bank type BWH 1
### General parameters and dimensions

#### Radial piston pump (3 cylinders)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HC 14</td>
<td>700 - 160</td>
<td>0.2 - 1.05</td>
<td>0.2 - 1.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.18</td>
<td>6.3</td>
<td>197</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>HC 12</td>
<td>600 - 120</td>
<td>0.4 - 2.15</td>
<td>0.5 - 2.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HC 24</td>
<td>700 - 185</td>
<td>0.27 - 2.27</td>
<td>0.3 - 2.7</td>
<td>150</td>
<td>0.4 - 1.6</td>
<td>0.5 - 1.9</td>
<td>0.55</td>
<td>10.1</td>
<td>243</td>
<td>148</td>
<td>148</td>
</tr>
<tr>
<td>HC 22</td>
<td>700 - 140</td>
<td>0.52 - 4.41</td>
<td>0.6 - 5.3</td>
<td>150</td>
<td>0.9 - 3.4</td>
<td>1.1 - 4</td>
<td>0.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) The actual power consumption depends on the respective operation pressure and can be up to 1.5 x $P_n$
2) Without oil filling

#### Gear pump

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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<tbody>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The dimensions in mm are as follows:
- **H**: Height
- **B**: Width
- **T**: Depth
Circuit example:

HC 24/0.64 - A2/400
- BWH 1 F 1-DH3 R/230-33-G24
- 3x400V 50Hz

1 Compact hydraulic power pack
2 Connection block
3 Adapter plate
4 Valve section
5 End plate

Associated technical data sheets:
- Compact hydraulic power pack type HC and HCW: D 7900
- Compact hydraulic power pack type HCG: D 7900 G

Connection blocks:
- Type A, B and C: Page 62

Directly mountable valve banks:
- Type BA: Page 144
- Type BVH: Page 124

Directly mountable valve banks:
- Type VB: Page 114
- Type BWH, BWN: Page 120
Compact hydraulic power packs

1.2 Compact hydraulic power pack type KA and KAW

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type KA and KAW includes an electric drive which runs in oil. The stator is securely attached to the housing (tank). The compact hydraulic power pack is suitable for hydraulic systems with the operating modes S2 or S3. The heat is dissipated via surface convection so that no external cooler is usually necessary.

For systems with high loads, an external fan that enables additional heat dissipation can be optionally mounted on the housing. The fan is powered by a separate motor independently of the pump motor. The type KA contains a 3-phase motor, the type KAW contains a single-phase-motor. The compact hydraulic power pack type KA and KAW is available in horizontal and vertical versions. Modules can be added to the tank so that different usable oil volumes are possible. Either single-circuit systems or dual-circuit systems can be selected. A radial piston pump or external gear pump can be used as a hydraulic pump. The compact hydraulic power pack type KA and KAW is suitable as a highly compact control system, since connection blocks and valve banks can be directly mounted.

Features and benefits:
- Additional separately driven fan for maximum utilisation of power
- Fill/usable volumes can be flexibly extended by modular tank extensions
- Long lifetime and excellent reliability achieved by using radial piston pumps
- Low oil fill volumes make it environmentally sound thanks to small cost of disposal and low costs for hydraulic fluid
- Co-ordinated range of valves and accessories from modular system
- Suitable for vertical and horizontal installation
- Optimum efficiency thanks to suboil motor cooling, direct transmission of force and cleverly designed heat dissipation

Intended applications:
- Brake and rotor adjustment modules on wind turbines
- Clamping systems on machine tools and appliances
- Hydraulic torque wrenches
- Rivets and clinching equipment
- Presses
- Handling systems

Nomenclature:
- Radial piston or gear pump with integrated electric motor (3-phase or 1-phase version)

Design:
- Oil immersed hydraulic power pack for intermittent or load/no load operation (S3-service)

$p_{max}$: Radial piston pump 700 bar
Gear pump 180 bar

$q_{max}$: Radial piston pump 7 lpm
($V_g = 2.29 \text{ cm}^3/\text{rev}$)
Gear pump approx. 24.1 lpm
($V_g = 7.9 \text{ cm}^3/\text{rev}$)

$V_{tank \ max}$: 30 l
## Design and order coding example

<table>
<thead>
<tr>
<th>KA28</th>
<th>22</th>
<th>L1</th>
<th>KFTP</th>
<th>/HZ0,59/8,8</th>
<th>- ...</th>
<th>- 3x400V</th>
<th>- G1/2x300</th>
</tr>
</thead>
</table>

**Oil drain hose**

**Motor voltage**
- 3 ~ 400V 50 Hz, 3 ~ 460V 60 Hz, 3 ~ 690V 50 Hz,
- 1 ~ 230V 50 Hz, 1 ~ 110V 60 Hz (1~phase motor)

### Valve design

#### Pump version

- **Single circuit pump**
- Radial piston pump H or gear pump Z

- **Dual circuit pump**
- with joint connection pedestal for pressure connections P1 and P3
- Combinations: Radial piston pump - radial piston pump (HH) and radial piston pump - gear pump (HZ)

#### Additional function

- Oil sight glass
- Level gauge with level switch
- Temperature switch
- Silica gel filter (instead of breather filter)
- Additional fans
- Various electrical connection variants

### Installation position

- Horizontal for low installation heights (type KA..L) or vertical (type KA..S)

### Tank size

- Type KA (3~phase motor) and KAW (1~phase motor, power reduction 30 ... 50% dep. on size), size 2 and 4

### Function

**Tank size**

**Basic type, size**

- Type KA (3~phase motor) and KAW (1~phase motor, power reduction 30 ... 50% dep. on size), size 2 and 4

### Circuit example:

**KA 231 LKP/H 0.59 - AX 34 D101VE1B/400 - BA 2**

- NBVP 16 G/R/AB 2.0 - M/0
- NBVP 16 Y/ABR 1.5/4 - M/0
- 1 - G 24

![Circuit diagram](image-url)
### General parameters and dimensions

#### 3-cylinder radial piston pump

<table>
<thead>
<tr>
<th>PKmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
</tr>
</thead>
<tbody>
<tr>
<td>bar</td>
<td>lpm</td>
<td>lpm</td>
<td>bar</td>
<td>lpm</td>
<td>lpm</td>
<td>lpm</td>
</tr>
<tr>
<td>KA 21</td>
<td>700 - 45</td>
<td>0,63 - 10,02</td>
<td>0,76 - 12,05</td>
<td>360 - 55</td>
<td>1,26 - 7,84</td>
<td>1,52 - 9,42</td>
</tr>
<tr>
<td>KA 22</td>
<td>700 - 140</td>
<td>0,63 - 0,02</td>
<td>0,76 - 12,05</td>
<td>700 - 180</td>
<td>1,26 - 7,84</td>
<td>1,52 - 9,42</td>
</tr>
<tr>
<td>KA 23</td>
<td>700 - 60</td>
<td>0,31 - 4,89</td>
<td>0,37 - 5,93</td>
<td>485 - 30</td>
<td>0,62 - 9,79</td>
<td>0,75 - 11,85</td>
</tr>
<tr>
<td>KA 24</td>
<td>700 - 160</td>
<td>0,31 - 4,89</td>
<td>0,37 - 5,93</td>
<td>700 - 80</td>
<td>0,62 - 9,79</td>
<td>0,75 - 11,85</td>
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<tr>
<td>KA 26</td>
<td>700 - 160</td>
<td>0,63 - 10,02</td>
<td>0,76 - 12,05</td>
<td>700 - 205</td>
<td>1,26 - 7,84</td>
<td>1,52 - 9,42</td>
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<tr>
<td>KA 28</td>
<td>700 - 185</td>
<td>0,31 - 4,89</td>
<td>0,37 - 5,93</td>
<td>700 - 90</td>
<td>0,62 - 9,79</td>
<td>0,75 - 11,85</td>
</tr>
</tbody>
</table>

#### 6-cylinder radial piston pump

<table>
<thead>
<tr>
<th>PKmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
</tr>
</thead>
<tbody>
<tr>
<td>bar</td>
<td>lpm</td>
<td>lpm</td>
<td>bar</td>
<td>lpm</td>
<td>lpm</td>
<td>lpm</td>
<td>lpm</td>
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<tr>
<td>KA 42</td>
<td>700 - 220</td>
<td>0,84 - 11,8</td>
<td>2,0 - 14,4</td>
<td>700 - 110</td>
<td>3,3 - 23,8</td>
<td>4,0 - 28,9</td>
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</tr>
<tr>
<td>KA 44</td>
<td>700 - 220</td>
<td>1,6 - 5,98</td>
<td>1,01 - 7,25</td>
<td>700 - 110</td>
<td>1,68 - 11,97</td>
<td>2,04 - 14,53</td>
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</tr>
</tbody>
</table>

#### Gear pump

<table>
<thead>
<tr>
<th>PKmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
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<td>bar</td>
<td>lpm</td>
<td>lpm</td>
<td>bar</td>
<td>lpm</td>
<td>lpm</td>
<td>lpm</td>
</tr>
<tr>
<td>KA 21</td>
<td>170 - 60</td>
<td>2,23 - 6,7</td>
<td>2,68 - 8,04</td>
<td>0,55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KA 22</td>
<td>170 - 55</td>
<td>2,23 - 22,04</td>
<td>2,68 - 26,47</td>
<td>1,1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KA 23</td>
<td>170 - 50</td>
<td>1,09 - 4,90</td>
<td>1,32 - 5,94</td>
<td>0,37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KA 24</td>
<td>170 - 65</td>
<td>1,09 - 10,74</td>
<td>1,32 - 13,04</td>
<td>0,75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KA 26</td>
<td>170 - 65</td>
<td>2,23 - 22,04</td>
<td>2,68 - 26,47</td>
<td>1,4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KA 28</td>
<td>170 - 75</td>
<td>1,09 - 10,74</td>
<td>1,32 - 13,04</td>
<td>1,2</td>
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</table>

<table>
<thead>
<tr>
<th>PKmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
<th>Qmax</th>
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</thead>
<tbody>
<tr>
<td>bar</td>
<td>lpm</td>
<td>lpm</td>
<td>bar</td>
<td>lpm</td>
<td>lpm</td>
<td>bar</td>
<td>lpm</td>
</tr>
<tr>
<td>KA 42</td>
<td>200 - 130</td>
<td>1,6 - 18,0</td>
<td>2,0 - 22,0</td>
<td>- 2,6</td>
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<td></td>
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</tr>
<tr>
<td>KA 44</td>
<td>200 - 130</td>
<td>0,84 - 9,1</td>
<td>1,01 - 11,1</td>
<td>- 1,5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

© HAWE Hydraulik SE
Circuit example:

KA 281 S16K/H3.61-FSHE-24VDC
-A 14/230
-BVH 11 W/CZ52/117GM/B3.5H
-82 - AC1002/130/3A
-XM 24
3x400V 50Hz

Associated technical data sheets:
- Compact hydraulic power packs type KA: D 8010, D 8010-4

Similar products:
- Type HC, HCG: Page 42

Suitable connection blocks:
- Type A, B and C: Page 62

Directly mountable valve banks:
- Type VB: Page 114
- Type BWH, BWN: Page 120
- Type SWR, SWS: Page 76
- Type BA: Page 144
- Type BVH: Page 124
Compact hydraulic power packs

1.2 Compact hydraulic power pack type MPN

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type MPN and MPNW includes an electric drive which runs in oil. The stator is securely attached to the housing (tank). The compact hydraulic power pack is suitable for hydraulic systems with the operating modes S2 or S3. The heat is dissipated via surface convection so that no external cooler is usually necessary.

The type MPN contains a 3-phase motor, the type MPNW contains a single-phase-motor. Different tank sizes enable different usable oil quantities. Either single-circuit systems or dual-circuit systems can be selected. A radial piston pump, an external gear pump or internal gear pump can be used as a hydraulic pump.

The compact hydraulic power pack type MPN and MPNW is suitable as a highly compact control system, since connection blocks and valve banks can be directly mounted.

Features and benefits:
- Intermittent or load/no load operation (S2-/S3-/S6-service)
- Long lifetime and excellent reliability achieved by using radial piston pumps
- Low oil fill volumes make it environmentally sound thanks to small cost of disposal and low costs for hydraulic fluid
- Two-stage valves and switch units for press control systems can be directly flange mounted
- Co-ordinated range of valves and accessories from modular system
- Dual-circuit pumps available

Intended applications:
- Brake and rotor adjustment modules on wind turbines
- Counterbalance as well as machine tools
- Presses and other shaping machines
- Handling and clamping systems on machine tools and fixtures
- Lubrication systems

Nomenclature:
- Radial piston and/or gear pump with integrated motor single or dual-circuit pump

Design:
- Oil immersed hydraulic power pack for intermittent or load/no load operation (S2-/S3-/S6-service)

$P_{\text{max}}$:
- Radial piston pump 700 bar (high pressure), gear pump 220 bar (low pressure)

$Q_{\text{max}}$:
- 12.4 lpm (high pressure) ($V_g = 9.17 \text{ cm}^3/\text{rev}$)
- 83 lpm (low pressure) ($V_g = 61 \text{ cm}^3/\text{rev}$)

$V_{\text{max}}$:
- 100 l
### Design and order coding example

<table>
<thead>
<tr>
<th>MPN 44</th>
<th>- H 1,5</th>
<th>- B10.20</th>
<th>D</th>
<th>- ...</th>
<th>- 3 ~ 230V 50 Hz</th>
</tr>
</thead>
</table>

**Motor voltage**
- 3 ~ 230/400V Δy 50 Hz, 3 ~ 500V γ 50 Hz
- 1 ~ 230V 50 Hz, 1 ~ 110V 60 Hz (single-phase-motor)

**Valve mounting**

**Additional options**
- Level gauge
- Level switch
- Temperature switch
- Various means of electrical connection

**Design**
- For installation in self-made oil tanks: as single pump or cover plate version
- With tank, usable volume $V_{usable}$ 10 l to 75 l

**Pump version**

- **Single-circuit pump**
  - Radial piston pump H or gear pump Z
  - Internal gear pump IZ

- **Dual-circuit pump**
  - Combinations:
    - Radial piston pump - radial piston pump (HH)
    - Radial piston pump - gear pump (HZ)

**Basic type, size**
- Type MPN (3-phase motor) and MPNW (single-phase motor)
- Depending on the size, single-phase motor has 30 to 50% less power

### Function

**Single stage pump**
(radial piston pump, gear pump)

![Single stage pump](image)

**Dual stage pump**
(radial piston/gear pump, gear pump/gear pump)

![Dual stage pump](image)

**Installation**
- **Hydraulic power pack** (incl. tank)

### Circuit example:

![Circuit example](image)
General parameters and dimensions

Single-circuit pump, dual-circuit pump
(without tank)

Compact hydraulic power pack
(tank with mounted valves)

<table>
<thead>
<tr>
<th>Max. pressure</th>
<th>Delivery flow</th>
<th>Max. pressure</th>
<th>Delivery flow</th>
<th>Dimensions [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_{max}$ [bar]</td>
<td>$Q_{pu}$ [lpm]</td>
<td>$Q_{pu}$ [lpm]</td>
<td>$p_{max}$ [bar]</td>
<td>$Q_{pu}$ [lpm]</td>
</tr>
<tr>
<td>700 - 250</td>
<td>2,39 - 7,33</td>
<td>2,87 - 8,8</td>
<td>200 - 60</td>
<td>8,46 - 30,02</td>
</tr>
<tr>
<td>700 - 250</td>
<td>1,53 - 5,37</td>
<td>1,84 - 6,44</td>
<td>200 - 55</td>
<td>5,37 - 25,99</td>
</tr>
<tr>
<td>700 - 250</td>
<td>3,16 - 11,12</td>
<td>3,8 - 13,34</td>
<td>200 - 40</td>
<td>12,41 - 71,73</td>
</tr>
<tr>
<td>700 - 330</td>
<td>2,36 - 4,06</td>
<td>2,83 - 4,87</td>
<td>220 - 60</td>
<td>4,16 - 34,91</td>
</tr>
<tr>
<td>700 - 340</td>
<td>3,1 - 3,49</td>
<td>3,7 - 4,19</td>
<td>220 - 45</td>
<td>2,7 - 68,16</td>
</tr>
</tbody>
</table>

1) The actual power consumption is dependent on the respective operation pressure and can be up to 1.5x$P_N$
2) Values apply to radial piston pump/gear pump versions

Version with tank:

<table>
<thead>
<tr>
<th>Size</th>
<th>Tank size</th>
<th>H [mm]</th>
<th>W [mm]</th>
<th>D [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPN 4</td>
<td>B 25</td>
<td>458</td>
<td>402</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>B 55</td>
<td>470</td>
<td>560</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>B 110</td>
<td>495</td>
<td>560</td>
<td>350</td>
</tr>
<tr>
<td></td>
<td>B 25 L</td>
<td>283</td>
<td>623</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>B 55 L</td>
<td>305</td>
<td>560</td>
<td>350</td>
</tr>
</tbody>
</table>
Circuit example:

MPN 44-Z 8.8-B 10 KT
-AS 1 F 3/160
-BA 2
-NBVP 16 G/R-GM/NZP 16 LZY 5/50-G 8 MA/GM/3-X 84 V-DG 5E-250-1/4
-NBVP 16 G-GM/NZP 16 LZY 5/50-G 8 MA/GM/3-X 84 V-DG 62
-1-G 24
-X 84 V-9/250
-3 x 400/230 V 50 Hz

Associated technical data sheets:
- Compact hydraulic power pack type MPN and MPNW: D 7207

Connection blocks:
- Type A, B and C: Page 62

Flange-mountable valve banks:
- Type VB: Page 114
- Type BWH, BWN: Page 120
- Type BA: Page 144
- Type BVH: Page 124
Compact hydraulic power packs

Compact hydraulic power packs are a type of hydraulic power pack. They are characterised by a highly compact design, since the motor shaft of the electric motor also acts as the pump shaft.

The ready-for-connection compact hydraulic power pack type HK, HKF, HKL and HKLW includes an electric drive which runs in oil. The stator is securely attached to the housing (tank). The compact hydraulic power pack is suitable for hydraulic systems with the operating modes S2, S3 or S6.

A fan, which effectively dissipates the heat from the hydraulic system, is mounted on the housing. In the case of type HKF, the fan is powered by a separate motor independently of the pump motor. In the case of type HK, the fan is securely attached to the motor shaft. An external cooler is not generally required. The type HK, HKF and HKL contains a 3-phase motor, the type HKLW contains a single-phase-motor. The compact hydraulic power pack type HK and HKF has a vertical housing, while type HKL and HKLW has a horizontal housing. Single-circuit, dual-circuit or triple-circuit systems can be selected. A radial piston pump, an external gear pump or internal gear pump can be used as a hydraulic pump.

The compact hydraulic power pack type HK, HKF, HKL and HKLW is suitable as a highly compact control system, since connection blocks and valve banks can be directly mounted.

**Features and benefits:**
- Suitable for continuous operation with intermittent load S6 and continuous operation S1
- Additional external fan for optimum use of power
- Wide range of applications, with three sizes available
- Long lifetime and excellent reliability thanks to use of radial piston pumps
- Environmentally friendly thanks to low oil filling volume; low cost of disposal and low hydraulic fluid costs
- Tailored range of valves and accessories from modular system
- One-circuit to three-circuit pumps available

**Intended applications:**
- Clamping systems on machine tools and turning centres
- Handling and clamping systems on machine tools and fixtures
- Welding machines, robots
- Endurance test bench construction
- Hydraulic torque wrenches

**Nomenclature:**
- Radial piston pump and/or gear pump with integrated motor (version for 3-phase mains)

**Design:**
- Oil immersed compact hydraulic power pack for permanent and intermittent operation (S1/S6 service)

**p<sub>max</sub>**
- Radial piston pump 700 bar (high pressure)
- Gear pump 180 bar (low pressure)

**Q<sub>max</sub>**
- Radial piston pump (high pressure): 13.0 lpm (V<sub>g</sub> = 9.17 cm<sup>3</sup>/rev)
- Gear pump (low pressure): 24 lpm (V<sub>g</sub> = 17.0 cm<sup>3</sup>/rev)

**V<sub>usable max</sub>**
- 11.1 l
Design and order coding example

<table>
<thead>
<tr>
<th>HK 34</th>
<th>8</th>
<th>LST</th>
<th>- H 3,6</th>
<th>3 x 400V 50Hz</th>
</tr>
</thead>
</table>

- **Motor voltage**: 3 ~ 230/400V Δy 50 Hz, 3 ~ 265/460V Δy 60 Hz
  - 1 ~ 230V 50 Hz, 1 ~ 115V 60 Hz (1-phase motor)

- **Pump version**
  - Single circuit pump
    - Radial piston pump H, gear pump Z, internal gear pump IZ
  - Dual circuit pump with joint connection pedestal for pressure ports P1 and P3
    - Combinations:
      - Radial piston pump - radial piston pump (HH)
      - Radial piston pump - gear pump (HZ)
  - Dual circuit pump with separate connection pedestals
    - Radial piston pump H or gear pump Z

- **Additional functions**
  - Temperature and level switch, single or double version
  - Additional leakage port (Type HK 4.L)

- **Tank size**
  - Type HK: Usable volume V_{usable} 0.85 l to15.4 l
  - Type HKL: Usable volume V_{usable} 1.7 l to 9.1 l
  - Various filler neck designs

- **Basic type, size**
  - Type HK, size 2 to 4, type HKF (with auxiliary blower for increased cooling), size 4
  - Type HKL (3-phase motor) and HKLW (1-phase motor), size 3

- **Additional versions**
  - With molded motor
  - With frequency-controlled drive

**Function**

- **Single stage pump**
  - (radial piston pump, or gear pump)

- **Dual stage pump**
  - (radial piston/radial piston pump, or gear pump/gear pump, or radial piston pump/gear pump)

  ![Joint pump pedestal](image1)
  ![Separate pump pedestals](image2)

- **Triple-circuit pump**
  - (only radial piston pump)

  ![Separate pump pedestals](image3)
General parameters and dimensions

Radial piston pump

<table>
<thead>
<tr>
<th>Model</th>
<th>Max. pressure</th>
<th>Delivery flow</th>
<th>Gear pump</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$p_{\text{max}}$ [bar]</td>
<td>$Q_{\text{pu}}$ [lpm] 50 Hz</td>
<td>$Q_{\text{pu}}$ [lpm] 60 Hz</td>
</tr>
<tr>
<td>HK 24</td>
<td>700 - 220</td>
<td>0.46 - 1.77</td>
<td>0.55 - 2.12</td>
</tr>
<tr>
<td>HK 33</td>
<td>560 - 100</td>
<td>1.25 - 6.5</td>
<td>1.5 - 7.8</td>
</tr>
<tr>
<td>HK 34</td>
<td>700 - 170</td>
<td>1.25 - 6.5</td>
<td>1.5 - 7.8</td>
</tr>
<tr>
<td>HK(F) 43</td>
<td>610 - 90</td>
<td>2.08 - 13.1</td>
<td>3.36 - 15.72</td>
</tr>
<tr>
<td>HK(F) 44</td>
<td>700 - 130</td>
<td>2.08 - 13.1</td>
<td>2.5 - 15.72</td>
</tr>
<tr>
<td>HK(F) 48</td>
<td>700 - 170</td>
<td>2.08 - 13.1</td>
<td>2.5 - 15.72</td>
</tr>
<tr>
<td>HK(W) 32</td>
<td>700 - 220</td>
<td>1.65 - 8.7</td>
<td>1.98 - 10.44</td>
</tr>
<tr>
<td>HK(W) 34</td>
<td>700 - 220</td>
<td>1.65 - 8.7</td>
<td>1.98 - 10.44</td>
</tr>
</tbody>
</table>

1) The actual power consumption is dependent on the respective operation pressure and can be up to 1.5 x $P_{\text{N}}$.
Circuit examples:

HKF 489 D-DT/1P1M-H2.6
-AS1/260
-BWN1F-HH5R-1-G24
-3x400/230V50Hz
Compact hydraulic power pack HKF 489 with level switch with two switch points (coding D-D); temperature switch (coding T) with Harting plug coding P1 and oil filler (coding M)

HK449/1P1-H 2.5-Z6.9
-AS1/400-G24
-AS1/110-G24
-3x400/230V50Hz
Compact hydraulic power pack HK 44 with radial piston pump H 2.5 and gear pump Z 6.9 on separate pump pedestals, two connection blocks (type AS1/..) with pressure limiting valve (400 bar and 110 bar) and idle circulation valve (mounting of valve banks possible)

Associated technical data sheets:
- Compact hydraulic power pack type HK 4: D 7600-4
- Compact hydraulic power pack type HK 3: D 7600-3
- Compact hydraulic power pack type HK 2: D 7600-2
- Compact hydraulic power pack type HKL and HKLW: D 7600-3L

Connection blocks:
- Type A, B and C: Page 62

Directly mountable valve banks:
- Type VB: Page 114
- Type BWH, BWN: Page 120
- Type BA: Page 144
- Type BVH: Page 124
1.2 Standard hydraulic power pack type FXU

Standard hydraulic power packs are a type of hydraulic power pack. They are characterised by their very flexible design and customer-specific modular adjustment options.

Units of the FXU (Flexunit) range are used to create pressure for stationary oil-hydraulic installations.

The units have oil containers made either of aluminium or of steel. The pump is located in the tank. Single pumps or combinations of pumps are possible.

Both radial piston pumps and external gear pumps are used as well as combinations of external gear pumps with radial piston pumps.

The pumps are installed below the tank cover in an aluminium container or in a steel container.

**Features and benefits:**
- Hydraulic power pack for continuous operation (S1 operation)
- Long lifetime and excellent reliability when using radial piston pumps
- Low noise production when using gear pumps
- Combinations of radial piston pumps and gear pumps available for dual-stage systems
- Quick to configure due to tailored modular system
- Customer-specific documentation with EPlan Fluid schematic, step model and adjusted data sheet
- Possible to directly mount all HAWE valve banks

**Intended applications:**
- Machine tools with a continuous flow rate requirement
- Recycling systems
- Plastics machinery
- Unloading stations in material handling
- Pressing applications such as vulcanising and briquetting
- Incremental launching systems for bridge building

**Nomenclature:**
- Standard hydraulic power pack (S1 operation)
- Single-circuit pump, dual-circuit pump
- With radial piston pump and/or gear pump in the tank

**Version:**
- Radial piston pump and/or gear pump

**P**<sub>max</sub>: HP/LP: 700/280 bar

**Q**<sub>max</sub>: HP/LP: 91/80 lpm

Radial piston pump: \( V_g = 64.2 \text{ cm}^3/\text{rev} \)

Gear pump: \( V_g = 63 \text{ cm}^3/\text{rev} \)

**V**<sub>max</sub>: 565 l

**Design and order coding example**

<table>
<thead>
<tr>
<th>FXU - Z9</th>
<th>BL 44 - F020/0A - NT1/A - UA - V4,0-3 x 400/230 V 50 Hz - A3/185</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Connection block</td>
</tr>
<tr>
<td></td>
<td>Pedestrial</td>
</tr>
<tr>
<td></td>
<td>Monitoring</td>
</tr>
<tr>
<td></td>
<td>Filter</td>
</tr>
<tr>
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<td>Filter</td>
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<tr>
<td></td>
<td>Tank Nominal size</td>
</tr>
<tr>
<td></td>
<td>Tank Nominal size</td>
</tr>
<tr>
<td></td>
<td>Pump Radial piston pump (R...) or gear pump (Z...)</td>
</tr>
</tbody>
</table>

**Basic type**
Function

Associated technical data sheets:
- Standard hydraulic power pack type FXU: D 6020
- Radial piston pump type R and RG: D 6010
- Dual-stage pump type RZ: D 6910

Suitable connection blocks:
- Connection blocks type A for hydraulic power packs: D 6905 A/1
- Connection blocks type B for hydraulic power packs: D 6905 B
- Connection block type C 5 and C 6: D 6905 C

Flange-mountable valve banks
- Valve bank (nominal size 6) type BA: D 7788
- Valve bank type BNG: D 7788 BNG
- Valve bank (directional seated valve) type BVH: D 7788 BV
- Valve bank (directional seated valve) type VB: D 7302
- Valve bank (directional seated valve) type BWN and BWH: D 7470 B/1

General parameters and dimensions

<table>
<thead>
<tr>
<th>Tank size</th>
<th>H [mm]</th>
<th>L [mm]</th>
<th>B [mm]</th>
<th>b [mm]</th>
<th>c [mm]</th>
<th>H1 [mm]</th>
<th>V_{\text{max}, \text{tank}} [l]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL 30</td>
<td>291</td>
<td>490</td>
<td>350</td>
<td>326</td>
<td>176</td>
<td>445</td>
<td>26</td>
</tr>
<tr>
<td>BL 44</td>
<td>324</td>
<td>515</td>
<td>425</td>
<td>341</td>
<td>241</td>
<td>614.5</td>
<td>40</td>
</tr>
<tr>
<td>BL 70</td>
<td>374</td>
<td>605</td>
<td>475</td>
<td>422.5</td>
<td>282.5</td>
<td>659.5</td>
<td>63</td>
</tr>
<tr>
<td>BS 100</td>
<td>693</td>
<td>670</td>
<td>528</td>
<td>--</td>
<td>--</td>
<td>667</td>
<td>90</td>
</tr>
<tr>
<td>BS 160</td>
<td>693</td>
<td>910</td>
<td>528</td>
<td>--</td>
<td>--</td>
<td>759.5</td>
<td>145</td>
</tr>
<tr>
<td>BS 250</td>
<td>693</td>
<td>1310</td>
<td>528</td>
<td>--</td>
<td>--</td>
<td>759.5</td>
<td>225</td>
</tr>
<tr>
<td>BS 400</td>
<td>765</td>
<td>1270</td>
<td>904</td>
<td>--</td>
<td>--</td>
<td>783</td>
<td>360</td>
</tr>
</tbody>
</table>
1.2 Air-driven hydraulic power pack type LP

Air-driven hydraulic power packs are pneumatically driven, reciprocally acting plunger pumps. They operate as pneumatic pressure amplifiers with oscillating movement and automatic stroke reversal control.

The air-driven hydraulic power pack type LP can generate up to 1500 bar. It is available as a single pump or as a hydraulic power pack with different tank sizes and valve banks. The delivery flow is dependent on the air pressure set and the hydraulic counter pressure currently present. It can drop away to standstill.

Applications are in laboratory presses, in fixture design, in lubrication systems or in potentially explosive atmospheres.

**Features and benefits:**
- High operating pressures
- Suitable for explosion-proof systems and equipment
- No electrical energy
- Hydraulic power packs with direct valve mounting

**Intended applications:**
- Construction and construction materials machinery
- Fixture design
- Testing and laboratory equipment

**Nomenclature:**
- Air-driven hydraulic power pack

**Design:**
- Hydraulic power pack

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_{\text{hydraul}}$</td>
<td>1500 bar</td>
</tr>
<tr>
<td>$p_{\text{air}}$</td>
<td>10 bar</td>
</tr>
<tr>
<td>$Q_{\text{max}}$</td>
<td>12 l/min</td>
</tr>
</tbody>
</table>

**Design and order coding example**

```
LP 125 - 16 /B4 VB 11 LP - HHH - 1
```

- **Valve mounting**
  - Valve bank type VB
  - Valve bank type BWN and BWH

- **Design**
  - **Hydraulic power pack**
    - Tank version, usable volume $V_{\text{usable}}$ 5 l to 28 l
    - Cover plate version (for installation in self-manufactured oil tanks)

- **Basic type, size**
  - Type LP, size 80, 125, 160

**Function**

![Diagram of the hydraulic power pack](image)
General parameters and dimensions

**Basic type and size**

<table>
<thead>
<tr>
<th>Type</th>
<th>B</th>
<th>H</th>
<th>T</th>
<th>h</th>
<th>V&lt;sub&gt;max&lt;/sub&gt; tank (l)</th>
<th>m (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP 80-...B4</td>
<td>200</td>
<td>242,5</td>
<td>200</td>
<td>94</td>
<td>7</td>
<td>5,7</td>
</tr>
<tr>
<td>LP 125-...B4</td>
<td>200</td>
<td>242,5</td>
<td>200</td>
<td>110</td>
<td>5,8</td>
<td>5,7</td>
</tr>
<tr>
<td>LP 125-...B10</td>
<td>324</td>
<td>332,5</td>
<td>200</td>
<td>132</td>
<td>16,6</td>
<td>8,5</td>
</tr>
<tr>
<td>LP 125-...B25</td>
<td>402</td>
<td>410</td>
<td>250</td>
<td>130</td>
<td>34</td>
<td>15,1</td>
</tr>
<tr>
<td>LP 160-...B10</td>
<td>324</td>
<td>332,5</td>
<td>200</td>
<td>132</td>
<td>13,5</td>
<td>8,5</td>
</tr>
<tr>
<td>LP 160-...B25</td>
<td>402</td>
<td>410</td>
<td>250</td>
<td>130</td>
<td>33</td>
<td>15,1</td>
</tr>
</tbody>
</table>

**Circuit example:**

LP 125-10/B 10 D  
-VB 11 LM-NRN-1-G 24

Hydraulic power pack in tank version with air-driven hydraulic pump type LP125-10, tank size B10 as well as level switch D (N/C contact) and valve bank type VB11 attached.

Associated technical data sheets:
- Air-driven hydraulic pump type LP: D 7280
- Hydraulic power pack type LP: D 7280 H

Valve banks:
- Type VB: Page 114
- Type BWH(N): Page 120
Mounted valves

1.2 Connection block type A, B and C

A connection block represents the connecting link between the hydraulic power pack and the hydraulic control. The connection blocks described here are suitable for combining with compact hydraulic power packs.

A valve bank can be directly attached to the connection block type A such that a compact hydraulic control unit is produced. As standard the type A contains a pressure-limiting valve that can be supplemented with a pressure or return line filter, or an idle circulation valve, among other items. The connection block type B controls single-acting cylinders, e.g. in pallet lifting equipment. The integrated pressure-limiting valve limits the maximum lifting force. The lowering speed is adjusted using the integrated throttle. The connection block type C has only a pump and return port and is used in hydraulic systems with decentral valve blocks.

The connection blocks type A, B and C can be combined, e.g. with the compact hydraulic power packs type KA, HK and MPN.

Features and benefits:
- Enables compact and sturdy direct mounting of ongoing components at the compact power packs of HAWE Hydraulik
- Intermediate plates enable versatile addition of other components
- Efficient and space saving solution for mounting individual valves or valve banks to single and dual circuit pumps
- Pressure/return line filters, pressure-limiting valves, pressure switches, etc. can be directly integrated

Intended applications:
- Lifting devices
- Machine tools
- Modules for braking or rotor blade adjustment at wind power systems
- Tracking systems for solar panels and parabolic antennas

Design and order coding example

AS3F2 /420 - G24

Solenoid voltage 12V DC, 24V DC, 230V AC
Pressure setting (bar)
Basic type Type A, B, C see table

Function
Options, type A, B, C

**Type A** with pressure-limiting valve (fixed or manually adjustable, also with unit approval as safety valve for safeguarding hydraulic accumulators)
- For direct pipe connection
- To attach valve banks

**Options:**
- Check valve in P gallery
- Prop. pressure-limiting valve
- Return line filter, Pressure filter
- Idle circulation valve (solenoid-actuated)
- Shut-off valve, accumulator charging valve

**Type B** with pressure-limiting valve to actuate single- and double-acting cylinders
- For direct pipe connection

**Options:**
- Check valve in P gallery
- Throttle for regulating the drain speed
- Idle circulation valve open or closed in neutral position
- Pressure switch in P gallery
- Pressure dispersal for independent return stroke (type B to DW)

**Type C** without additional elements
- For direct pipe connection

**Options:**
- For pipe connection (pump side) of all type A, B connection blocks
  (Type C15, C16 - connection block with hole pattern of the pump, type C36)

**Additional versions**
- Connection blocks for dual-stage pumps
- Intermediate blocks for dual-stage pumps type S, V, C30
- Spacer plates for single and dual-circuit pumps type U.
- Additional intermediate block for second pressure stage type V, S

---

**General parameters and dimensions**

<table>
<thead>
<tr>
<th>Type</th>
<th>Options</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS..</td>
<td>For direct pipe connection</td>
<td>HK 44/1 - H 2.08 - ASX 3 F2 B/400 - G 24</td>
</tr>
<tr>
<td>B..</td>
<td>For direct pipe connection</td>
<td>HC 14/1.95 - B 31/180 - EM 11V - 13/3 - G 24</td>
</tr>
</tbody>
</table>

---

**Associated technical data sheets:**
- Connection blocks type A for hydraulic power packs: D 6905 A/1
- Connection block type AX, with unit approval: D 6905 TUV
- Connection blocks type B for hydraulic power packs: D 6905 B
- Connection block type C 5 and C 6: D 6905 C

**Suitable compact hydraulic power packs:**
- See "Compact hydraulic power packs" section

**Products with shared connection pattern:**
- Two-stage valves type NE 21: Page 192
- Switch units type CR: Page 152

**Suited valve banks for combination:**
- Type VB: Page 114
- Type BWH, BWN: Page 120
- Type BA: Page 144
- Type BVH: Page 124
## Directional spool valves

<table>
<thead>
<tr>
<th>Directional spool valve type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG and SP</td>
<td>68</td>
</tr>
<tr>
<td>SW, SWP and NSWP</td>
<td>72</td>
</tr>
<tr>
<td>SWR and SWS</td>
<td>76</td>
</tr>
<tr>
<td>HSF</td>
<td>80</td>
</tr>
<tr>
<td>EDL</td>
<td>82</td>
</tr>
<tr>
<td>DL</td>
<td>86</td>
</tr>
<tr>
<td>PSL and PSV</td>
<td>90</td>
</tr>
<tr>
<td>PSLF, PSLV and SLF</td>
<td>96</td>
</tr>
<tr>
<td>NSMD</td>
<td>100</td>
</tr>
</tbody>
</table>
### On/off directional spool valve

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / actuation</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$q_{\text{max}}$ (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SG, SP</td>
<td>Directional spool valve, single valve</td>
<td>SG - 0: 400</td>
<td>SG - 0: 12</td>
</tr>
<tr>
<td></td>
<td>• Single valve for pipe connection</td>
<td>SG - 1: 400</td>
<td>SG - 1: 20</td>
</tr>
<tr>
<td></td>
<td>• Individual valve for manifold mounting</td>
<td>SG - 2: 400</td>
<td>SG - 2: 30</td>
</tr>
<tr>
<td></td>
<td>- Solenoid</td>
<td>SG - 3: 400</td>
<td>SG - 3: 50</td>
</tr>
<tr>
<td></td>
<td>- Manual</td>
<td>SG - 5: 400</td>
<td>SG - 5: 100</td>
</tr>
<tr>
<td></td>
<td>- Mechanical</td>
<td>SP - 1: 400</td>
<td>SP - 1: 12</td>
</tr>
<tr>
<td></td>
<td>- Pressure-actuated</td>
<td>SP - 3: 400</td>
<td>SP - 3: 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SP - 5: 400</td>
<td>SP - 5: 100</td>
</tr>
<tr>
<td>SW, SWP, NSWP</td>
<td>Directional spool valve, single valve</td>
<td>SW - 1: 315</td>
<td>SW - 1: 12</td>
</tr>
<tr>
<td></td>
<td>• For pipe connection</td>
<td>SW - 2: 315</td>
<td>SW - 2: 25</td>
</tr>
<tr>
<td></td>
<td>• Individual valve for manifold mounting</td>
<td>SWP - 1: 315</td>
<td>SWP - 1: 12</td>
</tr>
<tr>
<td></td>
<td>Directional spool valve, valve bank</td>
<td>SWP - 2: 315</td>
<td>SWP - 2: 25</td>
</tr>
<tr>
<td></td>
<td>• With manifold mounting</td>
<td>NSWP - 2: 315</td>
<td>NSWP - 2: 25</td>
</tr>
<tr>
<td></td>
<td>• Combination with pump units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Solenoid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SWR, SWS</td>
<td>Directional spool valve, valve bank</td>
<td>SWR - 1: 315</td>
<td>SWR - 1: 12</td>
</tr>
<tr>
<td></td>
<td>• With series connection</td>
<td>SWS - 2: 315</td>
<td>SWS - 2: 25</td>
</tr>
<tr>
<td></td>
<td>• Combination with pump units</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Solenoid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSF</td>
<td>Directional spool valve, single valve</td>
<td>3: 400</td>
<td>3: 80</td>
</tr>
<tr>
<td></td>
<td>• Individual valve for manifold mounting</td>
<td>4: 400</td>
<td>4: 160</td>
</tr>
<tr>
<td></td>
<td>- Electro-hydraulic</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Hydraulic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Proportional directional spool valve

<table>
<thead>
<tr>
<th>Type</th>
<th>Version / actuation</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$q_{\text{max}}$ (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EDL</strong></td>
<td>Prop. directional spool valve (load sensing) valve bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- With series connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Solenoid</td>
<td>2: 320</td>
<td>2: 50</td>
</tr>
<tr>
<td><strong>PSL, PSV</strong></td>
<td>Prop. directional spool valve (load sensing) valve bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- With series connection</td>
<td>2: 420</td>
<td>2: 60</td>
</tr>
<tr>
<td></td>
<td>- Manual</td>
<td>3: 420</td>
<td>3: 120</td>
</tr>
<tr>
<td></td>
<td>- Electro-hydraulic</td>
<td>5: 400</td>
<td>5: 270</td>
</tr>
<tr>
<td><strong>PSLF, PSVF, SLF</strong></td>
<td>Proportional directional spool valve (load sensing) single valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Individual valve for manifold mounting</td>
<td>3: 420</td>
<td>3: 120</td>
</tr>
<tr>
<td></td>
<td>- Valve bank</td>
<td>5: 400</td>
<td>5: 270</td>
</tr>
<tr>
<td></td>
<td>- With manifold mounting</td>
<td>7: 420</td>
<td>7: 500</td>
</tr>
</tbody>
</table>
### Valve combinations

<table>
<thead>
<tr>
<th>Type</th>
<th>Version / actuation</th>
<th>( p_{\text{max}} ) (bar)</th>
<th>( q_{\text{max}} ) (lpm)</th>
</tr>
</thead>
</table>
| NSMD | Combination of directional spool valve and pressure-reducing valve  
As single valve  
- Individual valve for manifold mounting  
As valve bank  
- Valve banks are available with type BA  
- electro-magnetic | 2: 120 | 2: 80 |
2.1 Directional spool valve type SG and SP

Directional spool valves are a type of directional valve. They control the direction of movement and the velocity of single and double-acting hydraulic consumers. The directional spool valve type SG is available as a single valve for pipe connection. Type SP is available as a valve for manifold mounting. Due to the robust design the directional spool valve type SG and SP reaches operating pressures up to 400 bar. It is of versatile use due to different types of actuation.

Intended applications include mobile hydraulics, in particular in special vehicles, in municipal trucks and in shipbuilding.

Features and benefits:
- Sturdy design
- Suited for maritime applications
- Various actuation variants

Intended applications:
- Mining machinery
- Cranes and lifting equipment
- Ship building
- Road vehicle

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>Directional spool valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Single valve for pipe connection</td>
</tr>
<tr>
<td></td>
<td>Individual valve for manifold mounting</td>
</tr>
<tr>
<td>Actuation:</td>
<td>Solenoid</td>
</tr>
<tr>
<td></td>
<td>Manual</td>
</tr>
<tr>
<td></td>
<td>With automatic spring return</td>
</tr>
<tr>
<td></td>
<td>With detent</td>
</tr>
<tr>
<td></td>
<td>Mechanical</td>
</tr>
<tr>
<td></td>
<td>Roller head</td>
</tr>
<tr>
<td></td>
<td>Pin head</td>
</tr>
<tr>
<td></td>
<td>Pressure-actuated</td>
</tr>
<tr>
<td></td>
<td>(Individual and combined with manual operation)</td>
</tr>
<tr>
<td></td>
<td>Hydraulic</td>
</tr>
<tr>
<td></td>
<td>Pneumatic</td>
</tr>
<tr>
<td>$p_{max}$:</td>
<td>400 bar</td>
</tr>
<tr>
<td>$Q_{max}$:</td>
<td>100 l/min</td>
</tr>
</tbody>
</table>
Design and order coding example

SP 1 D E 3E - A - MD 3/24 - 120

Pressure setting pressure limiting valve [bar]

Actuation mode

Pressure limiting valve

Function

- Parallel- or series connection
- Directional spool valves either with positive (blocked between switching positions) or negative (slightly floating position) overlap
- SP 1 with/without check valve insert

Basic type and size

- Directional spool valve SG 0 to 5, SP 1, SP 3, SP 5
- Directional spool valves type SP for manifold mounting, sizes 1, 3, 5

Function

Basic symbol

<table>
<thead>
<tr>
<th>SG</th>
<th>SP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual valve for pipe connection</td>
<td>Individual valve for manifold mounting</td>
</tr>
</tbody>
</table>

With pressure-limiting valve

Circuit symbol

- Circuit symbol Z, U, X: only for size 2, 3 and 5
### Actuations:

<table>
<thead>
<tr>
<th>Manual</th>
<th>Solenoid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, AK</td>
<td>C, CK</td>
</tr>
<tr>
<td></td>
<td>ME, MD</td>
</tr>
<tr>
<td></td>
<td>MU</td>
</tr>
</tbody>
</table>

- **Return spring**
- **Detent**

Solenoid voltage:
- 12V DC, 24V DC, 110V AC, 230V AC

### Actuations:

<table>
<thead>
<tr>
<th>Mechanical</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE, RD</td>
<td>BE, BD</td>
</tr>
<tr>
<td>NE, ND</td>
<td>NU</td>
</tr>
<tr>
<td>NM</td>
<td></td>
</tr>
</tbody>
</table>

- **Roller head**
- **Pin head**
- **Pneumatic**
- **Hydraulic**

Actuation forces:
- 90 - 280 N (according to size)

Control pressures:
- Pneumatic 5 - 10 bar
- Hydraulic 12 - 20 bar

### Actuations:

<table>
<thead>
<tr>
<th>Double acting</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD</td>
</tr>
<tr>
<td>KM</td>
</tr>
</tbody>
</table>

- **Pneumatic / manual**
- **Hydraulic / manual**

Control pressure:
- Pneumatic 5 ... 10 bar
- Hydraulic 12 ... 20 bar
### General parameters and dimensions

**SG with manual actuation**

**SP with solenoid actuation**

### Associated technical data sheets:
- Directional spool valve type SG and SP: D 5650/1
- Actuations:
  - Manual operation for directional spool valves, type S: D 6511/1
  - Electrical operation for directional spool valves type S: D 7055
  - Mechanical operation for directional spool valves, type S: D 5870
  - Pressure actuation for directional spool valves: D 6250

### Male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833

<table>
<thead>
<tr>
<th>Q&lt;sub&gt;max&lt;/sub&gt; [lpm]</th>
<th>Operating pressure p&lt;sub&gt;max&lt;/sub&gt; [bar] for actuation</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m&lt;sub&gt;max&lt;/sub&gt; [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Solenoid</td>
<td>Mechanical</td>
<td>Manual/pressure</td>
<td>H</td>
</tr>
<tr>
<td>SG 0</td>
<td>12</td>
<td>200</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>SG 1</td>
<td>20</td>
<td>200</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>SG 2</td>
<td>30</td>
<td>315</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>SG 3</td>
<td>50</td>
<td>315</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>SG 5</td>
<td>100</td>
<td>200</td>
<td>315</td>
<td>400</td>
</tr>
<tr>
<td>SP 1</td>
<td>20</td>
<td>200</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>SP 3</td>
<td>50</td>
<td>315</td>
<td>400</td>
<td>400</td>
</tr>
</tbody>
</table>
Directional spool valves

2.1 Directional spool valve type SW, SWP and NSWP

Directional spool valves are a type of directional valve. They control the direction of movement and the velocity of single and double-acting hydraulic consumers.

The directional spool valve type NSWP and SWP is available as a manifold mounting valve. Type NSWP is available with a nominal size 6 hole pattern (NG 6). Type SW is available as a single valve for pipe connection. The directional spool valve type NSWP can be flexibly adapted to different control tasks by means of additional functions in the pump line and/or on the consumer side (e.g. restrictors, restrictor check valves).

Intended applications for the directional spool valve type NSWP, SWP and SW include industrial hydraulics, in particular machine tools.

Features and benefits:
- Compact valve banks possible
- Proportional functions easy to control
- Large range of variants
- Can be combined with NG6 sub-plates (type BA2)

Intended applications:
- Machine tools
- Construction and construction materials machinery
- Offshore and marine technology
- Road vehicles

Design and order coding example

<table>
<thead>
<tr>
<th>NSWP2</th>
<th>G /M /R / ABR1,0 /50 /G24 - 3/8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single connection block for direct installation in the pipe G 3/8 (type NSWP and SWP2)</td>
</tr>
<tr>
<td></td>
<td>Voltage of the actuation solenoids 12V DC, 24V DC, 110V AC, 230V AC</td>
</tr>
<tr>
<td></td>
<td>Solenoids with various plug versions</td>
</tr>
<tr>
<td></td>
<td>Pressure switch or pressure gauge at A or B</td>
</tr>
<tr>
<td></td>
<td>Additional elements at A and/or B  Restrictor check valve or orifice</td>
</tr>
<tr>
<td></td>
<td>Additional elements at P  Check valve or orifice</td>
</tr>
<tr>
<td></td>
<td>Solenoid version  black/white solenoid or proportional solenoid</td>
</tr>
<tr>
<td></td>
<td>Solenoid with detent</td>
</tr>
<tr>
<td></td>
<td>Solenoid version conforming ATEX (p_{max} = 210 bar)</td>
</tr>
<tr>
<td></td>
<td>Function  Indiv. valve with check valve or orifice in gallery P and/or check valve in gallery R (type SWP)</td>
</tr>
<tr>
<td></td>
<td>Indiv. valve with 6/2-way function</td>
</tr>
<tr>
<td></td>
<td>Basic type, size  Directional spool valve SW, SWP size 1 and 2</td>
</tr>
<tr>
<td></td>
<td>NSWP size 2, connection hole pattern NG 6 (CETOP)</td>
</tr>
</tbody>
</table>
Function

Sub-plate for pipe connection

- 1/4 S(R)

Sub-plate with pressure limiting valve

1) Only for type SWP 1
2) Only for type NSWP and SWP 2

Valve sections

Basic symbol

Individual valve

Valve sections

Circuit symbol

May be connected either in parallel or in series within a valve bank

Only connected in series within a valve bank (only type SW1)

Spool for proportional adjustment

3) Only for type SWR 1
General parameters and dimensions

**SW**

1. Single connection block
2. Pressure-limiting valve

<table>
<thead>
<tr>
<th></th>
<th>Q_{\text{max}} [lpm]</th>
<th>P_{\text{max}} [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
<th>Sub-plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW/SWP 1</td>
<td>12</td>
<td>315</td>
<td>G 1/4</td>
<td>77 ... 90</td>
<td>40</td>
<td>40 ... 44</td>
</tr>
<tr>
<td>SW/SWP 2</td>
<td>25</td>
<td>315</td>
<td>G 3/8, G 1/4</td>
<td>78 ... 82.5</td>
<td>60</td>
<td>40 ... 45</td>
</tr>
<tr>
<td>NSWP2</td>
<td></td>
<td></td>
<td>NG 6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Circuit example 1:

BA2-A5  
-NSWP2G/M/03/NZP16V/PQ20/0 
-NSWP2G/M/R/B1,0 
-NSWP2K/M/20/0 
-NSWP2K/M/20/NZP16Q33/0 
-2-L24
Circuit example 2:

HKF44V9LD/1-Z16
-AL21D10V-F60/80-2
-BA2-NSMD2K/G/B2/0
-NSMD2G/GRK/B2/0
-NSWP2W/M/B1.0/06/S/0
-NG6X/0
-NSWP2W/M/B1.0/06/S/0
-NSMD2G/GRK/B2/0
-NG6X/0
-NSMD2K/G/B2/0
-80-AC2001/40-X24

Combinable products:
- Valve bank type BA: Page 144
- Intermediate plate type NZP: D 7788 Z
- 6/2-directional spool valve: Sk 7951-3-6/2

Similar products:
- Valve banks type SWR and SWS: Page 76
- Clamping modules type NSMD: Page 100

Associated technical data sheets:
- Directional spool valve type SW: D 7451
- Directional spool valve type NSWP 2: D 7451 N

Male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833
Directional spool valves are a type of directional valve. They control the direction of movement and the velocity of single and double-acting hydraulic consumers. The directional spool valve bank type SWS is available with series connection. The consumers can be operated with on-off or proportional control. Versions are available for usage in potentially explosive atmospheres. By means of additional functions in the pump line, in the intermediate plates (longitudinal and sandwich valve combination) and ancillary blocks the directional spool valve bank can be flexibly adapted to different control tasks.

Intended applications include mobile hydraulics, in particular civil engineering, agricultural engineering and material handling.

**Features and benefits:**
- Can be combined for forklift trucks with lifting modules
- Suitable for constant pressure systems
- Proportional movements can also be controlled independently of the load
- Extensive range of ancillary blocks
- Compact and extremely space-saving dimensions

**Intended applications:**
- Material handling
- Wind turbines
- Construction and construction materials
- Handling and assembly techn.
- Municipal trucks

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>directional spool valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Valve bank Combination with hydraulic power packs</td>
</tr>
<tr>
<td>Actuation:</td>
<td>Solenoid</td>
</tr>
<tr>
<td>$p_{\text{max}}$:</td>
<td>315 bar</td>
</tr>
<tr>
<td>$q_{\text{max}}$:</td>
<td>25 l/min</td>
</tr>
</tbody>
</table>

**Design and order coding example**

<table>
<thead>
<tr>
<th>SWR1</th>
<th>A-6/230 - GG - 1 - G24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid voltage</td>
<td>12V DC, 24V DC, 110V AC, 230V AC</td>
</tr>
<tr>
<td>End plate</td>
<td>Solenoids with various plug versions</td>
</tr>
<tr>
<td></td>
<td>Additional ports P and/or R (P can be blocked)</td>
</tr>
<tr>
<td></td>
<td>Idle circulation valve (ON/OFF, proportional)</td>
</tr>
<tr>
<td></td>
<td>End spool valve</td>
</tr>
<tr>
<td>Valve sections</td>
<td>Directional spool valve</td>
</tr>
<tr>
<td></td>
<td>Additional options for the valve sections:</td>
</tr>
<tr>
<td></td>
<td>Options upstream (orifice, flow controller)</td>
</tr>
<tr>
<td></td>
<td>Consumer-side additional functions in ancillary block, e.g. double check valves, shock valves (load-holding valves etc.)</td>
</tr>
<tr>
<td>Connection block/adapter plate</td>
<td>Pressure limiting valve (for pipe connection)</td>
</tr>
<tr>
<td></td>
<td>Idle circulation valve</td>
</tr>
<tr>
<td></td>
<td>3-way flow controller</td>
</tr>
</tbody>
</table>

**Basic type, size**

Type SWR 1 and SWS 2
**Function**

**Connection blocks:**

<table>
<thead>
<tr>
<th>A 6</th>
<th>F/D</th>
</tr>
</thead>
</table>

With fixed pressure limiting valve  
(for pipe connection)  

For direct mounting onto hydraulic power packs  
(type KA, HC, MP, HK)

**Valve sections:**

<table>
<thead>
<tr>
<th>Basic symbol</th>
<th>SWR 1</th>
<th>SWS 2</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>G</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>O</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>N</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>K</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Q</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>U</td>
</tr>
</tbody>
</table>

1. Ancillary block with additional function  
   (on the consumer side)  
2. Actuation  
3. Additional function  
   (on the pump side)

**Spool valves suited for prop. actuation**

<table>
<thead>
<tr>
<th>G</th>
<th>D</th>
</tr>
</thead>
</table>

**Additional versions for valve sections:**

- b/w solenoids with stroke limitation  
- prop. solenoids with stroke limitation  
- solenoids also available in ATEX-compliant version  
  \( p_{\text{max}} = 210 \) bar

**End plates (SWR 1/SWS 2):**

<table>
<thead>
<tr>
<th>Series</th>
<th>With circulation valve</th>
<th>With lockable pump output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Ancillary block type SWS 2 with additional functions (consumer side):**

<table>
<thead>
<tr>
<th>Releasable check valve</th>
<th>Shock valve</th>
<th>Sequence valve</th>
<th>Over center valve</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
General parameters and dimensions

1. Connection block
2. Valve section
3. End plate
4. Stroke limitation

<table>
<thead>
<tr>
<th></th>
<th>( \dot{Q}_{\text{max}} ) [lpm]</th>
<th>( \dot{p}_{\text{max}} ) [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>( m_{\text{max}} ) [kg]</th>
<th>Individual section</th>
<th>Connection block</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWR 1</td>
<td>12</td>
<td>315</td>
<td>G 1/4</td>
<td>77 - 90</td>
<td>40</td>
<td>1.1 - 1.5</td>
<td>0.6 - 0.7</td>
</tr>
<tr>
<td>SWS 2</td>
<td>25</td>
<td>315</td>
<td>G 3/8, G 1/4</td>
<td>78 - 82.5</td>
<td>60</td>
<td>1.1 - 2.4</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Circuit example:

SWS 2 A 7/200
Valve bank type SWS, size 2, connection block with pressure-limiting valve (manually adjustable, set to 200 bar)
- G/M/2/2 RH
  1. Valve section with circuit symbol G with solenoid actuation, no additional function in P gallery, with releasable check valves for A and B in the ancillary block
- G 10/MPF/DW/2 AL B 7/180 BLC 4/140
  2. Valve section with circuit symbol G and proportional spool, max. flow rate A and B with 10 lpm, proportional solenoid MP with stroke limitation for A and B, pressure compensator in P gallery of the basic block (DW), ancillary block with load-holding valve for A (set to 180 bar) and for B (set to 140 bar)
- E/M/R/2 AN100 BN 100-1-G 24
  3. Valve section with circuit symbol E and solenoid actuation, a check valve in the P gallery, ancillary block featuring shock and servo-suction valves for ports A and B (set to 100 bar), standard end plate, solenoid voltage 24V DC
Directional spool valve

2.1 Directional spool valve type HSF

Directional spool valves are a type of directional valve. They control the direction of movement and the velocity of single and double-acting hydraulic consumers. The directional spool valve type HSF is a manifold mounting valve. Due to the robust design, it reaches operating pressures of up to 400 bar. Adjustable threaded throttles are used to adjust the response time. Harsh switching operations and decompression surges, particularly in the event of high pressure and large consumer volumes, can be avoided this way.

**Features and benefits:**
- Smooth switching for large flow rate
- Suitable for high pressures due to steel housing

**Intended applications:**
- Mining machinery (incl. oil production)
- Cranes and lifting equipment
- Construction and construction materials machinery
- Material handling (industrial trucks, etc.)

---

**Design and order coding example**

<table>
<thead>
<tr>
<th>HSF4</th>
<th>/C321</th>
<th>- L</th>
<th>- 1</th>
<th>- G24</th>
<th>- 300</th>
</tr>
</thead>
</table>

- **Pressure setting pressure limiting valve [bar]**
- **Solenoid voltage**: 12V DC, 24V DC, 98V DC, 205V DC, 110V AC, 230V AC
- **End plate**: Internal or external control oil return
- **Valve sections**: With/without adjustable switching speed
- **Connection block**: With/without pressure limiting valve (Fixed or manually adjustable)
- **Internal or external control oil supply (max. 160 bar)**

**Basic type and size**

Type HSF: Manifold mounting

---

**Nomencature:**
- Directional spool valve

**Design:**
- Individual valve for manifold mounting

**Actuation:**
- Electro-hydraulic
- Hydraulic

**p_{max}**: 400 bar

**Q_{max}**: 160 l/min
### Function

**Valve sections:**

<table>
<thead>
<tr>
<th>Basic symbol</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSF</td>
<td>G</td>
</tr>
</tbody>
</table>

Manifold mounting valve  
All flow pattern symbols also available with adjustable response time

### General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>Q&lt;sub&gt;max&lt;/sub&gt; [l/min]</th>
<th>p&lt;sub&gt;max&lt;/sub&gt; [bar]</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>H</td>
<td>B</td>
</tr>
<tr>
<td>HSF 3</td>
<td>80</td>
<td>400</td>
<td>137</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>126</td>
</tr>
<tr>
<td>HSF 4</td>
<td>160</td>
<td>400</td>
<td>157</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>184</td>
</tr>
</tbody>
</table>

### Associated technical data sheets:
- Directional spool valve type PSL and PSV: D 7700-2; D 7700-3
- Directional spool valve type HSF: D 7493 E
- Directional spool valve type HSL: D 7493 L

### Male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833/1
2.1 Proportional directional spool valve type EDL

Proportional directional spool valves are a type of directional valve. They control the direction of movement and the velocity of individual or multiple hydraulic consumers actuated simultaneously. Control is independent of the load and continuous. The directional spool valve type EDL with series connection is actuated directly. The flow rates for the individual consumers can be individually adjusted. The proportional directional spool valve can be flexibly adapted to different control tasks by means of additional functions in the intermediate plates and ancillary blocks. The directional spool valve type EDL can be combined directly with the proportional directional spool valve type PSL and PSV in size 2 and is therefore suitable for constant and variable pump systems. It is used in mobile hydraulics, in particular in civil engineering and agricultural engineering.

Features and benefits:
- One valve for different control functions and small flow quantities
- Energy-saving closed-centre systems
- Compact and lightweight design
- Modular system can be directly combined with type PSL/PSV-2

Intended applications:
- Construction and construction materials machinery
- Cranes and lifting equipment
- Machines for forestry and agricultural purposes
- Municipal trucks

Design and order coding example

<table>
<thead>
<tr>
<th>EDL</th>
<th>- DA2</th>
<th>L</th>
<th>40/25</th>
<th>E</th>
<th>/2</th>
<th>- G24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid voltage</td>
<td>12V DC, 24V DC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ancillary blocks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confirmation</td>
<td>Type E, EI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volumetric flow</td>
<td>Volumetric flow indicator, side A, B (3...40)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spool</td>
<td>Type L, H</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spool block</td>
<td>Section with inflow controller</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Basic type: Type EDL: directly actuated proportional directional spool valve
**Function**

**Valve sections:**

**Circuit symbol**

<table>
<thead>
<tr>
<th>L</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>R</td>
</tr>
<tr>
<td>A</td>
<td>P</td>
</tr>
</tbody>
</table>

**Versions of valve sections:**

**Additional functions in the ancillary block:**
- Shock and servo-suction valves
- Load-holding valves
- Check valves with release, no leakage
- Floating and block functions can be switched

**Characteristic values for max. volumetric flows:**

<table>
<thead>
<tr>
<th>Size 2</th>
<th>Q&lt;sub&gt;A, B&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

- Characteristic value corresponds to the max. volumetric flow [lpm] of inflow controller versions at the consumer ports A and/or B
- Volumetric flows for A and/or B can be selected separately

**Actuations:**

<table>
<thead>
<tr>
<th>Basic type</th>
<th>Brief description</th>
<th>Circuit symbol (example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>electrical actuation with stroke limitation</td>
<td></td>
</tr>
<tr>
<td>EI</td>
<td>electrical actuation without stroke limitation and with emergency manual actuation</td>
<td></td>
</tr>
</tbody>
</table>
**General parameters and dimensions**

### PSL/EDL

1. Connection block
2. Valve section
3. End plate

#### Dimensions

<table>
<thead>
<tr>
<th>Flow [lpm]</th>
<th>Oper. pressure [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_{\text{max}}$</td>
<td>$Q_{\text{puc max}}$</td>
<td>$p_{\text{max}}$</td>
<td>$P, R$</td>
<td>$A, B$</td>
</tr>
<tr>
<td>EDL</td>
<td>3 ... 40</td>
<td>80</td>
<td>320</td>
<td>$G 1/2, 3/4-16$ UNF-2B</td>
</tr>
</tbody>
</table>

$^{1)}$ Dep. on actuation and additional functions
Circuit example:

PSV 3-2
- DA2L40/25/E/2
- DA2L25/16/E/24l-0-A4/210-B10-B4/210
- E4-G24

**Associated technical data sheets:**
- Proportional directional spool valve type EDL: D 8086
- Proportional directional spool valve, type PSL and PSV size 2: D 7700-2
- Proportional directional spool valve, type PSL, PSM and PSV size 3: D 7700-3
- Proportional directional spool valve, type PSL, PSM and PSV size 5: D 7700-5
- Connection block type HMPL and HMPV for proportional directional spool valve: D 7700 H
2.1 Directional spool valve bank type DL

Throttling directional spool valves are a type of directional valve. They continuously and manually meter the flow rate in hydraulic systems with single and double-acting consumers. The throttling directional spool valve type DL influences the speed of the consumer by throttling the pump circulation via a parallel circuit (bypass control). The close fit of the spool in the throttling directional spool valve means that the leakage is limited to a minimum for lifting functions.

The throttling directional spool valve type DL is suitable for applications in material handling and for lifting equipment.

**Features and benefits:**
- Compact design with up to 10 segments
- Various actuation variants for manual actuation
- Simple pressure reductions in downstream sections using intermediate plates
- Combinations possible for controlling lifting devices

**Intended applications:**
- Material handling (industrial trucks, etc.)
- Machines for agricultural and forestry purposes
- Construction and construction materials machinery
- Road vehicle

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>Throttling directional spool valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Valve bank design with integrated bypass pump circulation control</td>
</tr>
<tr>
<td>Actuation:</td>
<td>Manual</td>
</tr>
<tr>
<td>Return spring, detent</td>
<td></td>
</tr>
<tr>
<td>$p_{\text{max}}$:</td>
<td>315</td>
</tr>
<tr>
<td>$Q_{\text{max}}$:</td>
<td>90</td>
</tr>
</tbody>
</table>

**Design and order coding example**

<table>
<thead>
<tr>
<th>DL3</th>
<th>1</th>
<th>-3</th>
<th>GGD</th>
<th>-B/E1</th>
<th>-2</th>
<th>-210</th>
</tr>
</thead>
</table>

- **Pressure specification [bar]**
  - End plate
  - Actuation, mounting
  - Valve sections
    - Directional spool valve
    - Valve section options:
      - Intermediate plate with pressure-limiting valve for all downstream valve sections
      - Additional functions on the consumer side in the ancillary block (e.g. double check valves, shock valves, load-holding valves etc.) (size 3)
- **Port size**
  - 1/4, 3/8, 1/2 (BSPP)
- **Connection block**
  - With/without pressure limiting valve
  - With shock valve
- **Basic type, size**
  - Type DL, sizes 1 to 4
Function

Connection blocks:

<table>
<thead>
<tr>
<th>DL .5</th>
<th>DL .1</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram of DL .5 connection block" /></td>
<td><img src="image2.png" alt="Diagram of DL .1 connection block" /></td>
</tr>
</tbody>
</table>

Without pressure-limiting valve  
With pressure-limiting valve

Valve sections:

<table>
<thead>
<tr>
<th>Basic symbol</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>G and B</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Reduced internal leakage due to reduced spool valve play

Versions of valve sections:
- Additional function on the pump side (orifice, 2-way flow control valve)
- Valve sections for size 3 with consumer-side additional functions in ancillary block (e.g. double check valves, shock valves, load-holding valves etc.)
- Manual operation with return spring for switching position “a” and detent for switching position “b”
- Manual operation with detent in both switching positions
- Manual operation with combinations of contact switch, switch cam and switch carrier
- Manual operation with different mounting directions

End plates:

<table>
<thead>
<tr>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image9.png" alt="Standard end plate with port R" /></td>
<td><img src="image10.png" alt="End plate for subsequent connection of a DL" /></td>
</tr>
</tbody>
</table>
### General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>$Q_{\text{max}}$ [lpm]</th>
<th>$p_{\text{max}}$ [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>$m$ [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Characteristic value</td>
<td>A, B</td>
<td>H, P, R</td>
</tr>
<tr>
<td>DL 1</td>
<td>12 ... 16</td>
<td>315</td>
<td>1</td>
<td>G 1/4</td>
<td>G 3/8</td>
</tr>
<tr>
<td>DL 2</td>
<td>20 ... 30</td>
<td>315</td>
<td>2</td>
<td>G 3/8</td>
<td>G 3/8</td>
</tr>
<tr>
<td>DL 3</td>
<td>30 ... 60</td>
<td>250</td>
<td>3</td>
<td>G 1/2</td>
<td>G 1/2</td>
</tr>
<tr>
<td>DL 4</td>
<td>90</td>
<td>250</td>
<td>3</td>
<td>G 1/2</td>
<td>G 3/4</td>
</tr>
</tbody>
</table>

1. Connection block
2. Valve section
3. End plate
**Circuit example:**

**DL 21-2-G D G71 N-B/E1-2-180**

Directional spool valve DL, size 2 with pressure-limiting valve (set to 180 bar), port size 2 with G 3/8 threaded connections, circuit symbols G, D, G, N; circuit symbol G with pressure-limiting valve in port A (coding 71), valve sections with manual operation B (series with hand lever) and mounting type E1 (ports A, B are directed towards the front, valve spool is pushed into the housing for switching position “a”), valve bank with end plate 2 (coding 2)
Directional spool valves

2.1 Proportional directional spool valves type PSL and PSV

Proportional directional spool valves are a type of directional valve. They control the direction of movement and the velocity of individual or multiple hydraulic consumers actuated simultaneously. Control is independent of the load and continuous.

The proportional directional spool valve type PSL is suitable for constant pump systems and type PSV for variable pump systems with a pressure/flow controller. The volumetric flows and load pressures for the individual consumers can be individually adjusted. The proportional directional spool valve type PSL and PSV can be adapted to various control tasks, e.g. for safety functions. All sizes can be combined with each other.

The proportional directional spool valve type PSL and PSV is used in mobile hydraulics, in particular in crane and lifting equipment, construction and mining machinery, drilling equipment as well as in offshore and marine technology.

Features and benefits:
- One product for various control functions and volume quantities
- Energy-saving Closed-Center systems
- Compact and lightweight design
- Modular system with wide range of design variants

Intended applications:
- Construction/construction material machinery
- Mining machinery (incl. oil production)
- Cranes and lifting equipment
- Machines for forestry and agricultural purposes
- Municipal machinery

Design and order coding example

PSL41F /380 - 3 - A2340/40/EA/3 - E4 - G24

Solenoid voltage
12V DC, 24V DC
- Actuated via prop. amplifier or PLVC
- Solenoids with various plug versions
- Explosion proof solenoids

End plates
- Various connection threads
- Pressure limiting valve (piloted main pressure limiting valve)
- Suited for both constant and variable displacement pump systems (type PSM)

Basic type
Type PSL (hydraulic oil supply by constant pump), sizes 2, 3 and 5
Type PSV (hydraulic oil supply by variable pump), sizes 2, 3 and 5
Type HMPL (hydraulic oil supply by constant pump) for industrial trucks, sizes 2 and 3
Type HMPV (hydraulic oil supply by variable pump) for industrial trucks, sizes 2 and 3
Function

Connection blocks:

**PSL**

1. Pilot pressure regulating valve
2. 2/2-way solenoid valve

Connection block for constant pump systems with integrated 3-way controller, pressure-limiting valve and LS shutdown

**PSV**

Connection block for variable pump systems with or without pressure-limiting valve

**HMPL (HMPV)**

Connection block for constant delivery pump with incorporated proportional seated valve for lifting and lowering

Additional versions of connection blocks:
- 2/2-way solenoid valve for randomly switching the pump direction
- Additional damping option of the 3-way/pump controller
- Additional isolation valve to minimise the pump direction resistance
- Version with additional shut-off valve for the pump line, can be switched randomly
- Proportionally adjustable pressure limitation

Valve sections:

<table>
<thead>
<tr>
<th>Basic symbols</th>
<th>Circuit symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>M</td>
</tr>
</tbody>
</table>

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91/299
Versions of valve sections:
- Load pressure signal outputs at A, B; A and B together
- 3/3 directional spool valve with 2-way input and output controller
- Version with and without 2-way inflow controller
- Function deactivation feature
- Secondary pressure-limiting valves (can be selected for A and/or B)
- Prop. Pressure limitation of individual functions
- Version with ancillary blocks
- Intermediate plates for various additional functions
- Combination of various sizes possible in one valve bank
- Version with EX solenoid for use in potentially explosive areas
- Version with explosion-proof, intrinsically safe magnets for mining applications
- Version with CAN actuation

Additional functions in the ancillary block:
- Shock and servo-suction valves
- Load-holding valves
- Differential circuits
- Check valves with release, zero-leakage
- Floating and block functions can be switched
- Proportional seated valves in accordance with D 7490/1 for lifting and lowering functions with plunger cylinders

Characteristic values for max. volumetric flows:

<table>
<thead>
<tr>
<th>Size</th>
<th>Q&lt;sub&gt;A&lt;/sub&gt;, Q&lt;sub&gt;B&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size 2</td>
<td>3 6 10 16 25 40</td>
</tr>
<tr>
<td>Size 3</td>
<td>3 6 10 16 25 40 63 80</td>
</tr>
<tr>
<td>Size 5</td>
<td>16 25 40 63 80 120 160</td>
</tr>
</tbody>
</table>

- Characteristic value corresponds to the max. volumetric flow [lpm] of inflow controller versions at the consumer ports A and/or B
- Volumetric flows for A and/or B can be selected separately
- Increasing the control pressure enables 60 lpm (size 2), 120 lpm (size 3) and 240 lpm (size 5) per consumer port side.
- Version with 2-way inflow controller and check valve function, or damping elements
### Actuations:

<table>
<thead>
<tr>
<th>Basic type</th>
<th>Brief description</th>
<th>Circuit symbol (example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Manual actuation</td>
<td><img src="image" alt="Combination of electro-hydraulic and manual actuation" /></td>
</tr>
<tr>
<td>C</td>
<td>Detent (continuous)</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Electro-hydraulic actuation in combination with manual operation</td>
<td></td>
</tr>
<tr>
<td>EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EI CAN</td>
<td>CAN: Actuation variant with CAN control in combination with manual operation</td>
<td></td>
</tr>
<tr>
<td>EA CAN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H, P</td>
<td>Hydraulic and pneumatic actuation in combination with manual operation</td>
<td></td>
</tr>
<tr>
<td>HA, PA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEA</td>
<td>Combination of H, E and A actuation</td>
<td></td>
</tr>
</tbody>
</table>

### Intermediate plates:

- Electrically or hydraulically actuated shut-off valve for all downstream consumers
- With pressure-limiting valve to limit the operation pressure of all downstream valves
- For random switchable reduction of the volumetric flow of all downstream consumers
- Priority module, size 3

### End plates:

- **E1**
  
  ![Standard end plate](image)
  
  Standard end plate

- **E2**
  
  ![With additional Y-port for LS-input signal](image)
  
  With additional Y-port for LS-input signal

### Additional versions of end plates:

- End plate with internal leakage oil routing (no T gallery)
- End plates with additional P and R gallery
- Adapter plate to combine size 5 and 3 (coding ZPL 53), size 5 and 2 (coding ZPL 52) and size 3 and 2 (coding ZPL 32)
- End plate with integrated connection block function for dual-pump/dual-circuit systems
### General parameters and dimensions

<table>
<thead>
<tr>
<th>Flow [lpm]</th>
<th>Oper. pressure [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q\text{max}</td>
<td>Q\text{pu max}</td>
<td>p\text{max}</td>
<td>P, R</td>
<td>A, B</td>
</tr>
<tr>
<td>PSL/PSV 2</td>
<td>3 ... 54</td>
<td>80</td>
<td>420</td>
<td>G 1/2, 3/4-16 UNF-2B</td>
</tr>
<tr>
<td>PSL/PSV 3</td>
<td>3 ... 120</td>
<td>200</td>
<td>420</td>
<td>G 1/2, G 3/4, G 1, 1 1/16-12 UNF-2B</td>
</tr>
<tr>
<td>PSL/PSV 5</td>
<td>16 ... 240</td>
<td>300</td>
<td>400</td>
<td>G 1, G 1 1/4, 1 5/8-12 UNF-2B</td>
</tr>
</tbody>
</table>

\(^1\) Dep. on actuation and additional functions
Circuit example:

PSL 41/350 - 3
-32 J 25/16 A300 F1/EA
-42 O 80/63 C250/EA
-42 J 63/63 A100 B120 F3/EA
-31 L 40/16/A
- E2 - G24

Type PSL valve bank for constant pump systems

Connection block:
- Coding for thread size
  (here 4 = G 3/4)
- Coding for pilot pressure-reducing valve
  (here 1)
- Coding for set pressure at pressure-limiting valve (here 350 bar)

Size: 3

1. Valve section: (exemplary for all subsequent valve sections):
- Directional spool valve block with coding for consumer connection size (here 3 = G 1/2)
- Coding for the type of directional spool valve block (here 2)
- Circuit symbol (here J)
- Coding for max. consumer volumetric flow to ports A and B (here 25 and 16 lpm)
- Coding of additional functions (here A 300; secondary pressure-limiting valve at port A set to 300 bar, function deactivated for port A (here F1))
- Coding for actuation type (here EA)

End plate:
- Coding for end plate (here E2)
- Coding for 24V DC solenoid voltage (here G24)

Products suitable for combination:
- Load-holding valves type LHT, LHDV: Page 198
- Joystick: Proportional pressure-reducing valve type KFR 01: D 6600-01

Additional electrical components:
- Proportional amplifier: Page 272
- Programmable logic valve control type PLVC: Page 276
- CAN node type CAN-IO: Page 276
- Other electronic accessories See "Electronics"

Associated technical data sheets:
- Proportional directional spool valve, type PSL and PSV size 2: D 7700-2
- Proportional directional spool valve, type PSL, PSM and PSV size 3: D 7700-3
- Proportional directional spool valve, type PSL, PSM and PSV size 5: D 7700-5
- Actuation for proportional directional spool valves type PSL/PSV: D 7700 CAN

Associated technical data sheets:
- Connection block type HMPL and HMPV for proportional directional spool valve: D 7700 H
- Proportional directional spool valve type EDL: D 8086
Proportional directional spool valves are a type of directional valve. They control the
direction of movement and the velocity of individual or multiple hydraulic consumers
actuated simultaneously. Control is independent of the load and continuous.
The proportional directional spool valve type PSLF is suitable for constant pump systems
and type PSVF for variable pump systems with a pressure/flow controller. The proportional
directional spool valve type PSLF and PSVF is available as an individual manifold valve or in the valve bank. The volumetric flows and load pressures for the individual
consumers can be individually adjusted. The directional spool valve can be adapted
to different control tasks. Connections on the rear permit easy access to the valve for
servicing, even in tight installation spaces. All sizes can be combined with each other.
The proportional directional spool valve type PSLF and PSVF is used in mobile hydraulics,
in particular in crane and lifting equipment, construction and mining machinery, drilling
equipment as well as in offshore and marine technology.

**Features and benefits:**
- Max. flow 1000 lpm at 420 bar
- Rear side ports for easy access to valves, even in small installation spaces
- Flange design can be combined across all sizes with fast valve replacement
- Simultaneous operation of several functions at full speed

**Intended applications:**
- Construction machinery and machines for building materials
- Cranes and lifting equipment
- Offshore and marine technology
- Mining machinery

**Features and benefits:**
- Max. flow 1000 lpm at 420 bar
- Rear side ports for easy access to valves, even in small installation spaces
- Flange design can be combined across all sizes with fast valve replacement
- Simultaneous operation of several functions at full speed

**Intended applications:**
- Construction machinery and machines for building materials
- Cranes and lifting equipment
- Offshore and marine technology
- Mining machinery

**Nomenclature:**
- Prop. directional spool valve acc. to the
  Load-Sensing principle

**Design:**
- Individual manifold mounting valve
  Valve bank via individual manifold mounting valves

**Actuation:**
- Manual
  - Return spring
  - Detent
- Electro-hydraulic
  - Pressure
  - Hydraulic
  - Pneumatic

**p_{\text{max}}:** 400 bar
**Q_{\text{max, consumer}}:** 400 l/min
**Q_{\text{pu max}}:** 1000 lpm

**Design and order coding example**

<table>
<thead>
<tr>
<th>PSLF</th>
<th>A1/380/4</th>
<th>- 3</th>
<th>- A2J40/40/EA/3</th>
<th>- E2</th>
<th>- G24</th>
</tr>
</thead>
</table>

**Solenoid voltage**
- 12V DC, 24V DC
  - Operated using a proportional amplifier or PLVC
  - Magnets with different plug versions
  - Explosion-proof magnets

**End plates**

**Valve sections with actuation**

**Size**

**Connection block**
- Various connection threads
- Pressure-limiting valve (pilot-controlled main pressure-limiting valve) in connection block

**Basic type**
- Type PSLF (supply via constant pump),
- Type PSVF (supply via variable displacement pump),
  size 3, 5 and 7
**Function**

**Connection blocks:**

**PSLF**

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pilot pressure valve</td>
</tr>
<tr>
<td>2</td>
<td>2/2-way solenoid valve</td>
</tr>
</tbody>
</table>

Connection block for constant pump systems with integrated 3-way controller, pressure-limiting valve and LS shutdown

**PSVF**

Connection block for variable pump systems with and without pressure-limiting valve

**Additional versions of connection blocks:**

- 2/2-way solenoid actuated directional valve for arbitrary idle pump circulation
- Additional damping of the 3-way flow controller or pump controller
- Proportional adjustable pressure limitation

**Valve sections:**

<table>
<thead>
<tr>
<th>Basic symbol</th>
<th>Circuit symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Versions of valve sections:
- Load-signal outlets at A, B; A and B together
- Version with and without 2-way inflow controller
- Function deactivation
- Secondary pressure-limiting valves (can be individually selected for A and/or B)
- Proportional pressure limitation of the individual functions
- Sub-plates with different additional functions
- Sub-plates for ancillary blocks
- Sub-plates for combining various sizes
- Combination of various sizes in one valve bank possible
- Version with EX solenoid for use in potentially explosive areas
- Version with explosion-proof, intrinsically safe solenoids for mining applications

Key figures for max. flow rates:

<table>
<thead>
<tr>
<th>Size</th>
<th>Q₀, l/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size 3</td>
<td>3 6 10 16 25 40 63 80</td>
</tr>
<tr>
<td>Size 5</td>
<td>16 25 40 63 80 120 160</td>
</tr>
<tr>
<td>Size 7</td>
<td>120 160 250 320 400</td>
</tr>
</tbody>
</table>

- Key figure represents the max. flow rate (lpm) at consumer ports A or B for version with inflow controller
- Flow rates for A and/or B can be selected individually
- Increasing the control pressure means that 60 lpm (size 2), 120 lpm (size 3), 240 lpm (size 5) and 500 lpm (size 7) is possible per consumer port side.
- Versions with 2-way inflow controller and check valve function

Actuations:

<table>
<thead>
<tr>
<th>Basic type</th>
<th>Brief description</th>
<th>Circuit symbol (example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Manual operation</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Detent (stepless)</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Electro-hydraulic actuation in combination with manual operation</td>
<td>Combination of electro-hydraulic and manual operation</td>
</tr>
<tr>
<td>EA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EI CAN</td>
<td>CAN: Actuation variant with CAN control in combination with manual operation</td>
<td></td>
</tr>
<tr>
<td>EA CAN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H, P</td>
<td>Hydraulic and pneumatic actuation in combination with manual operation</td>
<td></td>
</tr>
<tr>
<td>HA, PA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEA</td>
<td>Combination of H, E and A actuation</td>
<td></td>
</tr>
</tbody>
</table>

End plates:

- E1  Standard end plate
- E2  Additional Y-input for LS control signal

Additional versions of end plates:
- End plate with internal leakage oil routing (no tank connection)
- End plates with additional R port
- Adapter plate for combining size 5 and 3 (coding ZPL 53)
General parameters and dimensions

Connection block

1. Connection block
2. Valve sections
3. End plate

<table>
<thead>
<tr>
<th>Flow [lpm]</th>
<th>Oper. pressure [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q&lt;sub&gt;max&lt;/sub&gt;</td>
<td>Q&lt;sub&gt;PU max&lt;/sub&gt;</td>
<td>p&lt;sub&gt;max&lt;/sub&gt;</td>
<td>P, R</td>
</tr>
<tr>
<td>PSLF/PSVF 3</td>
<td>3 - 120</td>
<td>200</td>
<td>420</td>
<td>G 3/4, 1 1/16-12 UN-2B</td>
</tr>
<tr>
<td>PSLF/PSVF 5</td>
<td>16 - 210</td>
<td>350</td>
<td>400</td>
<td>G 1, G 1 1/4, SAE 1 1/2&quot;</td>
</tr>
<tr>
<td>PSLF/PSVF 7</td>
<td>120 - 500</td>
<td>1000</td>
<td>400</td>
<td>G 1 1/2, SAE 1 1/2&quot;</td>
</tr>
</tbody>
</table>

1) Per valve section depending on actuation and additional functions
2) Per valve section complete with sub-plate

Products suitable for combination:
- Load-holding valves type LHT, LHDV: Page 198
- Joystick: Proportional pressure-reducing valve type KFB 01: D 6600-01

Additional electrical components:
- Proportional amplifier: Page 272
- Programmable logic valve control type PLVC: Page 276
- CAN node type CAN-IO: Page 276
- Other electronic accessories See "Electronics"

Associated technical data sheets:
- Proportional directional spool valve type PSLF, PSVF and SLF:
  D 7700-F
- Proportional directional spool valve banks type PSLF and PSVF size 7: D 7700-7F
- Actuation for proportional directional spool valves type PSL/PSV:
  D 7700 CAN
Directional spool valve

2.1 Clamping module type NSMD

Clamping modules combine a directional spool valve, pressure reducing valve and pressure switch.

The clamping module type NSMD has the standard connection pattern nominal size NG 6. It controls power-driven clamping devices, e.g. hydraulically-driven hollow and solid clamping cylinders for automatic lathes. It regulates the clamping pressure and monitors it. The clamping pressure is adjusted at the downstream pressure switch using a manual, mechanical or electrically-proportional adjustment device. A special safety circuit monitors the switching position of the valve.

Throttling options in the spool end position and/or rapid and creeping movements are possible as an additional function for one or both consumer ports. The clamping module type NSMD can be combined with other valves as a valve bank type BA to form a valve block.

Features and benefits:
- Directional valve, pressure-reducing valve and pressure switch in one device
- Adjustment of pressure-reducing valve and pressure switch with an adjustment device (manual or electro-proportional)
- The controlled pressure is picked up directly at the consumer port
- Valve with connection pattern in accordance with DIN 24340-A6

Intended applications:
- Machine tools (cutting)
- Machine tools (non-cutting) - forming and cutting
- Handling and mounting technology (industrial robots, etc.)

Features and benefits:
- Valve combination consisting of: Directional spool valve (4/3-, 4/2-way function)
- Pressure reducing valve with tracked pressure switch

Design:
- Individual valve for manifold mounting (Valve banks with sub-plates type BA are available)
- Actuation: Solenoid
- \( p_{\text{max}} \): 120 bar
- \( Q_{\text{max}} \): 25 l/min

Design and order coding example

<table>
<thead>
<tr>
<th>NSMD 2</th>
<th>D1</th>
<th>/MDA</th>
<th>/GRK</th>
<th>- G24</th>
</tr>
</thead>
</table>

Solenoid voltage
- 12V DC, 24V DC, 110V AC, 230V AC
- Solenoids with various plug versions

Clamping pressure adjustment, pressure range, switching flow rate
- Slotted head screw + hexagon nut
- Wing screw + wing nut
- Lockable turning handle
- Electro-proportional adjustment with/without additional function monitoring

Actuation Function
- With pressure switch
- With orifice (flow limitation in accumulator mode)

Basic type, size
- Type NSMD size 2 with connection hole pattern conf. NG 6
## Function

### Basic symbols

<table>
<thead>
<tr>
<th>Basic symbols</th>
<th>Symbols</th>
</tr>
</thead>
<tbody>
<tr>
<td>D, E, G, D1, E1, G1</td>
<td>D, E1, G1</td>
</tr>
<tr>
<td>D1, E1, G1</td>
<td>B, W, K</td>
</tr>
<tr>
<td>B1, W1, K1</td>
<td>X1L1</td>
</tr>
</tbody>
</table>

### Further functions:

- **G1/MD**
  - Pressure reducing function and throttle in switching positions a and b

- **G/MM6**
  - Rapid traverse and creeping in both directions

- **G/MMDA7**
  - Rapid traverse and creeping in one direction featuring also a limitation for rapid traverse (switching position a, c)
  - Rapid traverse in opposing direction (switching position b)

- **G/MMA7**
  - Switching position a, speed limitation is possible by means of a throttle with pressure reduction and pressure monitoring
  - Switching position with fixed rapid traverse speed without pressure reduction and pressure monitoring.
General parameters and dimensions

<table>
<thead>
<tr>
<th>NSMD2</th>
<th>25</th>
<th>120</th>
<th>H: 2 ... 17</th>
<th>1: 1 ... 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A: 4 ... 36</td>
<td>-: 2 ... 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>G: 5 ... 50</td>
<td>3: 3 ... 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B: 6 ... 60</td>
<td>4: 4 ... 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E: 8 ... 80</td>
<td>5: 5 ... 7</td>
</tr>
</tbody>
</table>

1) Mx port: G 1/8
2) Depending on circuit symbol and actuation type

- **Q<sub>max</sub>** [lpm]
- **p<sub>max</sub>** [bar]
- Clamping pressure range [bar]
- Trigger flow [lpm]
- Connection hole pattern
- Dimensions [mm]
- Individual valve [kg]
- Additional function

### NSMD2 K...

### NSMD2 G...

1) Mx port: G 1/8
2) Depending on circuit symbol and actuation type
Circuit examples:

**NSMD2K/M/GDK/B2.5-G24**

Clamping module type NSMD size 2 with standard connection diagram in accordance with DIN 24340-A6, circuit symbol K, detented version, clamping pressure range G, 5-50 bar and min. switching flow rate 2-4 lpm. Clamping pressure adjustment with a tracked pressure switch is actuated using a wing bolt and wing nut.

A 2.5 mm孔 orifice is present in the P gallery, 24V DC solenoid voltage.

**NSMD2G1/M/ED4V/1-G12**

Clamping module type NSMD size 2 with standard connection diagram, in accordance with DIN 24340-A6, circuit symbol G1 with pressure monitoring at port A, adjustable throttle position for switching position a and b. Valve for clamping pressure range E, 8-80 bar and switching flow rate 4-6 lpm. Clamping pressure adjustment with a tracked pressure switch is actuated using a self-locking turn knob. A 1 mm孔 orifice is present in the P gallery, 12V DC solenoid voltage.

HK 43L/1M-Z 9.8-AL 21F2-F60/70-2-BA 2 - NSMD2K/M/GDK/B2,5/0
1. End position control
2. Clamping device
3. Releasable double check valve
4. Stand-still controller
5. Tailstock spindle
6. Releasable check valve
7. End plate
coding 11
8. Clamping module with sub-plate
9. Compact hydraulic power pack with connection block

Associated technical data sheets:
- **Clamping module type NSMD: D 7787**

Products:
- Directional valves type NSWP2: Page 72
- Directional seated valves type NBVP16: Page 134

Plates:
- Valve banks type BA2: Page 144
- Intermediate plate type NZP: D 7788 Z

Male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833
## 2.2 Directional seated valves

<table>
<thead>
<tr>
<th>Type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directional seated valve type G, WG and others</td>
<td>108</td>
</tr>
<tr>
<td>Valve bank (directional seated valve) type VB</td>
<td>114</td>
</tr>
<tr>
<td>Directional seated valve type WN and WH</td>
<td>118</td>
</tr>
<tr>
<td>Valve bank (directional seated valve) type BWN and BWH</td>
<td>120</td>
</tr>
<tr>
<td>Valve bank (directional seated valve) type BVH</td>
<td>124</td>
</tr>
<tr>
<td>Directional seated valve type VZP</td>
<td>128</td>
</tr>
<tr>
<td>Directional seated valve type EM and EMP</td>
<td>130</td>
</tr>
<tr>
<td>Directional seated valve type BVG, BVP and NBVP</td>
<td>134</td>
</tr>
<tr>
<td>Directional seated valve type BVE</td>
<td>138</td>
</tr>
<tr>
<td>Directional seated valve type VP</td>
<td>140</td>
</tr>
<tr>
<td>Directional seated valve type VH, VHR, and VHP</td>
<td>142</td>
</tr>
<tr>
<td>Valve bank (nominal size 6) type BA</td>
<td>144</td>
</tr>
<tr>
<td>Lifting/lowering valve type HSV</td>
<td>150</td>
</tr>
<tr>
<td>Switch unit type CR</td>
<td>152</td>
</tr>
<tr>
<td>Lifting module type HMT and HST</td>
<td>154</td>
</tr>
</tbody>
</table>
### (Solenoid-actuated) seated valves

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / actuation</th>
<th>p&lt;sub&gt;max&lt;/sub&gt; (bar)</th>
<th>Q&lt;sub&gt;max&lt;/sub&gt; (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>G, WG and Others</strong></td>
<td>Directional seated valve with various actuations&lt;br&gt;• Individual valve for manifold mounting&lt;br&gt;– Solenoid&lt;br&gt;– Pressure-actuated&lt;br&gt;– Manual</td>
<td>0: 500&lt;br&gt;1: 700&lt;br&gt;2: 700&lt;br&gt;3: 400&lt;br&gt;4: 350</td>
<td>0: 6&lt;br&gt;1: 12&lt;br&gt;2: 25&lt;br&gt;3: 65&lt;br&gt;4: 120</td>
</tr>
<tr>
<td><strong>VB</strong></td>
<td>Directional seated valve, zero-leakage, valve bank&lt;br&gt;• For pipe connection&lt;br&gt;• Combination with pump units&lt;br&gt;– Solenoid&lt;br&gt;– Pressure-actuated&lt;br&gt;– Manual</td>
<td>01: 500&lt;br&gt;11: 700&lt;br&gt;21: 700&lt;br&gt;31: 400&lt;br&gt;41: 350</td>
<td>01: 6&lt;br&gt;11: 12&lt;br&gt;21: 25&lt;br&gt;31: 60&lt;br&gt;41: 120</td>
</tr>
<tr>
<td><strong>WN, WH</strong></td>
<td>Directional seated valve, zero-leakage, single valve&lt;br&gt;• Individual valve for manifold mounting&lt;br&gt;• Combination with connection block for pipe connection&lt;br&gt;– Solenoid</td>
<td>WN - 1: 350&lt;br&gt;WH - 1: 450&lt;br&gt;WH - 2: 350&lt;br&gt;WH - 3: 350&lt;br&gt;WH - 4: 350</td>
<td>WN - 1: 5&lt;br&gt;WH - 1: 8&lt;br&gt;WH - 2: 15&lt;br&gt;WH - 3: 30&lt;br&gt;WH - 4: 60</td>
</tr>
<tr>
<td><strong>BWH, BWN</strong></td>
<td>Directional seated valve, zero-leakage, valve bank&lt;br&gt;• For pipe connection&lt;br&gt;• Combination with pump units&lt;br&gt;– Solenoid</td>
<td>BWN - 1: 350&lt;br&gt;BWH - 1: 450&lt;br&gt;BWH - 2: 350&lt;br&gt;BWH - 3: 350</td>
<td>BWN - 1: 5&lt;br&gt;BWH - 1: 8&lt;br&gt;BWH - 2: 15&lt;br&gt;BWH - 3: 30</td>
</tr>
<tr>
<td><strong>BVH</strong></td>
<td>Version&lt;br&gt;• Valve bank for pipe connection&lt;br&gt;– Solenoid</td>
<td>11: 400</td>
<td>11: 20</td>
</tr>
<tr>
<td><strong>VZP</strong></td>
<td>Directional seated valve, zero-leakage, single valve&lt;br&gt;• Individual valve for manifold mounting&lt;br&gt;– Solenoid</td>
<td>1: 450</td>
<td>1: 15</td>
</tr>
<tr>
<td><strong>BVG, BVP, NBVP</strong></td>
<td>Directional seated valve, zero-leakage, single valve&lt;br&gt;• For pipe connection&lt;br&gt;• Individual valve for manifold mounting&lt;br&gt;– Solenoid&lt;br&gt;– Hydraulic&lt;br&gt;– Pneumatic&lt;br&gt;– Manual</td>
<td>1: 400</td>
<td>1: 20</td>
</tr>
<tr>
<td><strong>BVE</strong></td>
<td>Directional seated valve, zero-leakage, single valve&lt;br&gt;• Screw-in valve&lt;br&gt;• Combination with connection block for pipe connection&lt;br&gt;• Combination with connection block for manifold mounting&lt;br&gt;– Solenoid</td>
<td>1: 500&lt;br&gt;3: 400&lt;br&gt;5: 400</td>
<td>1: 20&lt;br&gt;3: 70&lt;br&gt;5: 300</td>
</tr>
<tr>
<td><strong>VP</strong></td>
<td>Directional seated valve, zero-leakage, single valve&lt;br&gt;• Individual valve for manifold mounting</td>
<td>1: 400</td>
<td>1: 15</td>
</tr>
<tr>
<td>Type</td>
<td>Design / actuation</td>
<td>$p_{\text{max}}$ (bar)</td>
<td>$q_{\text{max}}$ (lpm)</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------------------------------------------</td>
<td>------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>– Solenoid</td>
<td>定向密封阀, 无泄漏</td>
<td>VH - 1: 700</td>
<td>VH - 1: 12</td>
</tr>
<tr>
<td>– Hydraulic</td>
<td></td>
<td>VH - 2: 500</td>
<td>VH - 2: 25</td>
</tr>
<tr>
<td>– Pneumatic</td>
<td></td>
<td>VHP - 1: 700</td>
<td>VHP - 1: 12</td>
</tr>
<tr>
<td>VH, VHR, VHP</td>
<td>Single valve for pipe connection</td>
<td>VHR - 1: 700</td>
<td>VHR - 1: 12</td>
</tr>
<tr>
<td></td>
<td>Individual valve for manifold mounting</td>
<td>VHR - 2: 500</td>
<td>VHR - 2: 25</td>
</tr>
<tr>
<td></td>
<td>Valve bank</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manual</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Valve combinations

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / actuation</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$Q_{\text{max}}$ (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA</td>
<td><strong>Valve bank</strong></td>
<td>2: 500</td>
<td>2: 50</td>
</tr>
<tr>
<td></td>
<td>• Directional spool valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Directional spool valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Directional seated valve</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Solenoid</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Pressure-actuated</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Manual</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>– Mechanical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSV</td>
<td>• Single valve for pipe connection</td>
<td>21: 315</td>
<td>21: 20</td>
</tr>
<tr>
<td></td>
<td>– Solenoid</td>
<td>22: 315</td>
<td>22: 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>61: 350</td>
<td>61: 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>71: 400</td>
<td>71: 120</td>
</tr>
<tr>
<td>CR</td>
<td>• Single valve for pipe connection</td>
<td>HP/ LP: 4: 400/60</td>
<td>HP/ LP: 4: 8/80</td>
</tr>
<tr>
<td></td>
<td>– Solenoid</td>
<td>5: 400/60</td>
<td>5: 20/160</td>
</tr>
<tr>
<td>HMT, HST</td>
<td>• Valve bank</td>
<td>HST - 2: 315</td>
<td>HST - 2: 40</td>
</tr>
<tr>
<td></td>
<td>– Solenoid</td>
<td>HST - 3: 315</td>
<td>HST - 3: 80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HMT - 3: 315</td>
<td>HMT - 3: 90</td>
</tr>
</tbody>
</table>
Directional seated valves

2.2 Directional seated valve type G, WG and others

Directional seated valves are a type of directional valve. As ball valves they have zero leakage in the closed state.
The directional seated valve type G, WG, H, P, K, T and D is available as a 2/2, 3/2, 4/2, 3/3 and 4/3 directional seated valve with different actuation types. Actuation using a hand lever enables switchable pressures of up to 700 bar.
Appropriate connection blocks enable direct pipe connection. The directional seated valves are available in a combination of valves in valve bank type VB.

Features and benefits:
- Zero-leakage ball valve construction with high switching reliability
- Solenoid, pressure, mechanical or manual actuation
- Low shifting forces and gentle, smooth switching
- Operating pressures up to 700 bar

Intended applications:
- Machine tools (cutting and non-cutting)
- Clamping equipment, punching tools, jigs
- Rubber and plastics machinery
- Oil hydraulics and pneumatics

| Nomenclature: | Directional seated valve, zero leakage |
| Design: | Individual valve, manifold mounting combination with sub-plates for pipe connection |
| Actuation: | Solenoid |
| p_max: | 700 bar |
| Q_max: | 120 l/min |
## Design and order coding example

<table>
<thead>
<tr>
<th>G</th>
<th>R2</th>
<th>-</th>
<th>3</th>
<th>R</th>
<th>-</th>
<th>1/2</th>
<th>-</th>
<th>G24</th>
</tr>
</thead>
</table>

**Solenoid voltage** 12V DC, 24V DC, 110V AC, 230V AC

**Indiv. connection blocks for pipe connection**

**Additional versions:**
- Connection blocks with by-pass check valve or pressure limiting valve between P and R
- Connection block with bridge rectifier circuit. Check valves in "GRAETZ"-circuitry ensure flow direction through the valve

**Indiv. connection blocks for pipe connection**

**Additional elements**
- With check valve insert for port P
- With check valve insert for port P
- With return pressure stop for port R
- Position monitoring (size 3 and 4)

**Size**
- Size 0 to 4
  - Size 1 also available with industrial connection hole pattern NG 6 (CETOP), type NG
  - Size 12 with interchangeable coil
  - Size 22 reinforced version 700 bar

**Function**
- 2/2-way directional valve (R2, S2)
- 3/2-way directional valve (3, Z3)
- 3/3-way directional valve (21, 39)
- 4/3 directional valve (22, 45, 46, 47, 48, 49)
- 4/2-way directional valve (4, Z4)

**Actuation**
- Solenoid (G, WG)
- Hydraulic (H)
- Pneumatic (P)
- Mechanical (K, T, F, D)
### Function

<table>
<thead>
<tr>
<th>2/2-way directional valve</th>
<th>3/2-way directional valve</th>
<th>3/3-way directional valve</th>
<th>4/3-way directional valve</th>
<th>4/2-way directional valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>R2</td>
<td>S2</td>
<td>3</td>
<td>Z3</td>
<td>21, 39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22, 45, 46, 47, 48, 49</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Z4</td>
</tr>
</tbody>
</table>

- Simplified symbols for 3/3-, 4/3- and 4/2-way functions
- Type 21, 22 not in size 4
- Type 39, 45, 46, 47, 48, 49 only in size 22
- Type 4, Z4 only in size 1
### Actuation:

<table>
<thead>
<tr>
<th>Solenoid</th>
<th>Pressure</th>
<th>Mechanical</th>
<th>Manual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hydraulic</td>
<td>Pneumatic</td>
<td>Roller</td>
</tr>
<tr>
<td>G</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WG</td>
<td>H</td>
<td>P</td>
<td>K</td>
</tr>
</tbody>
</table>

- Valve with solenoid actuation also available in ATEX-compliant version (24V DC)

| Solenoid voltages:  | Control pressure $p_{\text{cont. max}}$ [bar]: | Shifting force [N]: | Shifting force [N]: | Shifting torque [Ncm]: |
| 12V DC, 24V DC     | 400... 700                                     | 25... 80            | 25... 80            | 45... 98             |
| (type G)            | 15                                               | 51... 20            |                     |                      |
| 230V AC             | 9... 16                                          | 2.5... 4            | 10.5... 30          | 20.5... 45           |
| (type WG)           |                                                   |                     | 4 and 5             |                      |
## General parameters and dimensions

### Individual valve

<table>
<thead>
<tr>
<th>Size</th>
<th>(H_{\text{max}})</th>
<th>(H_{1\text{max}})</th>
<th>(B)</th>
<th>(T_{\text{max}})</th>
<th>(T_{1})</th>
<th>(m_{\text{max}}) [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>90.5</td>
<td>110.5</td>
<td>36</td>
<td>75</td>
<td>41.5</td>
<td>40.0</td>
</tr>
<tr>
<td>1, 12</td>
<td>115</td>
<td>145</td>
<td>45</td>
<td>92</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>2, 22</td>
<td>126.5; 134.5</td>
<td>156.5; 161.5</td>
<td>56; 56</td>
<td>116; 116</td>
<td>62.5; 67.5</td>
<td>56; 56</td>
</tr>
<tr>
<td>3</td>
<td>162</td>
<td>202</td>
<td>70</td>
<td>144</td>
<td>91.5</td>
<td>70</td>
</tr>
<tr>
<td>4</td>
<td>226</td>
<td>226</td>
<td>80</td>
<td>162</td>
<td>127</td>
<td>125</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td>16.3/20.1</td>
</tr>
</tbody>
</table>

### Valve with connection block

| \(Q_{\text{max}}\) [lpm] | \(P_{\text{max}}\) [bar] | \| \| |
|--------------------------|--------------------------|--------------------------|--------------------------|
| Size | Solenoid | Pressure | Mechanical | Manual |
| \(G\) | \(WG\) | \(H\) | \(P\) | \(K\) | \(T\) | \(F\) | \(D\) | \(P, R, A, B\) |
| 0    | 6       | 300... 500         | 500 | -   | -   | -   | 500 | G 1/4             |
| 1, 12| 12      | 350... 500 (700)   | 500 | 700 | 400... 700 | 400... 700 | G 1/4 and G 3/8 |
| 2    | 25      | 350... 500        | 500 | -   | -   | -   | 500 | G 3/8 and G 1/2  |
| 22   | 25      | 700               | 500 | 400... 500 | 400... 500 | G 3/8 and G 1/2 |
| 3    | 65      | 350... 400        | 400 | 350 | -   | 350 | -   | G 1/2 and G 3/4  |
| 4    | 120     | 350               | -   | -   | -   | -   | -   | G 3/4 and G 1    |

### Ports

- G: \(P, R, A, B\)
- WG: \(500\)
Circuit example:

RZ 4.0/2-12.3-B 75-V 5.5
- 3 x 690/400 V 50 Hz

VB 22 AM 1/500
-G 49/U 22
-8 E-2-G 24

GR 2-12-3/8 C-G 24

Associated technical data sheets:
- Directional seated valve type G, WG and others: D 7300
- Directional seated valve type NG, NGW and others: D 7300 N
- Directional seated valve type G, WG and others with position monitoring: D 7300 H

Valve banks:
- Valve banks type VB: Page 114

Male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833
Directional seated valves

2.2 Valve bank (directional seated valve) type VB

A valve bank combines different valves for operating independent consumers. The valve bank type VB comprises several directional seated valves of type G, WG among others that are connected in parallel. The directional seated valves as ball valves have zero leakage in the closed state. They are attached to sub-plates. These sub-plates are clamped between the inlet section (P and R port) and the end plate via tension rods. Pressure switches or pressure-limiting valves can be integrated into the pumps and/or consumer lines.

2/2 and 3/2- 4/2, 3/3 and 4/3 directional seated valves are available with different types of actuation. The valve bank can be mounted directly to compact hydraulic power packs using connection blocks.

Features and benefits:
- Compact hydraulic controls for high pressure
- Combination with compact hydraulic power packs result in cost efficient turn-key solutions
- Elimination of time-consuming installation due to combination with hydraulic power packs
- Simple repairs thanks to modular structure of the systems

Intended applications:
- Machine tools (chipping and non-chipping)
- Clamping, punching and jigs
- Rubber and plastics machinery
- Oil hydraulics and pneumatics

---

Design and order coding example

<table>
<thead>
<tr>
<th>VB12</th>
<th>F</th>
<th>M</th>
<th>D C N R 5</th>
<th>1</th>
<th>WG230</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Solenoid voltage 12V DC, 24V DC, 110V AC, 230V AC
Port size G 1/4 (1), G 3/8 (2), G 1/2 (3) (BSPP)

Valve sections Symbols: 2/2-way directional valve, 3/2-way directional valve, 3/3-way directional valve, 4/3-way directional valve, 4/2-way directional valve

Valve section options
- Pressure switch for P or the consumer side
- Pressure reducing valve reducing the pressure in the downstream gallery P
- Orifices in gallery P and/or return pressure stop in gallery R

Sub-plates
- With 2-way flow controller by-passing to the tank
- Pressure reducing valve reducing the pressure in the downstream gallery P
- With pressure limiting valve and throttle
- With idle circulation valve and/or shuttle valve

Intermediate plates
- With pressure reduction for gallery P or throttle for port A (parallel connection)

Actuation Connection block/adapter plate
- For pipe connection
- For direct mounting at compact hydraulic power packs
- For direct mounting at hydraulic power packs

Basic type, size Type VB size 01, 12, 21, 22, 31, 41

---

Nomenclature: Directional seated valve, zero leakage
Design: Valve bank for pipe connection
Actuation: Solenoid
Pressure: Hydraulic, Pneumatic
Manual: Hand lever, Turn knob

<table>
<thead>
<tr>
<th>p&lt;sub&gt;max&lt;/sub&gt;</th>
<th>700 bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q&lt;sub&gt;max&lt;/sub&gt;</td>
<td>120 l/min</td>
</tr>
</tbody>
</table>
Function

Connection blocks:

A .-1../ For pipe connection, with fixed pressure limiting valve (/.. pressure specification in bar)

C, D, E For mounting onto hydraulic power packs type R, Z and RZ, depending on tank and size

F For mounting onto compact hydraulic power packs (type KA, HC, MP, MPN, HK)

G

Valve sections:

A D F B C E Q P O

- A not for VB 01, VB 11 only with tapped ports G 1/4

H L N R Y I S T

Simplified flow pattern

J, G39 G , G49 HX LX NX RX

Simplified flow pattern

End plates:

/2 /3 ... /65

/2, /3 ... /65 only available for VB01 and VB11
### General parameters and dimensions

1. Connection block
2. Valve sections
3. Pressure switches
4. End plate (here with pressure switches)

<table>
<thead>
<tr>
<th></th>
<th>( Q_{\text{max}} ) [lpm]</th>
<th>( p_{\text{max}} ) [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Solenoid</td>
<td>Pressure</td>
<td>Manual</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VB 01</td>
<td>6</td>
<td>300 ... 500</td>
<td>M</td>
<td>H</td>
<td>P</td>
</tr>
<tr>
<td>VB 12</td>
<td>12</td>
<td>350 ... 500 (700)</td>
<td>M</td>
<td>H</td>
<td>P</td>
</tr>
<tr>
<td>VB 21</td>
<td>25</td>
<td>350 ... 500 (700)</td>
<td>M</td>
<td>H</td>
<td>P</td>
</tr>
<tr>
<td>VB 22</td>
<td>25</td>
<td>700</td>
<td>M</td>
<td>H</td>
<td>P</td>
</tr>
<tr>
<td>VB 31</td>
<td>65</td>
<td>350 ... 400</td>
<td>M</td>
<td>H</td>
<td>P</td>
</tr>
<tr>
<td>VB 41</td>
<td>120</td>
<td>350</td>
<td>M</td>
<td>H</td>
<td>P</td>
</tr>
</tbody>
</table>
Circuit example:
MP24A - H1.39/B5 - A1/300
Compact hydraulic power pack type MP size 2, connection block with pressure limiting valve (tool adjustable)

- VB01FM - FRN/32 - 1 - WG230
Valve bank type VB size 0 with 3 valves (actuation type M (solenoid), solenoid voltage 230V 50/60 Hz) and end plate. Here 32 with pressure switch and drain valve

Parameters of the circuit example:
- \( Q_{pu} \approx 1.39 \text{ lpm (at 1450 rpm)} \)
- \( p_{max} \approx 400 \text{ bar} \)
- \( p_{sys} \approx 300 \text{ bar (set pressure of the pressure-limiting valve)} \)
- Tank \( V_{usable} \approx 6 \text{ l, } V_{total} \approx 7.7 \text{ l} \)

Suites compact hydraulic power packs:
- Type MP, MPN, MPNW, MPW: Page 50
- Type HC, HCW, HC: Page 42
- Type HK, HKF, HKL: Page 54
- Type NPC: Page 40
- Type KA, KAW: Page 46
- Connection blocks type A: Page 62

Suites hydraulic power packs:
- Standard power pack FXU with pumps R, RG, RZ: Page 58

Corresponding pamphlets (data sheets):
- Valve bank (directional seated valve) type VB: D 7302

Suites valves:
- Directional seated valves with various actuations: Page 108

Accessories:
- Pressure switches type DG 3.., DG 5 E: Page 262
- Pressure reducing valves type CDK: Page 180

Male connectors:
- Line connector type MSD and others: D 7163
- Economy circuit type MSD: D 7813, D 7833
Directional seated valves

Directional seated valves are a type of directional valve. As ball valves they have zero leakage in the closed state.
The directional seated valves type WN and WH are manifold mounting valves. 2/2 and 3/2 directional seated valves are available. These are also available combined as 3/3 and 4/3 directional seated valves. The type WH contains an internal pressure balance. As a result, the permissible operating pressure is higher than the type WN.
Appropriate connection blocks enable direct pipe connection. The directional seated valves are available in a combination of valves in valve bank type BWN and BWH.

Features and benefits:
- Excellent price/performance ratio
- Compact design
- Directional seated valves with zero leakage
- Solenoid version with 8-watt technology

Intended applications:
- Machines for forestry and agricultural purposes
- Clamping, punching and jigs
- Clamping equipment, punching tools, jigs
- Process engineering systems

Design and order coding example

<table>
<thead>
<tr>
<th>WN1</th>
<th>H</th>
<th>1</th>
<th>- 1/4</th>
<th>- G24</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>12V DC, 24V DC, 110V AC, 230V AC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solenoid voltage</td>
<td>Versions with M12-plug and 8-Watt solenoid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single connection block</td>
<td>Port size G 1/4, G 3/8, G 1/2 (BSPP)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional elements</td>
<td>Return pressure stop for port R</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check valve insert for port P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure limiting valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>2/2-way directional valve (F, D, Q, E)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3/2-way directional valve (H, R, M, N)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3/3-way directional valve (J, U)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4/2-way directional valve (W)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic type, size</td>
<td>Type WN, size 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type WH, size 1 to 4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Actuation: Solenoid

$P_{max}$: 450 bar

$Q_{max}$: 60 l/min

Nomenclature: Directional seated valve, zero leakage
Function

- Symbols show type WH
  View type WH
- Type WN 1 without de-pressuring duct for the solenoid (add. leakage duct is not necessary)
  Type WN 1 without solenoid relief (no leakage line)

### General parameters and dimensions

**Individual valve**

<table>
<thead>
<tr>
<th>Q$_{max}$ [lpm]</th>
<th>p$_{max}$ [bar]</th>
<th>Ports</th>
<th>Dimensions (individual valve) [mm]</th>
<th>m$_{max}$ [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>320 ... 350 G 1/4</td>
<td>87</td>
<td>35 35</td>
<td>0.6</td>
</tr>
<tr>
<td>8</td>
<td>450 G 1/4</td>
<td>87</td>
<td>35 35</td>
<td>0.6</td>
</tr>
<tr>
<td>15</td>
<td>350 G 1/4</td>
<td>95.2</td>
<td>101.7 35 35</td>
<td>0.65 0.7</td>
</tr>
<tr>
<td>30</td>
<td>350 G 3/8</td>
<td>93.5</td>
<td>103.5 45 45</td>
<td>1.2 1.3</td>
</tr>
<tr>
<td>60</td>
<td>350 G 1/2</td>
<td>118</td>
<td>133 60 60</td>
<td>2.7 3.0</td>
</tr>
</tbody>
</table>

**Valve with sub-plate for pipe connection**

<table>
<thead>
<tr>
<th>Q$_{max}$ [lpm]</th>
<th>p$_{max}$ [bar]</th>
<th>Ports</th>
<th>Dimensions (with sub-plate) [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>320 ... 350 G 1/4</td>
<td>87</td>
<td>35 35</td>
<td>0.6</td>
</tr>
<tr>
<td>8</td>
<td>450 G 1/4</td>
<td>87</td>
<td>35 35</td>
<td>0.6</td>
</tr>
<tr>
<td>15</td>
<td>350 G 1/4</td>
<td>95.2</td>
<td>101.7 35 35</td>
<td>0.65 0.7</td>
</tr>
<tr>
<td>30</td>
<td>350 G 3/8</td>
<td>93.5</td>
<td>103.5 45 45</td>
<td>1.2 1.3</td>
</tr>
<tr>
<td>60</td>
<td>350 G 1/2</td>
<td>118</td>
<td>133 60 60</td>
<td>2.7 3.0</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- Directional seated valve type WN and WH: D 7470 A/1
- Valve banks:
  - Type BWN1, BWH: Page 120

Male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, Economy circuit type MSD 4 P55: D 7833
Directional seated valves

2.2 Valve bank (directional seated valve) type BWN and BWH

A valve bank combines different valves for operating independent consumers.
The valve bank type BWN or BWH comprises several directional seated valves of type WN or WH that are connected in parallel. The directional seated valves as ball valves have zero leakage in the closed state. They are attached to sub-plates. These sub-plates are clamped between the inlet section (P and R port) and the end plate via tension rods. Pressure switches or pressure-limiting valves can be integrated into the pumps and/or consumer lines.

2/2 and 3/2- directional seated valves. Combined, these are also available as 3/3 and 4/3 directional seated valves. The valve bank can be mounted directly to compact hydraulic power packs using connection blocks.

Features and benefits:
- Modular concept
- Adapter plates for flange-mounting on hydraulic power packs or combination with other valve types
- With the valve bank version, option to incorporate additional functions in the sub-plate, such as pressure-limiting valves, pressure switches etc.
- Energy-efficient solutions in connection with hydraulic accumulators

Intended applications:
- Machine tools (chipping and non-chipping)
- Rubber and plastic machinery
- Mining machinery (incl. oil production)
- Rubber and plastics machinery

Nomenclature:
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directional seated</td>
<td>valve, zero leakage</td>
</tr>
<tr>
<td>Design</td>
<td>Valve bank</td>
</tr>
<tr>
<td></td>
<td>▪ For pipe connection</td>
</tr>
<tr>
<td></td>
<td>▪ Combination with hydraulic power packs</td>
</tr>
<tr>
<td>Actuation</td>
<td>Solenoid</td>
</tr>
<tr>
<td>$p_{max}$</td>
<td>450 bar</td>
</tr>
<tr>
<td>$Q_{max}$</td>
<td>30 lpm</td>
</tr>
</tbody>
</table>

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### Design and order coding example

<table>
<thead>
<tr>
<th>BWH2</th>
<th>A-1/300</th>
<th>- FH5N5</th>
<th>- 1</th>
<th>- 1</th>
<th>- G24</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Solenoid voltage** 12V DC, 24V DC, 110V AC, 230V AC
  - Versions with M12-plug and 8-Watt solenoid

- **Port size** G 1/4, G 3/8 (BSPP)

- **End plate**
  - With one or two pressure switches
  - With accumulator drain valve
  - With additional pressure limiting valve in gallery P

- **Valve sections**
  - Directional valves type WH or WN
  - Valve section options:
    - Return pressure stop
    - Pressure switch for the consumer ports or for gallery P
    - Pressure limiting valves at the consumer port
    - Pressure reducing valve reducing the pressure in the downstream P gallery
  - Additional sections:
    - Pressure reducing valve
    - Indiv. sub-plate with pressure switch
    - Separation plate for gallery P

- **Connection block/adapter plates**
  - For pipe connection, with/without pressure limiting valve, manually or fixed, with/without prop. pressure limiting valve
  - For direct mounting at compact hydraulic power packs
  - For direct mounting at hydraulic power packs
  - Adapter plates for combination with directional valves type BVZP or SWR/SWP

- **Basic type, size** Type BWN, size 1 and type BWH, size 1 to 3
**Function**

**Connection blocks/adapter plates:**

A-1/...

For pipe connection, with fixed pressure-limiting valve (/....- pressure specification in bar)

For mounting onto hydraulic power packs

For mounting on compact hydraulic power packs with connection block (type KA, HC, MP, MPN and HK)

**Valve sections:**

D  F  B  Q  A  C  E  D

O  H  N  M  R  K

I  Y  S  T  J  U  L

Additional options for the valve sections:

- Pressure switches in the consumer or pump channel. The pressure switches (type DG 3..) are directly flange-mounted to the sub-plate.
- Pressure-limiting valves in the consumer channel (for 3/2- or 3/3-way directional valves, for size 1). The pressure-limiting valve is directly incorporated in the sub-plate.
- Pressure-reducing valves for pressure reduction in the subsequent pump channel.

**End plates:**

1  2  3../3..

Standard end plate  End plate with accumulator drain valve  End plate with one or two pressure switches connected to the P gallery
General parameters and dimensions

Version for pipe connection:

1. Connection block
2. Valve sections
3. End plate
4. Pressure switches

<table>
<thead>
<tr>
<th></th>
<th>( Q_{\text{max}} ) [tpm]</th>
<th>( p_{\text{max}} ) [bar]</th>
<th>Ports P, R, A, B</th>
<th>Dimensions [mm]</th>
<th>( m ) [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BWN 1</td>
<td>5</td>
<td>350</td>
<td>G 1/4</td>
<td>116.5 ... 131.5</td>
<td>38 ... 40</td>
</tr>
<tr>
<td>BWH 1</td>
<td>8</td>
<td>450</td>
<td>G 1/4</td>
<td>116.5 ... 131.5</td>
<td>38 ... 40</td>
</tr>
<tr>
<td>BWH 2</td>
<td>15</td>
<td>350</td>
<td>G 1/4</td>
<td>122 ... 157.5</td>
<td>38 ... 50</td>
</tr>
<tr>
<td>BWH 3</td>
<td>30</td>
<td>350</td>
<td>G 3/8</td>
<td>155.5 ... 168</td>
<td>50 ... 60</td>
</tr>
</tbody>
</table>

- Weight \( m \) [kg] per individual element: + 0.3 kg per pressure switch fitted

Associated publications:
- Valve bank (directional seated valve) type BWN and BWH: D 7470 B/1
- Directional seated valve type WN and WH: D 7470 A/1

Connection block:
- Type A: Page 62

Compact hydraulic power packs:
- Type HC, HCW, HCG: Page 42
- Type HK, HKF, HKL: Page 54

Hydraulic accessories:
- Type NPC: Page 40
- Type KA, KAW: Page 46
- Pressure switches type DG 3... DG 5E: Page 262
- Pressure reducing valves type CDK: Page 180
2.2 Valve bank (directional seated valve) type BVH

A valve bank combines different valves for operating independent consumers. The valve bank type BVH comprises several directional seated valves that are connected in parallel. As cone valves the directional seated valves have zero leakage in the closed state. The valve sections are connected using banjo bolts. 2/2, 3/2, 4/2 and 4/3-way directional seated valves are available. Depending on the functional requirement, pressure reducing valves, pressure switches, check valves, restrictors or restrictor check valves are integrated into the valve section. The valve bank can be flange-mounted directly on compact hydraulic power packs or integrated into a pipe system via a piping block.

**Features and benefits:**
- Flexible expandability
- Compact and lighter design (elimination of the base plates)

**Intended applications:**
- Auxiliary and clamping functions on machine tools and fixtures
- Auxiliary and clamping functions on forming machine tools
- Brake and rotor adjustment modules on wind turbines

**Design and order coding example**

**Valve sections**
- With individual pressure reduction (parallel connection)
- Additional elements:
  - Pressure-reducing valves
  - Orifice and/or check valve in P gallery
  - Orifice or restrictor check valve for A
  - Return pressure block in R gallery
  - Pressure switches for A

**Basic type**
Type BVH 11 for direct mounting onto connection blocks type A etc. (for compact hydraulic power packs type KA, MPN, HC, HK, HKF, HKL)

**Solenoid voltage**
12V DC, 24V DC, 110V AC, 230V AC

**End plate**
- With tapped plugs at P, R
- With accumulator port and drain valve

**Version**
Valve sections for pipe connection

**Actuation**
Solenoid

**p_m**
400 bar

**Q_m**
20 l/min
**Function**

**Connection blocks/adapter plates:**

**BVH**

Direct mounting onto connection blocks type A etc.

for compact hydraulic power packs type KA, MPN, HC, HK, HKF, HKL

---

**Valve sections:**

<table>
<thead>
<tr>
<th>H</th>
<th>M</th>
<th>W</th>
<th>D</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram H" /></td>
<td><img src="image2" alt="Diagram M" /></td>
<td><img src="image3" alt="Diagram W" /></td>
<td><img src="image4" alt="Diagram D" /></td>
<td><img src="image5" alt="Diagram G" /></td>
</tr>
</tbody>
</table>

**Additional options for the valve sections:**

**Individual pressure reduction (parallel connection):**

- **BVH 11 H/CZ...**
- **BVH 11 W/CZ...**
- **BVH 11 G/CZ...**
- **BVH 11 ZD**

**Pressure filter**

**Actuations:**

- **M:** Solenoid actuation \( (p_{\text{max}} = 400 \text{ bar}) \)
- **GM:** Solenoid actuation \( (p_{\text{max}} = 250 \text{ bar}) \)

**End plates:**

- **-1**
- **-81**

Tapped plug at P, R

with accumulator port and drain valve
General parameters and dimensions

(A1F1/310)

Type BVH valve bank for direct mounting at type A connection block

- BVH 11 H/M/R/2
- BVH 11 M/M/R B2.5/3
- BVH 11 W/CZ 5/35/M/R/22 - 81 - G 24

Valve section 1 with 3/2-way function circuit symbol H, P check valve (coding R), no pressure switch (coding 2)

Valve section 2 with 3/2-way function circuit symbol M, check valve and orifice in P gallery (coding R, B, 2, 5) and pressure switch for A (coding 3)

Valve section 3 with 4/2-way function circuit symbol W, individual pressure-reducing valve set to 35 bar (coding CZ5/35) and check valve in P gallery (coding R), no pressure switch

End plate for accumulator port (coding 8) and 24V DC solenoid voltage

Mounted valve type BVH

<table>
<thead>
<tr>
<th></th>
<th>Q_{max} [lpm]</th>
<th>p_{max} [bar]</th>
<th>Ports (BSPP)</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
<th>Valve section</th>
</tr>
</thead>
<tbody>
<tr>
<td>BVH</td>
<td>20</td>
<td>400</td>
<td>A, B, P, R, M H H1 B T</td>
<td>60 343 40/50 60</td>
<td>0,8</td>
<td></td>
</tr>
</tbody>
</table>
Associated technical data sheets:
- Valve bank (directional seated valve) type BVH: D 7788 BV

Compact hydraulic power packs:
- See section "Compact hydraulic power packs"

Connection blocks:
- Type A: Page 62

Combinable products:
- Directional seated valves type NBVP: Page 134
- Pressure reducing valves type CDK, DK: Page 180

Accessories:
- Pressure switches type DG: Page 262
- Hydraulic accumulator type AC: Page 258

Plug:
- Line connector type MSD and others: D 7163

Circuit example:
KA 281 SKT/Z 9.8

Compact hydraulic power pack type KA 1 kW motor power;
Connection block with return line filter and TÜV-approved safety valve set to 120 bar

Valve bank type BVH with three valve sections, two clamping functions with individually adjustable clamping pressure

Parameters of the circuit example
- \( Q_u = 9.8 \text{ lpm (at 1450 rpm)} \)
- \( p_{\text{max, } p_u} = 170 \text{ bar} \)
- \( p_{\text{system}} = 120 \text{ bar} \)
- \( p_{\text{switch-off feature}} = 50 \text{ bar} \)
- \( V_{\text{use}} = \text{approx. 3 l} \)
Directional seated valves

2.2 Directional seated valve type VZP

Directional seated valves are a type of directional valve. The seated valve type VZP is a manifold mounting valve. Zero-leakage ball-seated and cone-seated valves of the same size are combined.

The twin layout of the 3/2 and 2/2-way directional seated valves means that all functional elements for valve function and actuation share one housing, making them very compact. Depending on the pairing, these valves can realise either one 4/4, 4/3 or 3/3-way function, or two independent 3/2 and 2/2-way individual functions. Compared with individual valves for manifold mounting of conventional layout, the advantages are lower spatial requirements and the possibility of directly mounting pressure switches for monitoring the consumer pressure. A particularly compact option is to combine several valves connected in parallel in one valve bank (type BVZP).

Features and benefits:
- Good price-performance ratio
- Max. operating pressures up to 450 bar
- Adapter plates for flange-mounting on compact hydraulic power packs
- Option to incorporate additional functions in the sub-plate, such as pressure switches, throttle and check valve combinations etc.

Intended applications:
- Machine tools (cutting and non-cutting)
- Mining machinery (incl. oil production)
- Clamping equipment, punching tools, jigs
- Rubber and plastics machinery

Design and order coding example

<table>
<thead>
<tr>
<th>VZP1</th>
<th>H</th>
<th>12B1,0</th>
<th>-</th>
<th>G12</th>
</tr>
</thead>
</table>

Solenoid voltage 12V DC, 24V DC, 110V AC, 230V AC
- Versions with M12-plug and 8-Watt solenoid

Additional elements
- Indiv. valves with check valve insert in gallery P
- Indiv. valves with return pressure stop in gallery R
- Pressure switch for the consumer ports

Function
- 4/2-way functions via directional spool valve
- 4/3-way directional seated valve (G, D, E, O)
- 3/3-way directional seated valve (J, P)
- 2/2- and 3/2-way directional seated valve (F, D - H, M, N, R)

Basic type, size Twin valve type VZP, size 1
- Connection blocks for pipe connection

Nomenclature: Directional seated valve, zero leakage
Design: Individual valve, manifold mounting
Actuation: Solenoid
p<sub>max</sub>: 450 bar
Q<sub>max</sub>: 15 lpm
**Function**

Cone seated valves with 4/3- (4/4-) or 3/3- (3/4-) way functions up to 400 bar

<table>
<thead>
<tr>
<th>E</th>
<th>G</th>
<th>D</th>
<th>O</th>
<th>P</th>
<th>J</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 4. Switching position when both solenoids are energized simultaneously

Ball seated valves with 3/2- (2/2-) way functions up to 450 bar (always two valve functions in one valve body)

<table>
<thead>
<tr>
<th>H</th>
<th>N</th>
<th>M</th>
<th>R</th>
<th>F</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image2" alt="Diagram" /></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**General parameters and dimensions**

**VZP 1** (example with mounted pressure switches)

<table>
<thead>
<tr>
<th>Q_{\text{max}} [lpm]</th>
<th>P_{\text{max}} [bar]</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
<td>B</td>
<td>T</td>
</tr>
<tr>
<td>VZP 1</td>
<td>5... 15</td>
<td>250... 450</td>
<td>137... 142</td>
</tr>
</tbody>
</table>

- Weight m [kg] +0.3 kg per mounted pressure switch

**Associated technical data sheets:**
- Directional seated valve type VZP: D 7785 A

**Accessories:**
- Pressure switches type DG 3.., DG 5E: Page 262

**Male connectors:**
- Line connector type MSD and others: D 7163
Directional seated valves

2.2 Directional seated valve type EM and EMP

Directional seated valves are a type of directional valve. As cone valves they are tightly sealed without leakage in the closed state.

The directional seated valves type EM and EMP are screw-in valves. 2/2 directional seated valves with direct or pilot-controlled electromagnetic actuation are available. The directional seated valve type EM is available as a directional valve or damped switching (soft-shift). Type EMP is a proportionally actuated directional seated valve with throttle function.

Appropriate connection blocks make possible direct pipe connection or manifold mounting. You can obtain additional components, e.g. a drain valve, bypass throttle valve, pressure switch or flow control valve.

**Features and benefits:**
- Zero leakage in blocked state
- Directly switching up to approx. 3 lpm and piloted up to 160 lpm
- Minimized flow resistance even at high flow rate
- Long lifetime due to hardened valve seats

**Intended applications:**
- Cranes and lifting equipment
- Road construction industry
- Materials handling, industrial trucks etc.
- Handling and assembly robots, etc.

**Design and order coding example**

EM 21 V - 3/8 - G24

**Solenoid voltage**
- 12V DC, 24V DC, 110V AC, 230V AC

**Versions with**
- Versions with M12-plug and 8-Watt solenoid
- Quarter-turn plug, plugs of Co. KOSTAL or AMP

**Connection blocks**

**Versions with**
- Drain valve
- Drain valve and drop-rate braking valve
- Drain valve and by-pass check valve
- Bypass- throttle
- Pressure switch
- 2-way flow controller

**Function**
- V - 2/2-way valve (NC-type)
- S - 2/2-way valve (NO-type)

**Basic type, size**
- Type EM: Directional valve, size 1 to 4
- Type EMP: Prop. valve, size 1 to 4

**Actuation:** Solenoid

**p_{max}**
- 450 bar

**Q_{max}**
- 160 lpm
## Function

<table>
<thead>
<tr>
<th></th>
<th>Flow in arrowed direction</th>
<th>Arbitrary flow direction</th>
<th>Flow in arrowed direction</th>
<th>Arbitrary flow direction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energized open</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Directly actuated</td>
<td><strong>EM .1 D</strong></td>
<td></td>
<td><strong>EM .1 DS</strong></td>
<td></td>
</tr>
<tr>
<td>Pilot actuated</td>
<td><strong>EM .1 V</strong></td>
<td><strong>EMP .1 V</strong></td>
<td><strong>EM .2 V</strong></td>
<td><strong>EMP .1 S</strong></td>
</tr>
</tbody>
</table>

## Circuit example:

HMPL 5 US 1/PVPV/250-3
- A2 L 25/25/EI/3 BL 5 D7/120
- 32 L 25/25 C160/EI
- 32 L 63/63 C220/EI
- E4 - AMP 12 K4
### General parameters and dimensions

#### Screw-in valve

![Screw-in valve](image)

1. Screw-in valve

#### Valve compl. with connection block for pipe connection

![Connection block](image)

1. Connection block

<table>
<thead>
<tr>
<th></th>
<th>Screw-in valve</th>
<th>Valve with connection block</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q&lt;sub&gt;max&lt;/sub&gt;</strong> [lpm]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>p&lt;sub&gt;max&lt;/sub&gt;</strong> [bar]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>G</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>m</strong> [kg]</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ports</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dimensions</strong> [mm]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>H1</strong></td>
<td><strong>H2</strong></td>
</tr>
<tr>
<td><strong>EM 11 (D, DS)</strong></td>
<td>5</td>
<td>450</td>
</tr>
<tr>
<td><strong>EM 21 (D, DS)</strong></td>
<td>3</td>
<td>400</td>
</tr>
<tr>
<td><strong>EM 1.. (V, S)</strong></td>
<td>20</td>
<td>450</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EM/EMP 2.. (V, S)</strong></td>
<td>40</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EM/EMP 3.. (V, S)</strong></td>
<td>80</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EM/EMP 4.. (V, S)</strong></td>
<td>160</td>
<td>400</td>
</tr>
</tbody>
</table>

- Pressure above 300 bar only with manifolds made of steel. Pay attention to the possibly reduced rigidity of the thread with other materials (e.g. cast, aluminium).
Circuit example:

KA 442 LFK/HH 13.1/13.1
- SS-A 1 F 3/200
- BA 2
- NBVP 16 G/R-GM/NZP 16 TSPG/TB 0/3
- NBVP 16 G/R-GM/3
- 2-G 24
- X 84 G-9/250
- 3 x 400/230V 50 Hz-4.0 kW/24V DC

Suitable products:
- Intermediate plates NG 6 type NZP: D 7788 Z
- Connection blocks type HMPL and HMPV: Page 90
- Lifting/lowering valves type HSV: Page 150
- Lifting modules type HST, HMT etc.: Page 154

Associated technical data sheets:
- Directional seated valves type EM, EMP: D 7490/1, D 7490/1 E

Accessories:
- Pressure switches type DG 3., DG 5E: Page 262
- Drop-rate braking valves type SB, SQ, SJ: Page 210
- Suitable proportional amplifiers: Page 272

Male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833
- Proportional amplifier type EV2S: Page 274
Directional seated valves

2.2 Directional seated valve type BVG, BVP and NBVP

Directional seated valves are a type of directional valve. As cone valves they are tightly sealed without leakage in the closed state.

The directional seated valve type BVG is installed directly in the pipe. The valves type BVP and NBVP are valves for manifold mounting. The type NBVP has the standard connection pattern nominal size NG 6. 2/2, 3/2, 3/3 and 4/3 directional seated valves are available with different types of actuation. All connections can be subjected to the same pressures. Depending on the functional requirement, a check valve, restrictors and/or restrictor check valves are integrated into type NBVP, for example. Type NBVP is used together with other valves in valve bank type BA.

Features and benefits:
- Explosion-proof design
- 4th switching position on 4/3 directional valves
- 8-Watt solenoid

Intended applications:
- Machine tools
- Woodworking and processing machinery
- Testing machinery
- Jig construction

### Design and order coding example

<table>
<thead>
<tr>
<th>BVG</th>
<th>- R</th>
<th>/B2</th>
<th>- 1/4</th>
<th>- WGM 230</th>
</tr>
</thead>
</table>

**Actuations:** Solenoid, hydraulic, pneumatic, manual

**Connection size or connection block**

**Additional elements**
- Orifice in one port
- NBVP: orifice and/or check valve in the P gallery, orifice, restrictor check valve and/or pressure switches in port A, B, return pressure stop in T

**Function**
- 2/2-way directional valve (R, S), also available in version with position monitoring (RK, SK)
- 3/2-way directional valve (Z, Y), also available in version with position monitoring (ZK)
- 4/3-way directional valve (G, D)

**Basic type, size**
- Type BVG and BVP, size 1 and 3
- Type NBVP (with standard connection pattern NG 6), size 1

**Nomenclature:**
- Directional seated valve, zero leakage

**Design:**
- Individual valve for pipe connection
- Individual valve, Manifold mounting

**Actuation:**
- Solenoid
- Hydraulic
- Pneumatic
- Manual

**p<sub>max</sub>:** 400 bar

**q<sub>max</sub>:** 20 l/min
**Actuations:**

<table>
<thead>
<tr>
<th>Solenoid</th>
<th>Hydraulic</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Solenoid Actuation Symbol" /></td>
<td><img src="image2" alt="Hydraulic Actuation Symbol" /></td>
</tr>
</tbody>
</table>

Solenoid voltages: 12V DC, 24V DC, 110V AC, 230V AC
- BVP 1, NBVP16 also available in ATEX-compliant version
- Version with M12 plug and 8-watt solenoid

**Pneumatic**

![Pneumatic Actuation Symbol](image3)

Control pressure:
- $p_{\text{cont. min}} = 2...3.5 \text{ bar}$
- $p_{\text{cont. max}} = 15 \text{ bar}$

**Manual**

![Manual Actuation Symbol](image4)

Actuation torque:
- approx. $1.5...3 \text{ Nm}$

**Function**

<table>
<thead>
<tr>
<th>R</th>
<th>RK</th>
<th>S</th>
<th>SK</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Function Symbol R" /></td>
<td><img src="image6" alt="Function Symbol RK" /></td>
<td><img src="image7" alt="Function Symbol S" /></td>
<td><img src="image8" alt="Function Symbol SK" /></td>
<td><img src="image9" alt="Function Symbol Z" /></td>
</tr>
</tbody>
</table>

- Further circuit symbols available

<table>
<thead>
<tr>
<th>ZK</th>
<th>Y</th>
<th>G</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image10" alt="Function Symbol ZK" /></td>
<td><img src="image11" alt="Function Symbol Y" /></td>
<td><img src="image12" alt="Function Symbol G" /></td>
<td><img src="image13" alt="Function Symbol D" /></td>
</tr>
</tbody>
</table>

- Additional switching symbols available
- G, D: only for type NBVP16
- Versions with contact switch for position monitoring
### General parameters and dimensions

**BVG, BVP, NBVP**

#### Version for pipe connection (solenoid actuation)

#### Version for base manifold mounting (hydraulic actuation)

<table>
<thead>
<tr>
<th></th>
<th>$Q_{\text{max}}$ [lpm]</th>
<th>$p_{\text{max}}$ [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>$m_{\text{max}}$ [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BVG 1</td>
<td>20</td>
<td>400/250$^1$</td>
<td>G 1/4, G 3/8</td>
<td>H&lt;sub&gt;max&lt;/sub&gt; 115 (130)</td>
<td>B&lt;sub&gt;max&lt;/sub&gt; 60</td>
</tr>
<tr>
<td>BVP 1</td>
<td></td>
<td></td>
<td></td>
<td>B&lt;sub&gt;max&lt;/sub&gt; 35</td>
<td></td>
</tr>
<tr>
<td>NBVP 16</td>
<td>20</td>
<td>400/250$^1$</td>
<td>NG 6</td>
<td>T&lt;sub&gt;max&lt;/sub&gt; 45</td>
<td></td>
</tr>
</tbody>
</table>

$^1$ with solenoid actuation GM.. and WGM
Circuit example:

BA2A5
- NBVP16G/B2.0R/3
- NBVP16G/B2.0R/3
- NBVP16G/R/S/NZP16Q22/3
- NBVP16G/R/S/NZP16Q22/3
- NBVP16Y/B2.0R/2/NZP16CZ5/50/3 - X84V - 9/100A
- NBVP16W/B2.0R/3
- 2 - LM24

Associated technical data sheets:

**Directional seated valves**
- Directional seated valve type BVG 1 and BVP 1: D 7765
- Directional seated valve type NBVP 16: D 7765 N

**Products:**
- Type BA: Page 144
- Type NZP: Page 144
- Type BVH: Page 124

**Male connectors:**
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833
Directional seated valves

2.2 Directional seated valve type BVE

Directional seated valves are a type of directional valve. As cone valves they are tightly sealed without leakage in the closed state.
The directional seated valve type BVE is a screw-in valve. 2/2 and 3/2 directional seated valves are available. All connections can be subjected to the same pressures.
 Optionally a version for highly viscous media (e.g. lubricating grease) is available.
Appropriate connection blocks make possible direct pipe connection or manifold mounting.

Features and benefits:
- Any flow direction
- No interaction between actuation elements and medium
- No resinification or sticking as a result of increased temperatures is possible.
- For highly viscous media (e.g. lubricating grease)

Intended applications:
- Lubrication systems
- Mining machinery
- Construction and construction material machinery
- Handling and mounting technology

Nomenclature: Directional seated valve, zero leakage
Design: Individual valve for pipe connection
Individual valve for manifold mounting
Actuation: Solenoid
\[p_{\text{max}}:\] 500 bar
\[Q_{\text{max}}:\] 300 l/min

Design and order coding example

<table>
<thead>
<tr>
<th>BVE1</th>
<th>- R - B1.0</th>
<th>- G 24</th>
<th>- 3/8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port size or connection block</td>
<td>Version</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Solenoid voltages | With threaded connection
| | For manifold mounting |
| Versions with | M12 plug and 8 watt solenoid
| | AMP, DEUTSCH plugs |
| Additional elements | Orifice in one port |
| Function | 2/2-way directional valve (R, S)
| | 3/2-way directional valve (Z) |
| Basic type, size | Type BVE, size 1, 3 and 5 |

Actuations:
- Solenoid
Function

<table>
<thead>
<tr>
<th>R</th>
<th>S</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

General parameters and dimensions

<table>
<thead>
<tr>
<th>Q_{max} [lpm]</th>
<th>p_{max} [bar]</th>
<th>Dimensions [mm]</th>
<th>m_{max} [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>H_{max}</td>
<td>B_{max}</td>
</tr>
<tr>
<td>BVE 1</td>
<td>20</td>
<td>500</td>
<td>121</td>
</tr>
<tr>
<td>BVE 3</td>
<td>70</td>
<td>400</td>
<td>122,5</td>
</tr>
<tr>
<td>BVE 5</td>
<td>300</td>
<td>400</td>
<td>206,5</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- Directional seated valve type BVE: D 7921

Similar products:
- Type BA: Page 144
- Type NZP: Page 144
- Type BVH: Page 124
- Type BVG, BVP, NBVP: Page 134

Suitable male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833
Directional seated valves

2.2 Directional seated valve type VP

Directional seated valves are a type of directional valve. As cone valves they are tightly sealed without leakage in the closed state.

The directional seated valve type VP is a valve for manifold mounting. 2/2, 3/2 and 4/2 directional seated valves with different types of actuation are available. All connections can be subjected to the same pressures.

The directional seated valve type VP is suitable above all for highly viscous media (e.g. lubricating grease). Appropriate connection blocks make possible direct pipe connection.

Features and benefits:
- Any flow direction
- No interaction between actuation elements and medium
- No sticking or resinification as a result of increased temperatures is possible.
- Suitable for highly viscous media (e.g. lubricating grease)
- Explosion-proof version

Intended applications:
- Lubricating systems
- Mining machinery
- Construction and construction materials machinery
- Handling and assembly technology

Design and order coding example

<table>
<thead>
<tr>
<th>VP1</th>
<th>- R</th>
<th>- 3/4</th>
<th>- G24</th>
</tr>
</thead>
</table>

Actuation
- Solenoid
- Mechanical: roller, feeler
- Manual: lever, turn-knob

Optional connection block
For direct pipe connection

Function
- 2/2-way directional seated valve (R, S)
- 3/2-way directional seated valve (Z)
- 4/2-way directional seated valve (W, G)

Basic type, size
- Type VP, size 1
- Versions conforming ATEX

Actuation:
- Solenoid
- Hydraulic
- Pneumatic

Solenoid voltage:
12V DC; 24V DC; 110V AC, 230V AC

Hydraulic
Control pressure:
\( p_{\text{control min}} = 24 \text{ bar} \)
\( p_{\text{control max}} = 320 \text{ bar} \)

Pneumatic
Control pressure:
\( p_{\text{control min}} = 2 \ldots 3.5 \text{ bar} \)
\( p_{\text{control max}} = 15 \text{ bar} \)
## Function

<table>
<thead>
<tr>
<th>R</th>
<th>S</th>
<th>Z</th>
<th>G</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram R]</td>
<td>![Diagram S]</td>
<td>![Diagram Z]</td>
<td>![Diagram G]</td>
<td>![Diagram W]</td>
</tr>
</tbody>
</table>

### General parameters and dimensions

<table>
<thead>
<tr>
<th>Individual valve</th>
<th>Valve with sub-plate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example: VP1R-G24</td>
<td>Example: VP1W-3/4-WG 230</td>
</tr>
</tbody>
</table>

### Individual valve

#### Example: VP1R-G24

- $Q_{\text{max}}$ [lpm]
- $p_{\text{max}}$ [bar]
- Ports: A, B, C
- Dimensions [mm]:
  - $H_{\text{max}}$
  - $B_{\text{max}}$
  - $T_{\text{max}}$
- $m_{\text{max}}$ [kg]:

<table>
<thead>
<tr>
<th></th>
<th>$Q_{\text{max}}$</th>
<th>$p_{\text{max}}$</th>
<th>Ports</th>
<th>Dimensions</th>
<th>$m_{\text{max}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>VP 1</td>
<td>15</td>
<td>400</td>
<td>A, B, C</td>
<td>$H_{\text{max}}$</td>
<td>1.0</td>
</tr>
<tr>
<td>VP 1 with sub-plate</td>
<td>147 ... 177</td>
<td>50 ... 100</td>
<td>G 1/4, G 3/8, G 3/4</td>
<td>$B_{\text{max}}$</td>
<td>45 ... 80</td>
</tr>
</tbody>
</table>

- $H_{\text{max}}$: Values apply for electro-magnetic actuation

### Associated technical data sheets:
- Directional seated valve type VP: D 7915

### Similar products:
- Directional seated valve type BVG1, BVP1, NBVP16: [Page 134](#)
- Directional seated valve type BVE: [Page 138](#)

### Male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833
Directional seated valves

2.2 Directional seated valve type VH, VHR, and VHP

Directional seated valves are a type of directional valve. As ball valves they have zero leakage in the closed state.

A hand lever operates the eccentric shaft that controls the plunger for opening or closing the valve seats. The actuation is undertaken via the hand lever with automatic centring in the neutral position or with a notch. The directional seated valve type VH is suitable for pipe connection. The directional seated valve bank type VHR comprises several valves of type VH that have been clamped together connected in parallel via a tension rod to form a valve bank. The directional seated valve type VHP is available as a manifold mounting valve.

Features and benefits:
- Pressures up to 700 bar manually switchable
- Actuation using hand lever with automatic centring in zero position or with notch
- Different arrangements in valve bank possible
- Leakage-free seated valve technology

Intended applications:
- Construction and construction materials machinery
- Offshore and marine technology
- Process engineering systems
- Oil hydraulics and pneumatics

Design and order coding example

<table>
<thead>
<tr>
<th>VH 1</th>
<th>H1</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHR 1</td>
<td>G1/N1/E2</td>
</tr>
</tbody>
</table>

Function/valve sections with actuation
- Hand lever with automatic return (1) or detent (2)

Additional versions:
- Actuation with contact switch for neutral position monitoring (K), optionally for single valves and valve banks

Basic type, size
- Type VH (Individual valve for pipe connection)
- Type VHP (Individual valve, manifold mounting)
- Type VHR (Valve bank)
- Size 1 and 2

Actuation:
- Return spring
- Detent

Return spring : automatic return to neutral position only up to approx. 50 bar. At pressures over 50 ... 700 bar the lever must be reset manually.
### Function

#### Basic symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>VH</th>
<th>VHP</th>
<th>VHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>E</td>
<td>D</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>M</td>
<td>F</td>
<td>G</td>
<td>H</td>
</tr>
<tr>
<td>N</td>
<td>G</td>
<td>H</td>
<td>I</td>
</tr>
<tr>
<td>D</td>
<td>H</td>
<td>I</td>
<td>J</td>
</tr>
<tr>
<td>H</td>
<td>I</td>
<td>J</td>
<td>K</td>
</tr>
<tr>
<td>L</td>
<td>J</td>
<td>K</td>
<td>L</td>
</tr>
<tr>
<td>S</td>
<td>K</td>
<td>L</td>
<td>M</td>
</tr>
</tbody>
</table>

- On type VHR max. 7 or 5 valves (size 1 or 2) can be combined
- Type H, L, and S only as a single valve, not for type VHR

#### General parameters and dimensions

**Individual valve VH..**

- Q<sub>max</sub> [lpm]: 12
- p<sub>max</sub> [bar]: 700
- Ports: G 1/4
- Dimensions [mm]: H 50, H1 172, B 50, T 90
- Mass [kg]: 1.6

**Valve bank VHR..**

- Q<sub>max</sub> [lpm]: 25
- p<sub>max</sub> [bar]: 500
- Ports: G 3/8
- Dimensions [mm]: H 60, H1 162, B 60, T 120
- Mass [kg]: 3

### Associated technical data sheets:

- Directional seated valve type VH, VHP and VHR: D 7647

### Similar products:

- Directional seated valve type NBVP 16: D 7765 N
Mounted valves

2.2 Valve bank (nominal size 6) type BA

A valve bank combines different valves for operating independent consumers. The directional valve bank type BA consists of several valve sections that are fitted to sub-plates with NG 6. Using these items compact control blocks can be assembled flexibly. The intermediate plates type NZP make possible additional functions and contain, e.g., pressure-reducing valves, shock valves, load-holding valves etc. An intermediate plate can be inserted between the sub-plate and the valve. The valve bank type BA can be flange-mounted directly on the compact hydraulic power pack.

Features and benefits:
- Sub-plates for flexible combination of directional valve types with NG 6 (CETOP) standard connection pattern
- Valve bank can be flange mounted directly on the connection block of a compact hydraulic power pack or connected as a separately arranged valve bank for pipe connection
- Pressure switches and/or any other monitoring elements can be connected directly
- Additional elements, such as orifices, throttles and check valves for connections P, R, A and B can be integrated
- Hydraulic accumulator can be mounted directly

Intended applications:
- Clamping systems on machine tools and equipment
- Process control on deforming machine tools
- Brake and rotor adjustment modules on wind turbines

Nomenclature: Sub-plates/directional seated valve, zero leakage
Version: Valve section with sub-plates for pipe connection
Actuation: Solenoid
- Pressure-operated
  - Hydraulic
  - Pneumatic
- Manual
  - Mechanical
  - Pin
  - Roller

\[p_{\text{max}}\]: 500 bar
\[Q_{\text{max}}\]: 50 lpm
### Design and order coding example

<table>
<thead>
<tr>
<th>BA2 A5</th>
<th>NBVP16</th>
<th>S</th>
<th>NBVP16</th>
<th>G</th>
<th>NSWP2</th>
<th>G</th>
<th>B0,8 R</th>
<th>B0,6 R</th>
<th>/ABR2,0/BBR1,5</th>
<th>/ABR1,0/BBR1,5</th>
<th>/A389/400</th>
<th>/S</th>
<th>/S</th>
<th>/0</th>
<th>/3</th>
<th>/0</th>
<th>- 1</th>
<th>- G24</th>
</tr>
</thead>
</table>

**Solenoid voltage** 12V DC, 24V DC, 230V AC, 110V AC

**End plate**
- Drain valve with/without pressure switches
- with one or two accumulator ports with/without release valve and/or with/without drain valve

**Sub-plate**
- Check valves with release
- Throttle
- Additional pressure gauge connections

**Additional elements in R**
- Return pressure stop

**Additional elements in A, B**
- Throttle check valve in A and/or B
- Throttle valve in A and/or B

**Additional elements in P**
- Check valve
- Orifice

**Circuit symbol of the directional valve**

**Valve sections**
- **Directional valves**
  - Type NSMD2, NSWP2, NBVP16, NBMD16, NG..-1, NZP16

**Intermediate plates for series connection**
- Type CZ: with pressure-reducing valve in P gallery

**Intermediate plates for parallel connection type NZP**
- with throttle and/or throttle check valves
- with pressure-reducing valves
- with short-circuit and by-pass valves
- for random switching of a 2nd speed

**Connection block**
- Direct mounting onto type A, AF etc. connection blocks (for type KA, MP, MPN, HC, HK(F), HKL compact hydraulic power packs)
- Variant for pipe connection with/without pressure-limiting valve (A5)
**Function**

**Connection blocks/adapter plates:**

<table>
<thead>
<tr>
<th>BA2 ..</th>
<th>BA2 A5</th>
<th>BA2 A8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct mounting onto type A, AF etc. connection blocks at type KA, MP, MPN, HC, HK(F), HKL compact hydraulic power packs</td>
<td>Version for pipe connection without pressure-limiting valve</td>
<td>Like version BA2 A5 but with check valve in R</td>
</tr>
</tbody>
</table>

**Sub-plates for plate assembly valve**

<table>
<thead>
<tr>
<th>BA2../0</th>
<th>BA2../1</th>
<th>BA2../2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**BA2../3**

<table>
<thead>
<tr>
<th>BA2../5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Valve section additional options**

**Intermediate plates for 2nd speed with orifice/throttle in P and T gallery**

<table>
<thead>
<tr>
<th>/NZP16(T)V/P(T)Q20...</th>
<th>/NZP16(T)S/P(T)B...</th>
<th>/NZP16(T)VP</th>
<th>/NZP16(T)SP</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Intermediate plates for 2nd speed with orifice/throttle in P and T gallery" /></td>
<td><img src="image" alt="Intermediate plates for 2nd speed with orifice/throttle in P and T gallery" /></td>
<td><img src="image" alt="Intermediate plate for variable speed adaptation via proportional throttle in P and T gallery" /></td>
<td><img src="image" alt="Intermediate plate for variable speed adaptation via proportional throttle in P and T gallery" /></td>
</tr>
</tbody>
</table>

Example: .../NZP16TV/TB1.0/...
Type B1.0 orifice and type EM21V by-pass valve in T gallery

Example: .../NZP16VP/...
Type EMP21V proportional throttle valve in P gallery
Intermediate plate (series connection) with pressure-reducing valve for pressure reduction of the subsequent P gallery

Example: BAZ-CZ2/180/5R
Type CDK3 pressure-reducing valve set to 180 bar with check valve

Intermediate plates (parallel connection) with pressure-reducing valve in P gallery

Example: .../NZP16(26)CZ...
Type CDK0.8 pressure-reducing valve set to 350 bar with orifice and check valve in P gallery

### Actuations:

<table>
<thead>
<tr>
<th>M:</th>
<th>Solenoid actuation (p(_{\text{max}}) = 400 bar)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GM:</td>
<td>Solenoid actuation (p(_{\text{max}}) = 250 bar)</td>
</tr>
<tr>
<td>H:</td>
<td>Hydraulic actuation</td>
</tr>
<tr>
<td>P:</td>
<td>Pneumatic</td>
</tr>
<tr>
<td>A:</td>
<td>Manual actuation</td>
</tr>
<tr>
<td>T:</td>
<td>Pin</td>
</tr>
<tr>
<td>K:</td>
<td>Roller</td>
</tr>
</tbody>
</table>

### End plates

<table>
<thead>
<tr>
<th>-1</th>
<th>-6</th>
<th>-422</th>
<th>-8</th>
<th>-80/-8W</th>
<th>-880(88W)/...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td>with drain valve</td>
<td>with drain valve and pressure switches</td>
<td>with accumulator port and drain valve</td>
<td>with accumulator port and release valve</td>
<td>with two accumulator ports and release valve</td>
</tr>
</tbody>
</table>

---

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147/299
### General parameters and dimensions

**Mounted valve type BA**

<table>
<thead>
<tr>
<th>Q&lt;sub&gt;max&lt;/sub&gt; [lpm]</th>
<th>P&lt;sub&gt;max&lt;/sub&gt; [bar]</th>
<th>Ports (BSPP)</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
<th>Valve section</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A, B, P, R, M</td>
<td>H</td>
<td>B</td>
<td>T</td>
</tr>
<tr>
<td>20</td>
<td>400</td>
<td>G 1/4, G 3/8</td>
<td>139</td>
<td>50</td>
<td>60</td>
</tr>
</tbody>
</table>

1 Sub-plates type BA2
Circuit example:

HK 449 LDT/1 - Z16
- AL21R F2 - F/50/60 - 7/45

Type HK compact hydraulic power pack size 4;
connection block with accumulator charging valve, setting: 50 bar,
pressure-limiting valve, setting: 60 bar,
filter and pressure switch, setting: 45 bar

Parameters of the example circuit:
- \( Q_{pu} = 16 \text{ lpm (at 1450 rpm)} \)
- \( p_{max} = 110 \text{ bar} \)
- \( p_{system} = 60 \text{ bar} \)
  (pressure-limiting valve setting)
- \( p_{switch-off} = 50 \text{ bar} \)
- \( V_{load} = \text{approximately 5 l} \)

![Circuit Diagram]

Associated technical data sheets:
- Valve bank (nominal size 6) type BA: D 7788
- Intermediate plate type NZP: D 7788 Z

Suitable compact hydraulic power packs:
- See chapter on hydraulic power packs

Suitable connection block:
- Type A: Page 62

Combined products:
- Clamping module type NSMD: D 7787
- Directional spool valves type NSWP: Page 72
- Directional spool valve type SWPN: D 7451 AT
- Directional seated valves type NBVP: Page 134

Suitable accessories:
- Pressure switches type DG: Page 262
- Hydraulic accumulator type AC: Page 258

Suitable plugs:
- Line connector type MSD and others: D 7163
Lifting-lowering valves are a combination of directional valves and metering valves. The valve block type HSV provides the function of a 2/2-way directional seated valve with electrical actuation for lowering the load. Adjustable throttle valves or flow control valves independent of the load control the lowering speed. An integrated pressure-limiting valve limits the permissible load.

The lifting/lowering valve type HSV is used to control lifting equipment with single-acting cylinders.

Features and benefits:
- Optimum control of lifting and lowering function
- High pressures up to 400 bar
- Zero leakage to prevent unwanted lowering of loads and platforms
- Integrated overpressure protection

Intended applications:
- Cranes and lifting equipment
- Materials handling
- Road vehicle
- Mining machinery

Nomenclature:
- Valve combination consisting of:
  - 2/2-way directional seated valve, solenoid actuated
  - Pressure-limiting valve
  - Check valve optional
  - Throttle or 2-way flow control valve

Design:
- Individual valve for pipe connection

Actuation:
- Solenoid

$P_{\text{max}}$: 400 bar

$Q_{\text{max}}$: 120 l/min

Design and order coding example:

<table>
<thead>
<tr>
<th>HSV 21</th>
<th>- R1</th>
<th>- R-150</th>
<th>- G24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid voltage</td>
<td>12 V DC, 24 V DC, 110 V AC, 230 V AC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure limiting valve</td>
<td>HSV 21 and HSV 22 also in explosion-proof version</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Manually adjustable or fixed, pressure setting in bar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Basic type, size: Type HSV, sizes 2 and 7
Function

<table>
<thead>
<tr>
<th>Function</th>
<th>With throttle</th>
<th>Without throttle</th>
<th>With/without throttle</th>
<th>With 2-way flow control valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSV 21</td>
<td>R 1</td>
<td>R 2</td>
<td>R 3</td>
<td>S 1 ... S 4</td>
</tr>
<tr>
<td>HSV 22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSV 71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- Lifting/lowering valve type HSV: D 7032

Similar products:
- Connection block type HMPL and HMPV for proportional directional spool valve: D 7700 H

Male connectors:
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833

General parameters and dimensions

<table>
<thead>
<tr>
<th>HSV 21; HSV 22</th>
<th>Q&lt;sub&gt;max&lt;/sub&gt; [lpm]</th>
<th>p&lt;sub&gt;max&lt;/sub&gt; [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSV 21</td>
<td>20</td>
<td>315</td>
<td>P</td>
<td>A, R</td>
<td>H T T1</td>
</tr>
<tr>
<td>HSV 22</td>
<td>30</td>
<td>315</td>
<td>G 3/8</td>
<td>G 3/8</td>
<td>see illustration</td>
</tr>
<tr>
<td>HSV 71</td>
<td>120</td>
<td>315</td>
<td>G 3/4</td>
<td>G 3/4</td>
<td>100 80 160</td>
</tr>
</tbody>
</table>

1 2/2 directional seated valve
2 Pressure-limiting valve
3 Throttle
2.2 Switch unit type CR

Switch units combine the function of a directional seated valve with a pressure valve and check valve. They control dual stage pumps, a combination of high-pressure pump and low-pressure pump, in bottom and top ram presses. The low-pressure circuit and the high-pressure circuit are combined for rapid movement.

If the low-pressure value is reached or exceeded, the switch unit type CR switches the low-pressure circuit to circulation. The high-pressure pump carries out the pressing action. The switch unit hydraulic release acts automatically. It initiates surge-free decompression that relieves the press. In the closed state the switch unit has zero leakage.

The switch unit type CR can be attached directly to hydraulic power packs type MPN and RZ.

Features and benefits:
- Special valve for controlling upstroke presses
- Smooth, gentle switching
- No pressure drop during press operation due to zero leakage
- Fully automatic switching of the low-pressure pump to circulation

Intended applications:
- Machine tools (presses)
- Woodworking and processing machinery
- Printing and paper technology
- Foodstuff and packaging machinery

Nomenclature:
- Valve combination consisting of:
  - 2/2-directional seated valve
  - Ball-type check valve
  - Pressure valve

Design:
- Individual valve for pipe connection

Actuation:
- Solenoid
- Manual

Design and order coding example

<table>
<thead>
<tr>
<th>CR4</th>
<th>M-WG230</th>
<th>- 400/60</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High-/low pressure</td>
</tr>
<tr>
<td>Actuation mode</td>
<td>Solenoid</td>
<td></td>
</tr>
<tr>
<td>Voltage of the actuation solenoids</td>
<td>24V DC, 230V AC 50/60 Hz</td>
<td></td>
</tr>
<tr>
<td>Manually</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic type, size</td>
<td>Type CR, size 4 and 5</td>
<td></td>
</tr>
</tbody>
</table>
Function

CR 4M; CR 5M

CR 4H

1. Actuating solenoid
2. Pressure-limiting valve

General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>Q_{\text{max}} [lpm]</th>
<th>p_{\text{max}} [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HP</td>
<td>NP</td>
<td>A → R</td>
<td>HP</td>
<td>NP</td>
</tr>
<tr>
<td>CR 4M</td>
<td>8</td>
<td>80</td>
<td>200</td>
<td>400</td>
<td>(0) ... 60</td>
</tr>
<tr>
<td>CR 4H</td>
<td>8</td>
<td>80</td>
<td>200</td>
<td>400</td>
<td>(0) ... 60</td>
</tr>
<tr>
<td>CR 5M</td>
<td>20</td>
<td>160</td>
<td>300</td>
<td>400</td>
<td>(0) ... 60</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- Switch unit type CR: D 7150

Similar products:
- Two-stage valves type NE: Page 192

Hydraulic power packs:
- Compact hydraulic power packs type MP, MPN, MPNW, MPW: Page 50

Male connectors:
- Line connector type MSD and others: D 7163
Directional seated valves

2.2 Lifting module type HMT and HST

Lifting modules or hoist control valves are a combination of directional valves and pressure control valves. They are used to control a lifting function. The flow rate is controlled or limited proportionally both on lifting and also on lowering.

In the lifting module type HMT and HST directional seated valves are used that ensure the load is held securely. Two-way flow control valves are used to limit the maximum flow rate. Valve sections of type SWS can be attached space-savingly to the lifting module to control additional functions. The lifting module type HMT and HST is suitable for use in industrial trucks and agricultural machinery.

Features and benefits:
- Flexible design for fixed or variable displacement pump systems
- Low spatial requirements due to steel design
- Flexible combination with directional valves

Intended applications:
- Materials handling (industrial trucks etc.)
- Cranes and lifting equipment
- Road vehicle

Nomenclature: Valve combination according to type consisting of:
- 2-way flow control valves
- 2-way seated valves
- Directional spool functions

Design: Valve bank
Actuation: Solenoid

\[ p_{\text{max}}: \] 315 bar
\[ Q_{\text{max}}: \] 90 lpm

Design and order coding example

<table>
<thead>
<tr>
<th>HMT34D</th>
<th>- 1/250</th>
<th>- G/MP/0/2</th>
<th>- 31EP - G 24</th>
</tr>
</thead>
</table>

End plate
- With two P ports and one R port
- With prop. idle circulation valve
- With solenoid valve for the parking brake

Valve sections, ancillary- and intermediate blocks
- Various intermediate blocks for mast tilting, mast shifting, auxiliary hydraulics
- Directional valve sections type SWR 1 with additional functions
- Directional valve sections type SWS 2

Connection block
- Pressure setting [bar] of the pressure limiting valve

Additional versions
- Connection blocks type SWR, SWS
- With flow divider
- With/without pressure limiting valve
- With shut-off valve for P and H (lift)

Basic type
- Lifting modules and hoist control valves
Drive concept and application:

<table>
<thead>
<tr>
<th>Drive concept</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scissor lift</td>
</tr>
<tr>
<td>2</td>
<td>Miniature stacker, Walkie stacker</td>
</tr>
<tr>
<td></td>
<td>Counter balance truck</td>
</tr>
<tr>
<td></td>
<td>Reach truck</td>
</tr>
<tr>
<td></td>
<td>Order picker (warehouse)</td>
</tr>
</tbody>
</table>

HST | x | x | x | x | x | x | no man aloft | man aloft |
HMT | x | x | x | x | x | x | (*)

Drive concepts:
- 1: Constant pump, lifting/lowering via a controller (throttle)
- 2: Lifting via a speed-controlled pump, lowering via a controller (throttle)

Circuit example:

HMT 34-1/200-70F
-G/M/0/2 AN40 BN130
-D/M/0/02
-31E-P12/6 24

Lifting module type HMT, size 3, port size 4 with pressure-limiting valve (set to 200 bar), output controller with 70 l control orifice closed in normal position; segment G with shock and servo-suction valves (set values 40 and 130 bar) in ancillary block; end plate with idle circulation valve open in neutral position, proportional solenoid voltage for flow control valves 12V DC, solenoid voltage for directional spool valve and directional seated valves 24V DC

Tilting

1 Main stroke
2 Tilt
3 Fork adjustment
### Function

**Lifting modules and connection blocks:**

<table>
<thead>
<tr>
<th>HST</th>
<th>HMT</th>
</tr>
</thead>
</table>

![Diagram of HST and HMT modules](image)

**Intermediate blocks (main and initial lift):**

<table>
<thead>
<tr>
<th>Size 2</th>
<th>Size 3</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>D</th>
<th>T2</th>
<th>G/M/DW/2 AN... BN...</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Diagram of Size 2" /></td>
<td><img src="image" alt="Diagram of T2" /></td>
<td><img src="image" alt="Diagram of Size 3" /></td>
<td><img src="image" alt="Diagram of T2" /></td>
</tr>
</tbody>
</table>

- Size 2: Hole pattern SWR 1, size 3: Hole pattern SWR 2/SWS 2

**End plates:**

<table>
<thead>
<tr>
<th>Size 2 and 3</th>
<th>Size 2 and 3</th>
<th>Size 3</th>
<th>Size 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>21E</td>
<td>31E</td>
</tr>
</tbody>
</table>

| ![Diagram of Size 2](image) | ![Diagram of Size 2 and 3](image) | ![Diagram of Size 3](image) | ![Diagram of Size 3](image) |
**General parameters and dimensions**

<table>
<thead>
<tr>
<th></th>
<th>Q&lt;sub&gt;max&lt;/sub&gt; [lpm]</th>
<th>p&lt;sub&gt;max&lt;/sub&gt; (bar)</th>
<th>Note</th>
<th>Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>HST 2</td>
<td>20 - 40</td>
<td>315</td>
<td>Connection blocks of lifting module</td>
<td>P, R, H= G 1/2; M = G 3/8</td>
</tr>
<tr>
<td>HST 3</td>
<td>30 - 60</td>
<td></td>
<td>Add-on components:</td>
<td>P, R, H= G 3/4; M = G 3/8</td>
</tr>
<tr>
<td>HMT 3</td>
<td>70 - 90</td>
<td></td>
<td>- SWR/SWS-Valve sections</td>
<td>H, P, R= G 1/2; M = G 3/8</td>
</tr>
<tr>
<td>HMT 34</td>
<td>70 - 90</td>
<td></td>
<td>- Intermediate blocks</td>
<td>H= G 3/4; P, R = G 1/2; M = G 3/8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- End plates</td>
<td></td>
</tr>
</tbody>
</table>

**Associated technical data sheets:**
- Type HMT: Sk 7758 HMT ff
- Type HST: Sk 7650 HST ff

**Information on additional lifting modules on inquiry**

**Similar products:**
- Directional spool valves type SWR, SWS 2: Page 76
- Connection blocks type HMPL and HMPV: Page 90

**Male connectors:**
- Line connector type MSD and others: D 7163
- With economy circuit: D 7813, D 7833
- Proportional amplifier type EV25: D 7818/1
# Pressure control valves

<table>
<thead>
<tr>
<th>Valve Type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure-limiting valve type MV, SV and DMV</td>
<td>162</td>
</tr>
<tr>
<td>Pressure control valve type CMV, CMVZ, CSV and CSVZ</td>
<td>166</td>
</tr>
<tr>
<td>Pressure-limiting valve, pilot-controlled type DV, AS etc.</td>
<td>168</td>
</tr>
<tr>
<td>Sequence valves with check valve type VR</td>
<td>170</td>
</tr>
<tr>
<td>Proportional pressure-limiting valve type PMV and PDV</td>
<td>172</td>
</tr>
<tr>
<td>Pressure-reducing valve type ADC, ADM, ADME and AM</td>
<td>174</td>
</tr>
<tr>
<td>Pressure-reducing valve type ADM and VDM</td>
<td>176</td>
</tr>
<tr>
<td>Pressure-reducing valve type CDK, CLK, DK, DLZ and DZ</td>
<td>180</td>
</tr>
<tr>
<td>Proportional pressure-reducing valve type PM and PMZ</td>
<td>184</td>
</tr>
<tr>
<td>Proportional pressure-reducing valve type PDM</td>
<td>186</td>
</tr>
<tr>
<td>Proportional pressure-reducing valve type KFB and FB</td>
<td>188</td>
</tr>
<tr>
<td>Pressure-controlled shut-off valve type CNE</td>
<td>190</td>
</tr>
<tr>
<td>Two-stage valve type NE</td>
<td>192</td>
</tr>
<tr>
<td>Shut-off valve type LV and ALZ</td>
<td>194</td>
</tr>
<tr>
<td>Pressure-dependent shut-off valve type DSV and CDSV</td>
<td>196</td>
</tr>
<tr>
<td>Load-holding valve type LHK, LHDV and LHT</td>
<td>198</td>
</tr>
</tbody>
</table>
## Pressure-limiting and sequence valves (also proportional)

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / adjustability</th>
<th>( p_{\text{max}} ) (bar)</th>
<th>( q_{\text{max}} ) (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MV, SV, DMV</strong></td>
<td>Single valve for pipe connection or manifold mounting</td>
<td>MVG - 13: 700</td>
<td>MVG - 13: 8</td>
</tr>
<tr>
<td></td>
<td>Screw-in valve, installation kit</td>
<td>MVG - 14: 700</td>
<td>MVG - 14: 8</td>
</tr>
<tr>
<td></td>
<td>- Fixed</td>
<td>MV, SV - 4: 700</td>
<td>MV, SV - 4: 20</td>
</tr>
<tr>
<td></td>
<td>- Adjustable</td>
<td>MV, SV - 5: 700</td>
<td>MV, SV - 5: 40</td>
</tr>
<tr>
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<td>MV, SV - 6: 700</td>
<td>MV, SV - 6: 70</td>
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<tr>
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<td></td>
<td>MV, SV - 8: 700</td>
<td>MV, SV - 8: 160</td>
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<tr>
<td></td>
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<td>DMV - 4: 350</td>
<td>DMV - 4: 20</td>
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<td>DMV - 5: 350</td>
<td>DMV - 5: 40</td>
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<td>DMV - 6: 350</td>
<td>DMV - 6: 75</td>
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<td></td>
<td></td>
<td>DMV - 8: 315</td>
<td>DMV - 8: 160</td>
</tr>
<tr>
<td><strong>CMV(Z), CSV(Z)</strong></td>
<td>Screw-in valve</td>
<td>CMV - 1: 500</td>
<td>CMV - 1: 20</td>
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<tr>
<td></td>
<td>- Fixed</td>
<td>CMV - 2: 500</td>
<td>CMV - 2: 40</td>
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<tr>
<td></td>
<td>- Adjustable</td>
<td>CMV - 3: 500</td>
<td>CMV - 3: 60</td>
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<td></td>
<td></td>
<td>CSV - 2: 315</td>
<td>CSV - 2: 40</td>
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<tr>
<td></td>
<td></td>
<td>CSV - 3: 315</td>
<td>CSV - 3: 60</td>
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<tr>
<td></td>
<td></td>
<td>CSVZ - 2: 315</td>
<td>CSVZ - 2: 40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CMVZ - 2: 500</td>
<td>CMVZ - 2: 40</td>
</tr>
<tr>
<td><strong>DV, AS</strong></td>
<td>Single valve for pipe connection or manifold mounting</td>
<td>DV - 3: 420</td>
<td>DV - 3: 40</td>
</tr>
<tr>
<td></td>
<td>- Fixed</td>
<td>DV - 4: 420</td>
<td>DV - 4: 80</td>
</tr>
<tr>
<td></td>
<td>- Adjustable</td>
<td>DV - 5: 420</td>
<td>DV - 5: 120</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AS - 3: 350</td>
<td>AS - 3: 50</td>
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<td></td>
<td>AS - 4: 350</td>
<td>AS - 4: 80</td>
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<td></td>
<td>AS - 5: 350</td>
<td>AS - 5: 120</td>
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<td><strong>VR</strong></td>
<td>Insert valve</td>
<td>1: 315</td>
<td>1: 15</td>
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<td></td>
<td></td>
<td>2: 315</td>
<td>2: 40</td>
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<td>3: 315</td>
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<tr>
<td></td>
<td></td>
<td>4: 315</td>
<td>4: 120</td>
</tr>
<tr>
<td><strong>PMV, PDV</strong></td>
<td>Single valve for pipe connection or manifold mounting</td>
<td>PMV - 4: 700</td>
<td>PMV - 4: 16</td>
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<tr>
<td></td>
<td>- Electro-proportional</td>
<td>PMV - 5: 450</td>
<td>PMV - 5: 60</td>
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<td>PMV - 6: 320</td>
<td>PMV - 6: 75</td>
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<td>PMV - 8: 180</td>
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<td>PDV - 3: 350</td>
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<td>PDV - 4: 350</td>
<td>PDV - 4: 80</td>
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<td></td>
<td></td>
<td>PDV - 5: 350</td>
<td>PDV - 5: 120</td>
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</table>
**Pressure reducing valves (also proportional)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / adjustability</th>
<th>$p_{\text{max}}/p_{\text{a}}$ (bar)</th>
<th>$Q_{\text{max}}$ (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADC, ADM, ADME, AM</td>
<td>• Screw-in valve</td>
<td>ADC 1: 300/25</td>
<td>ADC 1: 2</td>
</tr>
<tr>
<td></td>
<td>• For pipe connection</td>
<td>ADM 1: 315/70</td>
<td>ADM 1: 10</td>
</tr>
<tr>
<td></td>
<td>• Fixed</td>
<td>ADME 1: 315/70</td>
<td>ADME 1: 8</td>
</tr>
<tr>
<td></td>
<td>• Adjustable</td>
<td>AM 1: 400/100</td>
<td>AM 1: 2</td>
</tr>
<tr>
<td>ADM, VDM</td>
<td>• Single valve for pipe connection or manifold mounting</td>
<td>ADM 1: 315/70</td>
<td>ADM 1: 10</td>
</tr>
<tr>
<td></td>
<td>• Directly controlled or pilot-controlled</td>
<td>ADM 11: 320/250</td>
<td>ADM 11: 12</td>
</tr>
<tr>
<td></td>
<td>• Fixed</td>
<td>ADM 21: 320/250</td>
<td>ADM 21: 25</td>
</tr>
<tr>
<td></td>
<td>• Adjustable</td>
<td>ADM 22: 320/250</td>
<td>ADM 22: 25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ADM 32: 320/250</td>
<td>ADM 32: 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ADM 33: 320/250</td>
<td>ADM 33: 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VDM 3: 400/300</td>
<td>VDM 3: 40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VDM 4: 400/300</td>
<td>VDM 4: 70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VDM 5: 400/300</td>
<td>VDM 5: 120</td>
</tr>
<tr>
<td>CDK, CLK, DK, DLZ, DZ</td>
<td>• Screw-in valve according to the 2-way principle</td>
<td>CDK - 3: 500/450</td>
<td>CDK - 3: 22</td>
</tr>
<tr>
<td></td>
<td>• Combination with connection block</td>
<td>CLK - 3: 500/450</td>
<td>CLK - 3: 22</td>
</tr>
<tr>
<td></td>
<td>• Fixed</td>
<td>DLZ - 3: 400/380</td>
<td>DLZ - 3: 22</td>
</tr>
<tr>
<td></td>
<td>• Adjustable</td>
<td>DK - 3: 500/450</td>
<td>DK - 3: 22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DZ - 3: 500/450</td>
<td>DZ - 3: 22</td>
</tr>
<tr>
<td>PM, PMZ</td>
<td>• Installation kit</td>
<td>PM - 1: 40/30</td>
<td>PM - 1: 2</td>
</tr>
<tr>
<td></td>
<td>• Individual valve for manifold mounting</td>
<td>PM - 11: 40/30</td>
<td>PM - 11: 2</td>
</tr>
<tr>
<td></td>
<td>• Electro-proportional</td>
<td>PM - 12: 40/30</td>
<td>PM - 12: 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PM - 22: 40/30</td>
<td>PM - 22: 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PMZ - 1: 40/30</td>
<td>PMZ - 1: 2</td>
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<tr>
<td>PDM</td>
<td>• Single valve for pipe connection or manifold mounting</td>
<td>11: 320/320</td>
<td>11: 12</td>
</tr>
<tr>
<td></td>
<td>• Electro-proportional</td>
<td>12: 320/320</td>
<td>12: 12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21: 320/180</td>
<td>21: 20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22: 320/180</td>
<td>22: 20</td>
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<td></td>
<td>3: 350/350</td>
<td>3: 40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4: 350/350</td>
<td>4: 80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5: 350/350</td>
<td>5: 120</td>
</tr>
<tr>
<td>KFB, FB</td>
<td>• Single valve for pipe connection</td>
<td>01: 120/30</td>
<td>01: 2</td>
</tr>
<tr>
<td></td>
<td>• Manual</td>
<td>01: 2</td>
<td></td>
</tr>
</tbody>
</table>
**Directional valves (follow-up, shut-off, switch-off valves)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / adjustability</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$q_{\text{max}}$ (lpm)</th>
</tr>
</thead>
</table>
| CNE  | ■ 2-way idle circulation valve  
       ■ Screw-in valve  
       - Fixed | 2: 500  
       21: 500  
       22: 420  
       23: 500 | 2: 30  
       21: 30  
       22: 30  
       23: 30|
| NE   | ■ Two-stage valve  
       (high-pressure /  
       low-pressure stage)  
       ■ Single valve for pipe connection  
       - Fixed | HP/LP:  
       20, 21: 700/55  
       70: 500/60  
       80: 500/30 | HP/LP:  
       20, 21: 10/40  
       70: 16/100  
       80: 25/180|
| LV, ALZ | ■ Shut-off valve (idle circulation valve, directly  
           controlled or pilot-controlled)  
       ■ Single valve for pipe connection or manifold  
           mounting  
       - Fixed  
       - Adjustable | LV - 10: 350  
       LV - 20: 350  
       LV - 25: 350  
       ALZ - 3: 350  
       ALZ - 4: 350  
       ALZ - 5: 350 | LV - 10: 12  
       LV - 20: 25  
       LV - 25: 15  
       ALZ - 3: 50  
       ALZ - 4: 80  
       ALZ - 5: 120|
| DSV, CDSV | ■ Single valve for pipe connection or manifold  
            mounting  
       ■ Screw-in valve  
       - Fixed  
       - Manual | CDSV - 1: 600  
       DSV - 21-1: 400  
       DSV - 2-2: 400  
       DSV - 2-3: 400 | CDSV - 1: 8  
       DSV - 21-1: 20  
       DSV - 2-2: 40  
       DSV - 2-3: 60|

**Load-holding valves**

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / adjustability</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$q_{\text{max}}$ (lpm)</th>
</tr>
</thead>
</table>
| LHK, LHDV, LHT | ■ Single valve for pipe connection or manifold  
                 mounting  
       ■ Screw-in valve, version for banjo bolt mounting  
       - Fixed  
       - Adjustable | LHK - 2: 400  
       LHK - 3: 360  
       LHK - 4: 350  
       LHDV - 33: 420  
       LHT - 2: 400  
       LHT - 3: 420  
       LHT - 5: 400 | LHK - 2: 20  
       LHK - 3: 60  
       LHK - 4: 100  
       LHDV - 33: 80  
       LHT - 2: 28  
       LHT - 3: 130  
       LHT - 5: 250|
Pressure control valves

2.3 Pressure-limiting valve type MV, SV and DMV

Pressure-limiting valves and sequence valves are types of pressure control valves. Pressure-limiting valves safeguard the system against excessive system pressure or limit the operation pressure. Sequence valves generate a constant pressure difference between the inlet and outlet flow. Type MV and SV is a directly controlled valve that is damped as standard. Versions that correspond to the Pressure Equipment Directive are also available.

Features and benefits:
- Operating pressures up to 700 bar
- Various adjustment options
- Numerous configurations

Intended applications:
- General hydraulic systems
- Test benches
- Hydraulic tools

Design and order coding example

<table>
<thead>
<tr>
<th>MVS 52</th>
<th>B</th>
<th>R</th>
<th>X</th>
<th>- 650</th>
</tr>
</thead>
</table>

- Pressure setting
  - Optionally without dampening (X)
- Adjustability (while pressurized)
  - fixed
  - Manually adjustable
  - Adjustable with turn knob (self-locking/lockable)

Pressure range and volumetric flow
- Pressure ranges A, B, C, E and F

Basic type, size
- Type MV.., DMV.. and SV..

Additional versions
- Pressure-limiting valves with unit approval (TÜV valves) (type MVX, MVSX, MVEX, MVPX, SVX, size 4, 5 and 6)
- Various actuations: ball head for controls via cam, lever etc. (type MVG and MVP only)
<table>
<thead>
<tr>
<th>Function</th>
<th>MV</th>
<th>MVS</th>
<th>MVE</th>
<th>SV</th>
<th>MVP</th>
<th>DMV</th>
<th>MVCS</th>
<th>SVC</th>
<th>MVB</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV</td>
<td>MVG</td>
<td></td>
<td></td>
<td>SV</td>
<td>MVP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function</td>
<td>Pressure limiting valve</td>
<td>Pressure limiting valve and differential pressure regulators</td>
<td>Pressure limiting valve</td>
<td>Pressure-limiting valve with free reflux R→P via a bypass check valve</td>
<td>Pressure limiting valve and differential pressure regulators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brief description</td>
<td>Corner valve for pipe connection</td>
<td>Corner valve for pipe connection</td>
<td>Screw-in valve</td>
<td>Straight-way valve for straight pipe installation</td>
<td>Manifold mounting valve</td>
<td>Twin valve as shock valve for hydraulic motors</td>
<td>Corner valve for pipe connection</td>
<td>Straight-way valve for straight pipe installation</td>
<td>Assembly kit</td>
</tr>
<tr>
<td>Size</td>
<td>4, 5, 6</td>
<td>13, 14, 4, 5, 6, 8</td>
<td>4, 5, 6, 8</td>
<td>13, 14, 4, 5, 6, 8</td>
<td>4, 5, 6, 8</td>
<td>13, 14, 4, 5, 6</td>
<td>4, 5, 6</td>
<td>4, 5, 6, 8</td>
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</tr>
<tr>
<td>$p_{perm}$ [bar]</td>
<td>20</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>350</td>
<td>500</td>
<td>500</td>
<td>200</td>
</tr>
</tbody>
</table>

1) Only size 4, 5, 6, and 8
Type MVG and MVGC only size 13 and 14

Circuit example:
General parameters and dimensions

See following table for dimensions.
### Associated technical data sheets:
- Pressure-limiting valve type MV, SV and DMV: D 7000/1
- Pressure-limiting valve and pre-load valve type MVG, MVE and MVP: D 3726
- Pressure-limiting valve (installation kit) type MV: D 7000 E/1
- Multiple pressure-limiting valve type MV: D 7000 M
- Pressure-limiting valve, with unit approval type MV .X: D 7000 TÜV

### Similar products:
- Pressure control valves for screwing in type CMV, CSV: Page 166
- Pilot-controlled pressure control valves type DV: Page 168
- Pilot-controlled pressure control valves type A: Page 168

### Table: Basic Data

<table>
<thead>
<tr>
<th>Size</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
<th>Size</th>
<th>Pressure range/Flow</th>
<th>Ports 1)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Hmax</td>
<td>B/SW</td>
<td>Tmax</td>
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</tr>
<tr>
<td>MV, MVS, MVCS, MVE</td>
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<tr>
<td>4</td>
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<td>29</td>
<td>60</td>
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<td>E: 160/20</td>
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<tr>
<td>6</td>
<td>164</td>
<td>36</td>
<td>70</td>
<td>0.7</td>
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<td>8</td>
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<td>40</td>
<td>60</td>
<td>2.0</td>
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<td>DMV</td>
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<td>65</td>
<td>1.3</td>
<td>E: 160/40</td>
</tr>
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<td>142.5</td>
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<td>75</td>
<td>1.8</td>
<td>C: 315/40</td>
</tr>
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<td>80</td>
<td>96</td>
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</tr>
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<td>F: 80/75</td>
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<tr>
<td>5</td>
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<td>40</td>
<td>0.5</td>
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<td>6</td>
<td>133</td>
<td>35</td>
<td>50</td>
<td>0.8</td>
<td>C: 315/75</td>
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<td>50</td>
<td>60</td>
<td>1.6</td>
<td>B: 500/75</td>
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<td>13, 14</td>
<td>82</td>
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<td>50</td>
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<td>75</td>
<td>SW 27</td>
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<td>MVGC</td>
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<td>13, 14</td>
<td>94</td>
<td>20</td>
<td>42</td>
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<td>E: 160/160</td>
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<td>SV, SVC</td>
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<td>-</td>
<td>SW 22</td>
<td>87</td>
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<td>N: 50/8</td>
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<tr>
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<td>-</td>
<td>SW 27</td>
<td>108</td>
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<td>-</td>
<td>SW 32</td>
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<td>SV</td>
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<td>-</td>
<td>SW 41</td>
<td>157</td>
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</tr>
</tbody>
</table>

1) For pipe connection versions only
2.3 Pressure control valve type CMV, CMVZ, CSV and CSVZ

Pressure-limiting valves and sequence valves are types of pressure control valves. Pressure-limiting valves safeguard the system against excessive system pressure or limit the operation pressure. Sequence valves generate a constant pressure difference between the inlet and outlet flow.

Type CMV and CSV is a directly controlled valve that is damped as standard. Versions that correspond to the Pressure Equipment Directive are also available. Type CMVZ and CSVZ is not influenced by the pressure conditions downstream and is therefore suitable for use in loss-free sequence control systems.

Valve type CMV and CSV can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make.

Features and benefits:
- Operating pressures up to 500 bar
- Various adjustment options
- Easily produced mounting hole

Intended applications:
- General hydraulic systems
- Test benches
- Hydraulic tools

Features and benefits:
- Operating pressures up to 500 bar
- Various adjustment options
- Easily produced mounting hole

Intended applications:
- General hydraulic systems
- Test benches
- Hydraulic tools

Nomenclature:
- Pressure-limiting valve
- Sequence valve (directly controlled)

Design:
- Screw-in valve

Adjustment:
- Tool adjustable (fixed)
- Manually (adjustable)

Design and order coding example

<table>
<thead>
<tr>
<th>CMV 3</th>
<th>F</th>
<th>R</th>
<th>- 200</th>
<th>- 1/4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Single connection block for pipe connection

Pressure setting [bar]
Adjustability (while pressurized)  fixed or manually adjustable
Pressure range  Pressure ranges B, C, E and F

Basic type, size
Type CMV (pressure limiting valve), size 1 to 3
Type CSV (pressure difference valve), size 2 to 3

Additional versions:
- Sequence valves CMVZ or CSVZ
- Version with unit approval type CMVX
- Undamped version (CMV)
### Function

<table>
<thead>
<tr>
<th>CMV</th>
<th>CMVZ</th>
<th>CSV</th>
<th>CSVZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure limiting valve (port R pressure resistant)</td>
<td>Sequence valves with by-pass check valve</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### General parameters and dimensions

#### CMV/CMVZ

<table>
<thead>
<tr>
<th>Size</th>
<th>Q_{max} [lpm]</th>
<th>Pressure range p_{max} [bar]</th>
<th>M</th>
<th>SW = a/f</th>
<th>Dimensions [mm]</th>
<th>m [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMV, CMVZ</td>
<td>1</td>
<td>20</td>
<td>F: 80</td>
<td>M 16 x 1.5 SW 22</td>
<td>H_{max}</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>40</td>
<td>E: 160 C: 315</td>
<td>M 20 x 1.5 SW 24</td>
<td>94</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>60</td>
<td>B: 500</td>
<td>M 24 x 1.5 SW 30</td>
<td>114</td>
<td>83</td>
</tr>
<tr>
<td>CSV, CSVZ</td>
<td>2</td>
<td>40</td>
<td></td>
<td>M 20 x 1.5 SW 24</td>
<td>104</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>60</td>
<td></td>
<td>M 24 x 1.5 SW 30</td>
<td>122</td>
<td>82</td>
</tr>
</tbody>
</table>

#### CSV/CSVZ

### Associated technical data sheets:
- Pressure control valve type CMV, CMVZ, CSV and CSVZ: D 7710 MV
- Safety valve with unit approval type CMVX: D 7710 TUV
- Pilot-controlled pressure control valves type DV: Page 168
- Pilot-controlled pressure control valves type AS: Page 168

### Similar products:
- Pressure-limiting valves type MV, SV etc.: Page 162
- Miniature pressure-limiting valves type MVG etc.: Page 162
Pressure valves

2.3 Pressure-limiting valve, pilot-controlled type DV, AS etc.

Pressure-limiting valves are a type of pressure control valve. They safeguard the system against excessive system pressure or limit the operation pressure. The pressure-limiting valve type DV and AS is pilot-controlled. Type AS also has an additional check valve in the consumer port.

Features and benefits:
- Various adjustment options
- Various additional functions

Intended applications:
- General hydraulic systems
- Test benches

Nomenclature:
- Pressure-limiting valve
- Sequence valve
- Switch-off/release valve (pilot-controlled)

Design:
- Single valve for pipe connection
- Individual valve for manifold mounting

Adjustment:
- Tool adjustable (fixed)
- Manually (adjustable)

$p_{\text{max}}$: 420 bar

$q_{\text{max}}$: 120 l/min

### Design and order coding example

<table>
<thead>
<tr>
<th>DV3</th>
<th>G</th>
<th>H</th>
<th>R</th>
<th>- WN 1F-24</th>
<th>- 200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pressure setting [bar]**

- 2/2-way directional seated valve
- Optionally with mounted 2/2-way directional seated valve for arbitrary idle circulation

**Adjustability in operation**
- fixed or manually adjustable (R)
- Various actuations for the pilot valve: ball head for controls via cam, lever etc. (type DV, DVE)

**Pressure range**
- N: 2 to 100 bar
- H: 5 to 420 bar

**Line connection**
- Pipe connection or manifold mounting

**Basic type, size**
- Type DV (internal control oil drain)
- Type DVE (external control oil drain)
- Type DF (valve for remote control), size 3 to 5
- Type AS (additional check valve), size 3 to 5
- Type AE (release valve), size 3 to 5

**Additional versions:**
- Additional switching combinations with the types AS and AE
## Function

<table>
<thead>
<tr>
<th>Valve Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DV, DVE, DF</td>
<td>Pressure limiting, sequence valve, follow-up valve or 2/2-way directional valve (remote controlled, depending on the kind of valve connected to port X)</td>
</tr>
<tr>
<td>AS, ASE, AE</td>
<td>Pressure limiting valve, release valve (remote controlled), combined function as pressure limiting valve possible (type ASE)</td>
</tr>
</tbody>
</table>

## General parameters and dimensions

### DV .. G

<table>
<thead>
<tr>
<th>Size</th>
<th>Q&lt;sub&gt;max&lt;/sub&gt; [lpm]</th>
<th>Pressure range: p&lt;sub&gt;max&lt;/sub&gt; [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>50</td>
<td>N: 100 H: 420</td>
<td>H 1/2</td>
<td>30 60 - 66 -</td>
<td>1,1 / -</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td></td>
<td>H 3/4</td>
<td>40 65 60 71 78</td>
<td>1,5 / 2,0</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
<td></td>
<td>G 1</td>
<td>50 80 88 73 81</td>
<td>2,0 / 2,5</td>
</tr>
</tbody>
</table>

### DV .. P

<table>
<thead>
<tr>
<th>Size</th>
<th>Q&lt;sub&gt;max&lt;/sub&gt; [lpm]</th>
<th>Pressure range: p&lt;sub&gt;max&lt;/sub&gt; [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>50</td>
<td>N: 200 H: 350/300 (type AE)</td>
<td>G 1/2</td>
<td>40 - 60 - 80 -</td>
<td>1,8</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td></td>
<td>G 3/4</td>
<td>40 40 70 80 94 60</td>
<td>2,2</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
<td></td>
<td>G 1</td>
<td>6,3 40 100 94 85 80</td>
<td>4,1</td>
</tr>
</tbody>
</table>

1) Versions for pipe connection/manifold mounting (with installed solenoid valve + 0.6 kg)

## Associated technical data sheets:

- Pressure-limiting valve, pilot-controlled type DV, DVE and DF: Page 4350
- Pressure valve with check valve type AL, AE and AS: Page 6170

## Similar products:

- Pressure-limiting valves type MV, SV etc.: Page 162
- Miniature pressure-limiting valves type MVG etc.: Page 162
- Pressure-limiting valves type CMV(Z): Page 166
Pressure valves

2.3 Sequence valves with check valve type VR

Pre-load valves, also called sequence valves are a type of pressure control valve. They generate a largely constant pressure drop between the inlet and outlet on the valve. In the opposite direction the flow can pass freely. In the normal position the valve has minor leakage.

The sequence valve type VR is available as a screw-in valve and in a housing version for in-line installation.

The primary application area is in return lines for oscillation damping, mainly in lifting equipment, lifting platforms, handling systems and in lifting gantries as fall protection.

**Features and benefits:**
- Compact screw-in valve

**Intended applications:**
- Lifting equipment
- Lifting platforms
- Handling technology

### Nomenclature:
- Sequence valve

### Design:
- Screw-in valve
- Combination with housing for pipe connection

### Adjustment:
- Fixed (non-adjustable)

<table>
<thead>
<tr>
<th>p_{max}</th>
<th>Δp_{max}</th>
<th>Q_{max}</th>
</tr>
</thead>
<tbody>
<tr>
<td>315 bar</td>
<td>15 bar</td>
<td>120 l/min</td>
</tr>
</tbody>
</table>

### Design and order coding example

<table>
<thead>
<tr>
<th>VR</th>
<th>Pre-load pressure</th>
<th>Design with housing</th>
<th>Basic type, size</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Cartridge valve</td>
<td>Cartridge valve</td>
<td>Type VR, size 1 to 4</td>
</tr>
<tr>
<td>3</td>
<td>Versions with housing for pipe connection</td>
<td>Versions with housing for pipe connection</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Design with metric fine thread</td>
<td>Design with metric fine thread</td>
<td></td>
</tr>
</tbody>
</table>

| 3  | Open-up pressure Δp_{max} 3 to 15 bar | Open-up pressure Δp_{max} 3 to 15 bar |
## Function

**VR**

Screw-in valve  

Version with housing for pipe connection

### General parameters and dimensions

<table>
<thead>
<tr>
<th>VR 3 3 C</th>
<th>VR 4 9 E</th>
<th>VR 1 15 G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insert valve</td>
<td>Version with housing</td>
<td>Version with housing</td>
</tr>
</tbody>
</table>

### Insert valve

<table>
<thead>
<tr>
<th>Q_{max} [lpm]</th>
<th>Δp_{max} [bar] 1)</th>
<th>Dimensions [mm]</th>
<th>m [g] 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR 1</td>
<td>15</td>
<td>3, 5, 7, 9, 12, 15</td>
<td>G 1/4 (A)</td>
</tr>
<tr>
<td>VR 2</td>
<td>40</td>
<td>3, 5, 7, 9, 12, 15</td>
<td>G 3/8 (A)</td>
</tr>
<tr>
<td>VR 3</td>
<td>65</td>
<td>3, 5, 7, 9, 12</td>
<td>G 1/2 (A)</td>
</tr>
<tr>
<td>VR 4</td>
<td>120</td>
<td>3, 5, 7, 9, 12</td>
<td>G 3/4 (A)</td>
</tr>
</tbody>
</table>

1) The selected pre-load pressure e.g. opening pressure cannot be altered
2) Individual valve/design with housing

### Associated technical data sheets:

- Pre-load check valve type VR: D 7340

### Similar products:

- Pressure-limiting valves type MV, SV etc.: Page 162
- Miniature pressure-limiting valves type MVG etc.: Page 162
- Pilot-controlled pressure control valves type DV: Page 168
- Pressure-limiting valves type CMV: Page 166
2.3 Proportional pressure-limiting valve type PMV and PDV

Proportional pressure-limiting valves are a type of pressure control valve. They remotely control the pressure in hydraulic systems continuously and electrically. The pressure-limiting valve type PMV is a directly actuated valve in a spring-loaded ball version. The pressure can be set to up to 700 bar. The pressure-limiting valve type PDV is a pilot valve in a piston version, where pressures up to 350 bar can be set. The pressure-limiting valve type PMV and PDV is available as a single valve for pipe connection or as a manifold mounting valve.

The proportional pressure-limiting valve is particularly suitable for maximum pressure limitation in hydraulic systems.

Features and benefits:
- Max. operating pressure 700 bar
- Precise control

Intended applications:
- General hydraulics
- Test benches
- Mining machinery

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>Prop. pressure-limiting valve (directly controlled or piloted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Individual valve for pipe connection</td>
</tr>
<tr>
<td></td>
<td>Individual valve</td>
</tr>
<tr>
<td></td>
<td>Manifold mounting</td>
</tr>
<tr>
<td>Adjustment:</td>
<td>Electro-proportional</td>
</tr>
<tr>
<td>( p_{\text{max}} ):</td>
<td>700 bar</td>
</tr>
<tr>
<td>( q_{\text{max}} ):</td>
<td>120 l/min</td>
</tr>
</tbody>
</table>

Design and order coding example

<table>
<thead>
<tr>
<th>PDV4G</th>
<th>PMVP4</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>-44</td>
</tr>
</tbody>
</table>

- Solenoid voltage
  - Prop. solenoid
    - 12V DC, 24V DC
    - Control using proportional amplifier or PLVC

- Basic type, port size, size
  - Type PMV (pipe connection), type PMVP (manifold mounting)
    - Optionally with separate control oil supply, i.e. pressure reduction right above 0 bar, zero-leakage in the main pump circuit (type PMVS, PMVPS)
  - Type PDV.G (pipe connection), type PDV.P (manifold mounting)
    - Additionally with 2/2-way solenoid valves for arbitrary idle circulation

Function

PMV, PDV

Pipe connection

Manifold mounting valve
General parameters and dimensions

PMV

PMVP

PDV..G

PDV..P

<table>
<thead>
<tr>
<th>Size</th>
<th>Qmax [lpm]</th>
<th>Pressure range pmax [bar]</th>
<th>Ports ¹)</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>H</td>
<td>B</td>
<td>T</td>
</tr>
<tr>
<td>PMV/PMVP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>41: 180</td>
<td>G 1/4, G 3/8</td>
<td>97/95</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42: 180</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>43: 240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>41: 110</td>
<td>G 1/4, G 3/8, G 1/2</td>
<td>98/95</td>
<td>35/40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42: 270</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>43: 320</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>75</td>
<td>41: 80</td>
<td>G 3/8, G 1/2, G 3/4</td>
<td>102/95</td>
<td>40/50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42: 130</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>43: 190</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>44: 320</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>120</td>
<td>41: 45</td>
<td>G 3/4, G 1</td>
<td>107/97</td>
<td>45/60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>42: 70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>43: 110</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>44: 180</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PDV..G/PDV.P</td>
<td></td>
<td>N: 130</td>
<td>G 1/2</td>
<td>96</td>
<td>66</td>
</tr>
<tr>
<td>3</td>
<td>40</td>
<td>M: 200</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td>H: 350</td>
<td>G 3/4</td>
<td>99.5</td>
<td>71/78</td>
</tr>
<tr>
<td>5</td>
<td>120</td>
<td></td>
<td>G 1</td>
<td>104.5</td>
<td>73/81</td>
</tr>
</tbody>
</table>

¹) For pipe connection versions only

Associated technical data sheets:
- Proportional pressure-limiting valve type PMV and PMVP: D 7485/1
- Proportional pressure-limiting valve type PDV and PDM: D 7486
- Proportional pressure-limiting valve type NPMVP: D 7485 N
- Intermediate plate type NZP: D 7788 Z

Suitable accessories:
- Proportional amplifier type EV1M3: Page 272
- Proportional amplifier type EV2S: "CAN-IO, EV2S-CAN"
- Proportional amplifier type EV1D: Page 272
Pressure reducing valves are a type of pressure control valve. They maintain a largely constant outlet pressure even at a variable (higher) inlet pressure. The pressure reducing valve type ADC and AM is suitable for the supply of control circuits with low oil consumption. These valves feature an override compensation, i.e. acting like a pressure-limiting valve if the secondary pressure exceeds the set pressure e.g. due to external forces. There is a design-related leakage flow.

**Features and benefits:**
- Compact design
- Numerous configurations

**Intended applications:**
- For control oil supply in pilot circuits

**Nomenclature:**
- Pressure reducing valve

**Design:**
- Screw-in valve
  - Valve for pipe connection

**Adjustment:**
- Fixed (non-adjustable)

**Pressure downstream**
- Pressure at port A [bar]

**Basic type**
- Type ADC, AM
  - Version with housing for manifold mounting (type AM 11)
- Type ADM, ADME
  - Type ADM 1 adjustable version available

**Design and order coding example**

<table>
<thead>
<tr>
<th>ADC 1</th>
<th>- 25</th>
<th>- 1/4</th>
</tr>
</thead>
</table>

- **Design**
  - Cartridge valve
  - Design with housing for direct pipe connection
  - Version with housing for manifold mounting (type AM 11)

- **Pressure downstream**
  - Pressure at port A [bar]

**Function**

<table>
<thead>
<tr>
<th>ADC, AM, ADM, ADME</th>
</tr>
</thead>
</table>

- **Screw-in valve**
- **Pipe installation**
## General parameters and dimensions

### ADC 1 - 25
Pressure reducing valve type ADC 1 as screw-in valve, pressure at A (on the consumer side) approx. 25 bar

### AM 1 - 20 - 1/4
Pressure reducing valve type AM 1, version for pipe connection (threaded connections G 1/4), pressure at A (on the consumer side) approx. 20 bar

### ADME 1 - ...

### ADM 1 - 70
Pressure reducing valve type ADM 1, version for pipe connection, pressure at A (on the consumer side) approx. 70 bar

### Associated technical data sheets:
- Pressure-reducing valve type ADC, ADM, ADME and AM: Page 185
- Prop. pressure reducing valves type PDM: Page 186
- Miniature prop. pressure reducing valves type PM, PMZ: Page 184

### Similar products:
- Pressure reducing valves type ADM, VDM: Page 176
- Pressure reducing valves type CDK: Page 180

---

### Table: General parameters and dimensions

<table>
<thead>
<tr>
<th>Valve Type</th>
<th>$Q_{\text{max}}$ [lpm]</th>
<th>$p_{\text{max}}$ [bar]</th>
<th>Outlet pressure [bar] at A</th>
<th>Ports 1)</th>
<th>$m_{\text{max}}$ [kg]</th>
<th>Screw-In Valve</th>
<th>Pipe Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADC 1</td>
<td>2</td>
<td>300</td>
<td>15, 25</td>
<td>G 1/4</td>
<td>0.03</td>
<td>0.03</td>
<td>0.32</td>
</tr>
<tr>
<td>AM 1</td>
<td>2</td>
<td>400</td>
<td>20, 30, 40, 100</td>
<td>G 1/4</td>
<td>0.03</td>
<td>0.03</td>
<td>0.3</td>
</tr>
<tr>
<td>ADM 1</td>
<td>8 ... 10</td>
<td>300</td>
<td>15, 20, 30, 70</td>
<td>G 1/4</td>
<td>-</td>
<td>-</td>
<td>0.34</td>
</tr>
<tr>
<td>ADME</td>
<td>8</td>
<td>300</td>
<td>15, 20, 30</td>
<td>-</td>
<td>0.05</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1) In version for pipe connection only
Pressure valves

2.3 Pressure-reducing valve type ADM and VDM

Pressure reducing valves are a type of pressure control valve. They maintain a largely constant outlet pressure even at a variable (higher) inlet pressure.

The pressure reducing valve type ADM is directly controlled, the type VDM is hydraulically pilot-controlled. These valves feature an override compensation, i.e. acting like a pressure-limiting valve if the secondary pressure exceeds the set pressure e.g. due to external forces.

There is a design-related leakage flow.

Features and benefits:
- With safety valve function
- Various adjustment options
- Various additional functions

Intended applications:
- General hydraulics
- Jigs
- Test benches

Nomenclature:
- Pressure reducing valve (directly-controlled or pilot-controlled)

Design:
- Single valve for pipe connection
- Individual valve for manifold mounting

Adjustment:
- Tool adjustable (fixed)
- Manually (adjustable)

\[ p_{\text{max}} \]: 400 bar
\[ p_{\text{max A}} \]: 300 bar
\[ Q_{\text{max}} \]: 120 l/min

Design and order coding example

<table>
<thead>
<tr>
<th>ADM 22</th>
<th>D</th>
<th>R</th>
<th>- 250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure setting [bar]</td>
<td>Fixed (-)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustability in operation</td>
<td>Manually adjustable (R)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjustable with turn knob (self-locking -V/lockable -H)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure range</td>
<td>Pressure ranges for outlet pressure at A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic type, size</td>
<td>Type ADM (non-piloted), size 1 to 3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VDM 5</th>
<th>H</th>
<th>R</th>
<th>- 250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure setting [bar]</td>
<td>Fixed (-)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustability in operation</td>
<td>Manually adjustable (R)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure range</td>
<td>Pressure ranges for outlet pressure at A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic type, size</td>
<td>Type VDM (hydraulically piloted), size 3 to 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hydraulically piloted pressure-reducing valve type VDX (pressure-limiting valve at port L)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Function

**ADM..**

Valve for pipe connection

**VDM..**

Valve for pipe connection

**ADM...P**

Manifold mounting valve

### General parameters and dimensions

**ADM 22 DR**

Version for pipe connection

Directly controlled pressure reducing valve type ADM, size 2

for pipe connection

(threaded connections G 3/8, coding 2), pressure range 30 to 120 bar (coding D), manually adjustable pressure (coding R)

**ADM...P**

Version as manifold mounting valve
VDM...G
Version for pipe connection

Version as manifold mounting valve
Pilot-controlled pressure reducing valve type VDM, size 5 for manifold mounting (coding P), pressure range 10 to 400 bar (coding H), pressure fixed at 250 bar

<table>
<thead>
<tr>
<th>Qₘₐₓ</th>
<th>Pₘₐₓ</th>
<th>Pₘₐₓ A</th>
<th>Ports</th>
<th>Leakage flow Q</th>
<th>Dimensions</th>
<th>mₘₐₓ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[lpm]</td>
<td>[bar]</td>
<td>[bar]</td>
<td></td>
<td>[mm]</td>
<td>[kg]</td>
</tr>
<tr>
<td>ADM 1..</td>
<td>12</td>
<td>300</td>
<td>F: 30</td>
<td>G 1/4</td>
<td>H</td>
<td>0.6/0.6</td>
</tr>
<tr>
<td>ADM 2..</td>
<td>25</td>
<td>F: 30</td>
<td>G 1/4, G 3/8</td>
<td>H1</td>
<td>0.7/0.85</td>
<td></td>
</tr>
<tr>
<td>ADM 3..</td>
<td>60</td>
<td>F: 25</td>
<td>G 3/8, G 1/2</td>
<td>H1</td>
<td>1.0/1.1</td>
<td></td>
</tr>
<tr>
<td>VDM 3..</td>
<td>40</td>
<td>400</td>
<td>N: 100</td>
<td>G 1/2</td>
<td>H: 400¹</td>
<td>1.1/-</td>
</tr>
<tr>
<td>VDM 4..</td>
<td>70</td>
<td>G 3/4</td>
<td>60</td>
<td>H: 400¹</td>
<td>1.5/2.0</td>
<td></td>
</tr>
<tr>
<td>VDM 5..</td>
<td>120</td>
<td>G 1</td>
<td>80</td>
<td>2.0/2.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Max. pressure difference between inlet and outlet pressure is 300 bar
2) For pipe connection versions only
3) Versions for pipe connection / manifold mounting

1 Pilot valve
Circuit example:

HK 43 LDT/1 M - ZZ 2.7/9.8
-AN 21 F 2-D45-F50
-BA 2
-NSMD 2 K/GRK/0
-1-G 24

Associated technical data sheets:
- Pressure-reducing valve type ADM: D 7120
- Pressure-reducing valve, pilot-controlled type VDM: D 5579
- Pressure reducing valves type CDK: Page 180
- Prop. pressure reducing valves type PDM: Page 186

Similar products:
- Miniature pressure reducing valves type ADC etc.: Page 174
- Miniature prop. pressure reducing valves type PM, PMZ: Page 184
Pressure valves

2.3 Pressure-reducing valve type CDK, CLK, DK, DLZ and DZ

Pressure reducing valves are a type of pressure control valve. They maintain a largely constant outlet pressure even at a variable (higher) inlet pressure. The pressure reducing valve type CLK features an override compensation, i.e. acting like a pressure-limiting valve if the secondary pressure exceeds the set pressure e.g. due to external forces. The pressure reducing valve type DK features a tracked pressure switch, e.g. pressure and switch are set simultaneously with an adjustment device. All versions have zero leakage when in the closed state. The valve type CDK and CLK can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make.

Features and benefits:
- Zero leakage in closed state

Intended applications:
- General hydraulic systems
- Jigs
- Test benches

Design and order coding example

<table>
<thead>
<tr>
<th>CDK 3-2</th>
<th>R - 250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure setting [bar]</td>
<td></td>
</tr>
<tr>
<td>Adjustment</td>
<td>Fixed (-)</td>
</tr>
<tr>
<td></td>
<td>Manually adjustable (R)</td>
</tr>
<tr>
<td></td>
<td>Adjustable with turn knob (self-locking -V/lockable -H)</td>
</tr>
<tr>
<td>Basic type and pressure range</td>
<td>Type CDK, type CLK (with additional override compensation)</td>
</tr>
<tr>
<td></td>
<td>Screw-in valve</td>
</tr>
<tr>
<td></td>
<td>Version with connection block for pipe connection with/without pressure-limiting valve</td>
</tr>
<tr>
<td></td>
<td>Version with connection block for manifold mounting with/without pressure-limiting valve</td>
</tr>
<tr>
<td></td>
<td>In intermediate plate design NG6 (type NZP)</td>
</tr>
</tbody>
</table>

| Nomenclature: | Pressure reducing valve (2-way valve) |
| Design: | Screw-in valve combination with a connection block for |
| | Pipe connection |
| | Manifold mounting |
| Adjustment: | Fixed |
| | Manually (adjustable) |
| $p_{max}$: | 500 bar |
| $Q_{max}$: | 22 l/min |
**Additional elements**  Orifice/throttle

**Pressure setting [bar]**
- Fixed (-)
- Manually adjustable (R)
- Adjustable with turn knob (self-locking -V/lockable -H)

**Basic type and pressure range**
- Type DK (with tracked pressure switch)
- Type DZ with type CDK
- Type DLZ with type CLK
  - With bypass check valve
  - Manifold mounting
  - Version with connection block for pipe connection

**Function**

**CDK**

**CLK**

**CDK 3. -..-1/4-DG3.**

Screw-in valve

Version for pipe connection, a pressure switch type DG 3. May be installed as option, additional port for pressure gauge

**CDK 3. -..-P**

Manifold mounting valve

**DZ, DLZ**

Manifold mounting valve, optional with orifice/throttle and bypass check valve

**DK**

Manifold mounting valve with tracked pressure switch
## General parameters and dimensions

<table>
<thead>
<tr>
<th>Q₂₅₀[lpm]</th>
<th>Pressure range p₂₅₀[bar]</th>
<th>Ports (BSPP)</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>--</td>
<td>--</td>
<td>-</td>
<td>0.7</td>
</tr>
<tr>
<td>CDK 3.-.., CLK 3.-..</td>
<td>--08:450(^1)</td>
<td>G1/4</td>
<td>1.25</td>
</tr>
<tr>
<td>CDK 3.-..-1/4-DG3.</td>
<td>--01:500(^1)</td>
<td>-</td>
<td>1.4</td>
</tr>
<tr>
<td>CDK 3.-..-P</td>
<td>--1:300</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>DZ..., DLZ..., DK...</td>
<td>--11:380</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Only available as type CDK and DK
Circuit examples

Example of a version with large flow rate $Q_{\text{A} \to \text{P}}$
Example: $Q_p = 15$ lpm [formula]

Example of a version with undesired return flow

Use in the valve bank, shown here with seated valves type BVZP 1

$BVZP \ 1 \ \text{A} \ - \ 1/300 - G22/0$
$\ - G22/CZ2/100/4/2$
$\ - WN1H/10/4$
$\ - 1 - 1 - G 24$

Application example for undesired return flow

1. E.g. type RK 1E in accordance with $D\ 7445$
   (shown here screwed into connection A of the CDK 3 valve)
2. Type CDK 3-2-1/4-DG 34

Application example for large flow rate

1. E.g. type RK 2G in accordance with $D\ 7445$
2. $Q_{\text{return}} = 45$ lpm
3. $Q_p = 15$ lpm
4. Type CDK 3-2-1/4

Application example in the valve bank

1. Type CDK 3-2-100 shown here incorporated as $-/CZ\ 2/100...$

Associated technical data sheets:
- Pressure-reducing valve type CDK: $D\ 7745$
- Pressure-reducing valve type CLK: $D\ 7745\ L$
- Pressure-reducing valve type DK, DZ and DLZ: $D\ 7941$

Similar products:
- Pressure reducing valves type ADM, VDM, VDX: Page 176
- Miniature pressure reducing valves type ADC etc.: Page 174
- Prop. pressure reducing valves type PDM: Page 186

Intermediate plates:
- Intermediate plate type NZP: $D\ 7788\ Z$

Accessories:
- Pressure switches type DG 3., DG 5 E: Page 262
2.3 Proportional pressure-reducing valve type PM and PMZ

Proportional pressure-reducing valves are a type of pressure control valve. They remotely control the pressure in hydraulic systems continually and electrically. The proportional pressure-reducing valve type PM and PMZ is a directly actuated valve with a piston and is controlled electro-proportionally. It continuously maintains a constant pressure on the secondary pressure side, independently of the inlet side. The proportional pressure-reducing valve type PM is available as a single valve. The proportional pressure-reducing valve type PMZ is a twin valve. The proportional pressure-reducing valve type PM and PMZ is particularly suitable for use as a pilot valve for actuators.

Features and benefits:
- Compact design
- Numerous configurations
- Explosion-proof versions

Intended applications:
- For control oil supply in pilot circuits

Design and order coding example

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>Prop. pressure reducing valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Assembly kit</td>
</tr>
<tr>
<td></td>
<td>Individual valve</td>
</tr>
<tr>
<td></td>
<td>Manifold mounting</td>
</tr>
<tr>
<td>Adjustment:</td>
<td>Electro-proportional</td>
</tr>
<tr>
<td>$p_{\text{max} P}$</td>
<td>40 bar</td>
</tr>
<tr>
<td>$p_{\text{max} A}$</td>
<td>30 bar</td>
</tr>
<tr>
<td>$Q_{\text{max}}$</td>
<td>2 l/min</td>
</tr>
</tbody>
</table>

Seals
- Different materials NGR, FKM, EPDM

Solenoid voltage
- Prop. solenoid
  - 12V DC, 24V DC
  - Control using proportional amplifier or PLVC
    Type PMZ also in an explosion-proof version

Additional elements
- Orifice for oscillation damping in A and B
- Return pressure stop in R

Prop. adjustable nominal pressure difference [bar]

Basic type
- Type PM
  - Assembly kit (type PM 1, PMZ 01, PMZ 11)
- For manifold mounting (type PM 11, PM 12)
- Version in valve bank (type PMZ) with up to 10 prop. pressure-reducing valve sections

Function

<table>
<thead>
<tr>
<th>PM 1</th>
<th>PM 11</th>
<th>PMZ 1</th>
<th>PM 12</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>
General parameters and dimensions

<table>
<thead>
<tr>
<th>Design</th>
<th>Pressure range (prop. adjustable nom. pressure difference $\Delta p = p_A - p_R$)[bar]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM 1</td>
<td>Individual valve 0 ... 30</td>
</tr>
<tr>
<td>PM 11, PMZ 01</td>
<td>Twin valve 0 ... 30</td>
</tr>
<tr>
<td>Valve for manifold</td>
<td>Individual valve 0 ... 30</td>
</tr>
<tr>
<td>PM 12</td>
<td>Twin valve 0 ... 30</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- Proportional pressure-reducing valve type PM and PMZ: D 7625

Similar products:
- Proportional pressure-reducing valve type PDM: Page 186

Suitable accessories:
- Proportional amplifier type EV1M3: Page 272
- Proportional amplifier type EV2S: Page 274
- Proportional amplifier type EV1D: Page 272
2.3 Proportional pressure-reducing valve type PDM

Proportional pressure-reducing valves are a type of pressure control valve. They remotely control the pressure in hydraulic systems continually and electrically. The proportional pressure-reducing valve type PDM is a piloted valve with a piston and is controlled electro-proportionally. The valve has an external control oil drain. It continuously maintains a constant pressure on the secondary pressure side, independently of the inlet side. The pressure reducing valve is available as a single valve for pipe connection or as a manifold mounting valve.

The proportional pressure-reducing valve PDM is particularly suitable for dynamic control of the pressure level in hydraulic systems.

**Features and benefits:**
- Integrated overpressure function

**Intended applications:**
- General hydraulic systems
- Equipment
- Test benches
- Hydraulic tools

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>Prop. pressure-reducing valve (directly controlled or piloted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Individual valve for pipe connection</td>
</tr>
<tr>
<td></td>
<td>Individual valve</td>
</tr>
<tr>
<td></td>
<td>Manifold mounting</td>
</tr>
<tr>
<td>Adjustment:</td>
<td>Electro-proportional</td>
</tr>
<tr>
<td>$p_{max}$:</td>
<td>400 bar</td>
</tr>
<tr>
<td>$p_{max}$:</td>
<td>350 bar</td>
</tr>
<tr>
<td>$Q_{max}$:</td>
<td>120 l/min</td>
</tr>
</tbody>
</table>

**Design and order coding example**

<table>
<thead>
<tr>
<th>PDMP 2</th>
<th>PDM 4 G - 43 - G24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solenoid voltage</td>
<td>Prop. solenoid</td>
</tr>
<tr>
<td></td>
<td>12V DC, 24V DC</td>
</tr>
<tr>
<td>Pressure range</td>
<td>Pressure ranges for pressure downstream at A</td>
</tr>
<tr>
<td>Basic type, size, design</td>
<td>Type PDM (pipe connection), size 11, 21, 22</td>
</tr>
<tr>
<td></td>
<td>Type PDMP (manifold mounting), size 11, 22</td>
</tr>
<tr>
<td></td>
<td>Type PDM, size 3 to 5</td>
</tr>
<tr>
<td></td>
<td>Pipe connection (G), manifold mounting (P)</td>
</tr>
</tbody>
</table>

**Function**

PDM
Valve for pipe connection:

Manifold mounting valve:
General parameters and dimensions

**PDM 11, PDM 21, PDM 22**
Valve for pipe connection

**PDM 11 and PDMP 22**
Manifold mounting valve

<table>
<thead>
<tr>
<th></th>
<th>(Q_{\text{max}}) [lpm]</th>
<th>Pressure range (p_{\text{max}}) A [bar]</th>
<th>Ports 1)</th>
<th>Leakage flow (Q_{\text{leak}}) [lpm]</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDM 11</td>
<td>Directly controlled</td>
<td>12</td>
<td>G 1/4</td>
<td>&lt; 0.5</td>
<td>101</td>
<td>33</td>
</tr>
<tr>
<td>PDMP 11</td>
<td></td>
<td>41: 80</td>
<td></td>
<td></td>
<td>93,5</td>
<td>35</td>
</tr>
<tr>
<td>PDM 21/22</td>
<td></td>
<td>42: 130</td>
<td></td>
<td></td>
<td>42: 70</td>
<td>150</td>
</tr>
<tr>
<td>PDMP 22</td>
<td></td>
<td>43: 200</td>
<td></td>
<td></td>
<td>43: 110</td>
<td>150</td>
</tr>
<tr>
<td>PDM 3 G</td>
<td>Piloted</td>
<td>20</td>
<td>G 1/4, G 3/8</td>
<td>&lt; 0.5</td>
<td>101</td>
<td>38</td>
</tr>
<tr>
<td>PDM 4 G</td>
<td>N: 130</td>
<td>40</td>
<td>G 1/2</td>
<td>&lt; 0.8</td>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>PDM 5 G</td>
<td>M: 200</td>
<td>80</td>
<td>G 3/4</td>
<td></td>
<td>99.5</td>
<td>71</td>
</tr>
<tr>
<td>PDM 4 P</td>
<td>H: 350</td>
<td>120</td>
<td>G 1</td>
<td></td>
<td>104.5</td>
<td>73</td>
</tr>
<tr>
<td>PDM 5 P</td>
<td></td>
<td>80</td>
<td></td>
<td></td>
<td>99.5</td>
<td>78</td>
</tr>
</tbody>
</table>

1) For pipe connection versions

**PDM 3 to 5**

**PDM 4P and PDM 5P**

**Associated technical data sheets:**
- Prop. pressure reducing valves type PDM: **D 7486, D 7584/1**

**Similar products:**
- Proportional pressure-reducing valve type PM and PMZ: **Page 184**

**Suitable accessories:**
- Proportional amplifier type EV1M3: **Page 272**
- Proportional amplifier type EV2S: **Page 274**
- Proportional amplifier type EV1D: **Page 272**
2.3 Proportional pressure-reducing valve type KFB and FB

Proportional pressure-reducing valves are a type of pressure control valve. They manually and continuously operate hydraulic actuators at a distance. The proportional pressure-reducing valve type FB is available as a single valve for pipe connection. Type KFB is a valve bank and combines several valves. The proportional pressure-reducing valve type FB and KFB is primarily used for remote control of the directional spool valve type PSL or PSV.

Features and benefits:
- Sturdy design
- Precise control

Intended applications:
- For control oil supply in pilot circuits

Additional versions:
- With UNF thread

---

Design and order coding example

<table>
<thead>
<tr>
<th>KFB01</th>
<th>A /19 /F 1</th>
</tr>
</thead>
</table>

Additional elements for actuation
- Without labelling - with hand lever
- 005 - with hand lever bent at an angle of 5°
- 015 - With hand lever bent at an angle of 15°
- 025 - With hand lever bent at an angle of 25°
- 030 - With hand lever bent at an angle of 30°

Manual operation
- F - manual operation with return spring
- FC - detent

Pressure range of prop. pressure-reducing valve
- Pressure ranges
  - 4; 5.5; 7; 9; 11; 14; 19; 30

Valve sections
- A - Front section
- M - Middle section
- E - End section

Basic type, size
- Type KFB (valve bank)
- Type FB (single valve)

---

Nomenclature: 
- Proportional pressure-reducing valve
- Hydraulic joystick

Design: 
- Single valve / Valve bank in pipe connection

$p_{max}$: 
- 30 bar

$Q_{max}$: 
- 2 l/min
**Function**

Single valve

Valve bank

**General parameters and dimensions**

<table>
<thead>
<tr>
<th></th>
<th>Q_{max} [lpm]</th>
<th>Pressure range p_{max} [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB 01</td>
<td>2</td>
<td>30</td>
<td>G 1/4</td>
<td>H 215, B 35, T 50</td>
</tr>
<tr>
<td>KFB 01</td>
<td>2</td>
<td>30</td>
<td>G 1/4</td>
<td>H 215, B 35, T 50</td>
</tr>
</tbody>
</table>

**Associated technical data sheets:**
- Proportional pressure-reducing valve type KFB 01: D 6600-01
Pressure valves

2.3 Pressure-controlled shut-off valve type CNE

Shut-off valves are a type of pressure control valve. They receive the control oil from a high-pressure circuit and switch the delivery flow of a low-pressure pump to unpressurised circulation if the pressure value set has been reached. During this process, the consumer side is separated from the idle circulation by a zero-leakage check valve. If the pressure on the consumer side drops below the pressure setting, the idle circulation is interrupted and the oil fed to the consumer again.

Via a control line the higher pressure in the high-pressure circuit holds open the pressure-controlled 2 directional valve type CNE and with it the idle circulation. In the low-pressure circuit the valve acts simultaneously as a pressure-limiting valve.

The valve type CNE can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make.

Features and benefits:
- Compact design
- Easily produced mounting hole

Intended applications:
- Dual-stage systems (high-pressure, low-pressure)
- Jigs

### Nomenclature:
- 2-way circulation valve

### Design:
- Screw-in valve

### Adjustment:
- Fixed

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_{\text{max}}$</td>
<td>500 bar</td>
</tr>
<tr>
<td>$p_{\text{max adjust}}$</td>
<td>450 bar</td>
</tr>
<tr>
<td>$Q_{\text{max}}$</td>
<td>30 l/min</td>
</tr>
</tbody>
</table>

### Design and order coding example

CNE 2 C - 50

<table>
<thead>
<tr>
<th>Basic type, size</th>
<th>Pressure controlled 2-way valve type CNE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure setting [bar]</td>
<td>Pressure controlled 2-way valve type CNE</td>
</tr>
</tbody>
</table>

Additional versions:
- Additionally sealed tapped journal to minimize the internal leakage loss (type CNE 21)
- Additionally sealed tapped journal and piston to minimize leakage loss (type CNE 22 and CNE 23)
Associated technical data sheets:
- Pressure-controlled shut-off valve type CNE: D 7710 NE

Similar products:
- Two-stage valves type NE: Page 192
- Switch units type CR: Page 152
- Shut-off valves type LV, ALZ: Page 194
- Directional valves type AE: Page 168

Connection blocks:
- Connection block type A: Page 62

Circuit example:

HK448/1-HH...-AN21F2
Idle circulation valve integrated in connection block type AN 21 F2 for compact hydraulic power packs type HK with two pump circuits
Pressure valves

2.3 Two-stage valve type NE

Two-stage valves are a type of pressure control valve. They are used in hydraulic systems that are supplied by dual stage pumps, a combination of high-pressure pump and low-pressure pump.

The two-stage valve type NE combines the two pump delivery flows into a common volumetric flow. It switches the low-pressure pump to unpressurised circulation if the pressure value set is reached. It protects both pumps against exceeding the high or low-pressure value set.

The two-stage valve type NE is used with directional valves to control double-acting hydraulic cylinders.

Features and benefits:
- Operating pressures up to 700 bar
- Direct mounting on hydraulic power packs
- Direct combination with valve banks

Intended applications:
- Presses
- Test benches
- Hydraulic tools

Nomenclature:
- Two stage valve (high pressure (HP) / low pressure (LP) stage)

Design:
- Individual valve for pipe connection

Adjustment:
- Fixed

\[ P_{\text{max}}: \quad 700 \text{ bar (HP) / 80 bar (LP)} \]

\[ Q_{\text{max}}: \quad 25 \text{ (HP) / 180 (LP) lpm} \]

Design and order coding example

<table>
<thead>
<tr>
<th>NE 20</th>
<th>- 650/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure setting [bar]</td>
<td>High-/low pressure</td>
</tr>
<tr>
<td>Basic type</td>
<td>NE 20, 70 and 80</td>
</tr>
</tbody>
</table>

Additional versions:
- Direct attachment on pump units type MPN, RZ and FXU possible
- Valve banks type BV can be directly mounted (type NE 21)

Function

NE 20

NE 70, NE 80
General parameters and dimensions

NE 20

<table>
<thead>
<tr>
<th>Q_{max} [lpm]</th>
<th>p_{max} [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HD</td>
<td>ND</td>
<td>HD</td>
<td>ND</td>
<td>A, R</td>
</tr>
<tr>
<td>NE 20</td>
<td>10</td>
<td>40</td>
<td>20 ... 700</td>
<td>16 ... 80</td>
</tr>
<tr>
<td>NE 70</td>
<td>16</td>
<td>100</td>
<td>(0) ... 500</td>
<td>(0) ... 60</td>
</tr>
<tr>
<td>NE 80</td>
<td>25</td>
<td>180</td>
<td>(0) ... 500</td>
<td>(0) ... 30</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- Two-stage valve type NE: D 7161
- Pumps:
  - Compact hydraulic power packs type MP, MPN, MPW, MPNW: Page 50
  - D 6910, D 6910 H

Similar products:
- Idle circulation valves type CNE: Page 190
- (Press) switch units type CR: Page 152
- Directional seated valves type VB: Page 114
Pressure valves

2.3 Shut-off valve type LV and ALZ

Shut-off valves or accumulator charging valves are a type of pressure control valve. They switch the delivery flow of a pump to unpressurised circulation if the pressure value set is reached. During this process, the consumer side is separated from the idle circulation by a zero-leakage check valve. If the pressure drops in the consumer side, the idle circulation is interrupted and the oil fed to the consumer again.

The shut-off valve type LV and ALZ operates using automatically controlled (pulse independent) step switching in the pilot valve.

Features and benefits:
- Various means of adjustment
- Various additional functions

Intended applications:
- Test benches
- Accumulator systems
- Hydraulic tools

Intended applications:
- Test benches
- Accumulator systems
- Hydraulic tools

Nomenclature:
- Shut-off valve (idle circulation valve, directly controlled or pilot-controlled)

Design:
- Individual valve for pipe connection
- Individual valve
- Manifold mounting

Adjustment:
- Fixed
- Manually adjustable

$p_{max}$: 350 bar

$q_{max}$: 120 l/min

Design and order coding example

<table>
<thead>
<tr>
<th>LV 10 P</th>
<th>D CR</th>
<th>180 - 250</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALZ 3 G</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pressure setting [bar]
- Fixed (-)
- Manually adjustable (R)

Pressure range
- Fixed (-)
- Manually adjustable (R)

Basic type, size, design
- Type LV, size 10, 20, 25
  - Pipe connection (-)
  - Manifold mounting (P)
  - Design with low switching hysteresis (type LV 25)
- Type ALZ, size 3 to 5
  - Pipe connection (G)
  - Manifold mounting (P)

Function

LV, ALZ
For pipe connection: Manifold mounting valve:
### General parameters and dimensions

<table>
<thead>
<tr>
<th>Control</th>
<th>$Q_{\text{max}}$ [lpm]</th>
<th>Pressure range: $p_{\text{max}}$ [bar]</th>
<th>Ports 1)</th>
<th>Dimensions [mm]</th>
<th>$m$ [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV 10</td>
<td>Direct</td>
<td>12</td>
<td>F: 60</td>
<td>G 1/4</td>
<td>155 45 32 0.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E: 140</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D: 240</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C: 350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LV 20, LV 25</td>
<td></td>
<td>25</td>
<td>F: 80</td>
<td>G 3/8</td>
<td>205 50 32 1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E: 140</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D: 220</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C: 350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALZ 3 G</td>
<td>Piloted</td>
<td>50</td>
<td>F: 60</td>
<td>G 1/2</td>
<td>80 40 99 2.0</td>
</tr>
<tr>
<td>ALZ 4 G</td>
<td></td>
<td>80</td>
<td>E: 140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALZ 5 G</td>
<td></td>
<td>120</td>
<td>D: 240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALZ 4 P</td>
<td></td>
<td>80</td>
<td>C: 350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALZ 5 P</td>
<td></td>
<td>120</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) For pipe connection versions only

### Associated technical data sheets:
- Shut-off valve type LV: D 7529
- Shut-off valve type ALZ: D 6170 ALZ
- Pressure valve with check valve type AL, AE and AS: D 6170

### Similar products:
- Release valves type AE: Page 168
- Connection blocks type AL: Page 62
Pressure valves

2.3 Pressure-dependent shut-off valve type DSV and CDSV

Pressure-dependent shut-off valves are a type of pressure control valve. When a set pressure value is reached and exceeded, they block the flow to consumer line B with zero leakage. The valves will open again if the pressure on inflow side A falls below the set value defined by the spring tension.

The pressure-dependent shut-off valve type DSV and CDSV is used as a safeguard pressure gauge, for example.

Features and benefits:
- Various adjustment options

Intended applications:
- General hydraulic systems
- Test benches
- (Pressure gauge) protection valve

### Nomenclature:
- Shut-off valve

### Design:
- Single valve for pipe connection
  - Individual valve for manifold mounting
  - Screw-in valve

### Adjustment:
- Tool adjustable (fixed)
  - Manually (adjustable)

### Parameters:
- $p_{\text{max}}$: 600 bar
- $Q_{\text{max}}$: 60 l/min

#### Design and order coding example

<table>
<thead>
<tr>
<th>CDSV 1</th>
<th>A</th>
<th>- 1/4</th>
<th>- 400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Pressure setting [bar]</td>
<td>-1/4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Design with connection block</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cartridge valve</td>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>Pressure range</td>
<td>Fixed (-) or manually adjustable (R)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic type, size</td>
<td>Type CDSV (cartridge valve), size 1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DSV 21-1</th>
<th>B</th>
<th>- 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure setting [bar]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure range</td>
<td>Fixed (-) or manually adjustable (R)</td>
<td></td>
</tr>
<tr>
<td>Basic type, size</td>
<td>Type DSV (pipe connection), type DSVP (manifold mounting), size 1, 2, 3</td>
<td></td>
</tr>
</tbody>
</table>
### Function

<table>
<thead>
<tr>
<th>Valve Type</th>
<th>Design Description</th>
<th>Size</th>
<th>( Q_{\text{max}} ) [lpm]</th>
<th>( p_{\text{max}} ) [bar]</th>
<th>Ports</th>
<th>( H_{\text{max}} ) [mm]</th>
<th>SW = a/f</th>
<th>( m ) [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDSV 1</td>
<td>Screw-in valve</td>
<td>1</td>
<td>10</td>
<td>C: 120, B: 350, A: 600</td>
<td>M 16 x 1.5</td>
<td>69</td>
<td>SW 22</td>
<td>0.13</td>
</tr>
<tr>
<td>DSV 2</td>
<td>Version for pipe connection</td>
<td>1</td>
<td>20</td>
<td>D: 40, C: 100, B: 220, A: 600</td>
<td>G 1/4</td>
<td>185</td>
<td>SW 36</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>40</td>
<td>D: 20, C: 60, B: 120, A: 400</td>
<td>G 3/8</td>
<td>193</td>
<td>SW 36</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>60</td>
<td>D: 20, C: 60, B: 120, A: 400</td>
<td>G 1/2</td>
<td>193</td>
<td>SW 46</td>
<td>1.1</td>
</tr>
<tr>
<td>DSVP 2</td>
<td>Manifold mounting valve</td>
<td>1</td>
<td>20</td>
<td>D: 40, C: 100, B: 220, A: 600</td>
<td>G 1/4</td>
<td>181</td>
<td>-</td>
<td>1.1</td>
</tr>
</tbody>
</table>

1) Manifold mounting valve only in size 1

### General parameters and dimensions

#### Associated technical data sheets:
- Pressure-controlled shut-off valve type DSV: D 3990
- Pressure-controlled shut-off valve type CDSV: D 7876
2.3 Load-holding valve type LHK, LHDV and LHT

Load-holding valves are a type of pressure control valve. They prevent loads on cylinders or motors dropping in an uncontrolled manner. For this purpose they are pre-loaded with a pressure setting that is higher than the largest possible load. A hydraulic piston controls the opening of the valve to achieve the required lowering velocity.

The load-holding valves type LHK and LHT are suitable for applications that are not particularly prone to oscillations. The load-holding valve type LHDV has special damping characteristics. It is used particularly in conjunction with proportional directional spool valves, e.g. type PSL and PSV.

Shock valves and shuttle valves with or without restrictor check valves can be fitted in the load-holding valves type LHK, LHDV and LHT, e.g. to relieve hydraulic brakes with a delay.

Features and benefits:
- Operating pressures up to 420 bar
- Various adjustment options
- Various configurations

Intended applications:
- Cranes
- Construction machinery
- Lifting devices

Features:
- Operating pressures up to 420 bar
- Various adjustment options
- Various configurations

Intended applications:
- Cranes
- Construction machinery
- Lifting devices

Nomenclature:
- Load holding valve
- (over center valve, for one sided or alternating load direction)
- Single or twin valve

Design:
- Individual or twin valve for pipe connection
- Individual or twin manifold mounting valve
- Screw-in valve
- Version for banjo bolt mounting

p_{max}:
- 450 bar

Q_{max}:
- 250 l/min

Design and order coding example

<table>
<thead>
<tr>
<th>LHK44</th>
<th>G</th>
<th>- 11</th>
<th>- 160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure setting load-holding pressure [bar]</td>
<td>Design</td>
<td>Various housing designs available</td>
<td>Dampening</td>
</tr>
<tr>
<td>Basic type, size</td>
<td>Type LHK (valve only, without shock valve), size 2 to 4</td>
<td>Additional versions:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Version available as assembly kit</td>
</tr>
</tbody>
</table>
### Pressure setting [bar]
Load-holding pressure/load-holding pressure - shock valve pressure/shock valve pressure

### Nozzle
Release ratio may be altered with different orifice combinations in the range between 1 : 1.2 and 1 : 8.9

### Volumetric flow

### Additional elements
- With shock- and suction valves
- With shuttle valves for brakes
- With restrictor check valve

### Basic type, size
- Type LHDV (with tailored dampening characteristics), size 3
- Type LHT, size 2, 3 and 5

### Additional versions:
- Cartridge valve versions
- Type LHT
- Type LHTE, with discharge pressure compensation

### Function

**LHK 33 G-15...**

**LHK 44 G-21...**

**LHT 21 H-14...**

**LHT 33 P-11...**

**LHDV 33 G-25WD...**

**LHDV 33 G-25WD...**
### General parameters and dimensions

**LHK 44 G - 11 - 160**  
*Individual valve*

![Diagram of LHK 44 G - 11 - 160](image1)

**LHDV 33 - 25 WD - B 6 - 200/200 - 240/240**  
*Twin valve*

![Diagram of LHDV 33 - 25 WD - B 6 - 200/200 - 240/240](image2)

**LHT 33 P - 15**  
*Individual valve*

![Diagram of LHT 33 P - 15](image3)

<table>
<thead>
<tr>
<th>Design</th>
<th>$Q_{\text{max}}$ [lpm]</th>
<th>$p_{\text{max}}$ [bar]</th>
<th>Pilot ratio</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHK 22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>H/H1  B/B1</td>
<td>T/T1</td>
</tr>
<tr>
<td>Individual</td>
<td>20</td>
<td>400</td>
<td>1 : 4.6</td>
<td>G 3/8</td>
<td>97</td>
<td>32</td>
</tr>
<tr>
<td>Twin valve$^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>98</td>
<td>60</td>
</tr>
<tr>
<td>LHK 33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>123</td>
<td>40</td>
</tr>
<tr>
<td>Individual</td>
<td>60</td>
<td>360</td>
<td>1 : 4.4</td>
<td>G 1/2</td>
<td>123</td>
<td>40</td>
</tr>
<tr>
<td>Twin valve$^3$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>125...291</td>
<td>80</td>
</tr>
<tr>
<td>LHK 44</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170</td>
<td>45</td>
</tr>
<tr>
<td>Individual</td>
<td>100</td>
<td>350</td>
<td>1 : 4.4</td>
<td>G 3/4</td>
<td>170</td>
<td>45</td>
</tr>
<tr>
<td>Twin valve$^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170</td>
<td>90</td>
</tr>
<tr>
<td>LHDV 33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170</td>
<td>50</td>
</tr>
<tr>
<td>Individual</td>
<td>80</td>
<td>420</td>
<td>1 : 8...1 : 1.2$^3$</td>
<td>G 1/2</td>
<td>170</td>
<td>40</td>
</tr>
<tr>
<td>Valve$^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>170</td>
<td>1.8</td>
</tr>
<tr>
<td>LHT 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>132</td>
<td>40</td>
</tr>
<tr>
<td>Individual</td>
<td>25</td>
<td>400</td>
<td>1 : 8, 1 : 4</td>
<td>G 1/4</td>
<td>132</td>
<td>24.8</td>
</tr>
<tr>
<td>Twin valve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>132</td>
<td>50</td>
</tr>
<tr>
<td>LHT 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>128</td>
<td>70</td>
</tr>
<tr>
<td>Individual</td>
<td>130</td>
<td>450</td>
<td>1 : 7...1 : 0.53$^2$</td>
<td>G 1/2</td>
<td>128</td>
<td>40</td>
</tr>
<tr>
<td>Valve$^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>128</td>
<td>1.6</td>
</tr>
<tr>
<td>LHT 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>113</td>
<td>50</td>
</tr>
<tr>
<td>Individual</td>
<td>250</td>
<td>450</td>
<td>1 : 6...1 : 0.79$^3$</td>
<td>G 1</td>
<td>113</td>
<td>50</td>
</tr>
<tr>
<td>Valve$^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>113</td>
<td>1.0</td>
</tr>
</tbody>
</table>

1) Release ratio can be altered simply by changing the orifice  
2) Note: Design may be significantly different to the illustrated version!
Circuit example:

LHDV 33-25-D6-180/180-200
LHDV 33 P-15-D6-280/300
LHDV 33 P-15-D6-280/300
LHK 33 G-21-... in accordance with D 7100

Associated technical data sheets:
- Load-holding valve type LHK: D 7100
- Load-holding valve type LHDV: D 7770
- Load-holding valve type LHT: D 7918

Suitable proportional directional spool valve:
- Proportional directional valves type EDL: Page 90
- Proportional directional valves type PSL, PSV: Page 90
- Proportional directional valves type PSLF, PSVF: Page 96
## Valves

### 2.4 Flow valves

<table>
<thead>
<tr>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow control valve type SF, SD and SK</td>
<td>206</td>
</tr>
<tr>
<td>Flow control valve (lowering brake valve) type SB, SQ, SJ and DSJ</td>
<td>210</td>
</tr>
<tr>
<td>Proportional flow control valve type SE and SEH</td>
<td>212</td>
</tr>
<tr>
<td>Flow divider type TQ</td>
<td>216</td>
</tr>
<tr>
<td>Restrictors and restrictor check valve type EB, BE, BC</td>
<td>218</td>
</tr>
<tr>
<td>Throttle valve type Q, QR, QV and FG</td>
<td>220</td>
</tr>
<tr>
<td>Throttle valve type ED, restrictor check valve type RD and RDF</td>
<td>222</td>
</tr>
<tr>
<td>Throttle valve and restrictor check valve type CQ, CQR and CQV</td>
<td>224</td>
</tr>
<tr>
<td>Throttle valve and shut-off valve type AV, AVT and CAV</td>
<td>226</td>
</tr>
</tbody>
</table>
### Flow control valves

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / adjustability</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$q_{\text{max}}$ (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF, SD, SK</td>
<td>2-way and 3-way flow control valve: Single valve for pipe connection</td>
<td>SD - 3: 320</td>
<td>SD - 3: 60</td>
</tr>
<tr>
<td></td>
<td>Manifold mounting valve</td>
<td>SD - 4: 320</td>
<td>SD - 4: 90</td>
</tr>
<tr>
<td></td>
<td>- Mechanical</td>
<td>SD - 5: 320</td>
<td>SD - 5: 130</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SF - 3: 320</td>
<td>SF - 3: 60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SF - 4: 320</td>
<td>SF - 4: 90</td>
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<tr>
<td></td>
<td></td>
<td>SF - 5: 320</td>
<td>SF - 5: 130</td>
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<tr>
<td></td>
<td></td>
<td>SK - 3: 320</td>
<td>SK - 3: 60</td>
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<tr>
<td></td>
<td></td>
<td>SK - 4: 320</td>
<td>SK - 4: 90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SK - 5: 320</td>
<td>SK - 5: 130</td>
</tr>
<tr>
<td>SB, SQ, SJ, DSJ</td>
<td>2-way metering valve, drop-rate braking valve: Screw-in valve</td>
<td>SB - 0: 315</td>
<td>SB - 0: 15</td>
</tr>
<tr>
<td></td>
<td>Combination with housing for pipe connection: Tool adjustable, fixed</td>
<td>SB - 1: 315</td>
<td>SB - 1: 35</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SB - 2: 315</td>
<td>SB - 2: 67</td>
</tr>
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<td></td>
<td></td>
<td>SB - 3: 315</td>
<td>SB - 3: 150</td>
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<td>SB - 4: 315</td>
<td>SB - 4: 250</td>
</tr>
<tr>
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<td></td>
<td>SB - 5: 315</td>
<td>SB - 5: 400</td>
</tr>
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<td></td>
<td></td>
<td>SQ - 0: 315</td>
<td>SQ - 0: 15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SQ - 1: 315</td>
<td>SQ - 1: 25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SQ - 2: 315</td>
<td>SQ - 2: 67</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SQ - 3: 315</td>
<td>SQ - 3: 150</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SJ - 0: 315</td>
<td>SJ - 0: 15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DSJ - 1: 315</td>
<td>DSJ - 1: 25</td>
</tr>
<tr>
<td>SE, SEH</td>
<td>2-way and 3-way flow control valve: Single valve for pipe connection</td>
<td>SE - 3: 320</td>
<td>SE - 3: 50</td>
</tr>
<tr>
<td></td>
<td>Manifold mounting valve</td>
<td>SE - 4: 320</td>
<td>SE - 4: 90</td>
</tr>
<tr>
<td></td>
<td>- Electro-proportional</td>
<td>SEH - 2: 320</td>
<td>SEH - 2: 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SEH - 3: 320</td>
<td>SEH - 3: 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SEH - 4: 320</td>
<td>SEH - 4: 90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SEH - 5: 320</td>
<td>SEH - 5: 120</td>
</tr>
</tbody>
</table>

### Flow dividers

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / adjustability</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$q_{\text{max}}$ (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TQ</td>
<td>Flow dividers: Single valve for pipe connection, Manifold mounting valve</td>
<td>3: 350</td>
<td>3: 70</td>
</tr>
<tr>
<td></td>
<td>- Non-adjustable</td>
<td>43: 350</td>
<td>43: 120</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54: 350</td>
<td>54: 200</td>
</tr>
</tbody>
</table>
### Restrictors, restrictor check valves

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / features</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>$q_{\text{max}}$ (lpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EB, BE, BC</td>
<td><strong>Restrictor, restrictor check valve</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EB - 0: 500</td>
<td>EB - 0: 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EB - 1: 500</td>
<td>EB - 1: 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EB - 2: 500</td>
<td>EB - 2: 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EB - 3: 500</td>
<td>EB - 3: 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EB - 4: 500</td>
<td>EB - 4: 120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BE - 0: 500</td>
<td>BE - 0: 12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BE - 1: 500</td>
<td>BE - 1: 25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BE - 2: 500</td>
<td>BE - 2: 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BE - 3: 500</td>
<td>BE - 3: 80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BE - 4: 500</td>
<td>BE - 4: 120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BC - 1: 700</td>
<td>BC - 1: 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BC - 2: 700</td>
<td>BC - 2: 35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BC - 3: 500</td>
<td>BC - 3: 60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Plug-in valve
- Screw-in valve
- Combination with housing for pipe connection
### Throttle valves and throttle shut-off valves

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / adjustability</th>
<th>( p_{\text{max}} ) (bar)</th>
<th>( q_{\text{max}} ) (lpm)</th>
</tr>
</thead>
</table>
| Q, QR, QV, FG | **Throttle valve, restrictor check valve**  
- Screw-in valve  
- Single valve for pipe connection  
- Angle valve  
- Banjo bolt  
- Swivel fitting  
  - Tool adjustable | Q, QR - 20: 400  
Q, QR - 30: 400  
Q, QR - 40: 400  
Q, QR - 50: 400  
Q, QR - 60: 315 | Q, QR - 20: 12  
Q, QR - 30: 20  
Q, QR - 40: 40  
Q, QR - 50: 60  
Q, QR - 60: 80 | QV - 20: 400  
QV - 30: 400  
QV - 40: 400  
QV - 50: 400  
QV - 60: 315 | QV - 20: 8  
QV - 30: 12  
QV - 40: 20  
QV - 50: 30  
QV - 60: 50 | FG: 320 | FG: 0.8 |
| ED, RD, RDF | **Throttle valve, restrictor check valve**  
- Single valve for pipe connection  
  - Tool adjustable, fixed  
  - Manual, adjustable | ED, RD - 11: 500  
ED, RD - 21: 500  
ED, RD - 31: 500  
ED, RD - 41: 500  
ED, RD - 51: 500 | ED, RD - 11: 15  
ED, RD - 21: 35  
ED, RD - 31: 60  
ED, RD - 41: 100  
ED, RD - 51: 150 | RDF - 11: 500  
RDF - 21: 500  
RDF - 31: 500  
RDF - 41: 500  
RDF - 51: 500 | RDF - 11: 15  
RDF - 21: 35  
RDF - 31: 60  
RDF - 41: 100  
RDF - 51: 150 | |
| CQ, CQR, CQV | **Throttle valve, restrictor check valve**  
- Screw-in valve  
  - Tool adjustable | CQ - 2: 700  
CQR - 2: 700  
CQV - 2: 700 | CQ - 2: 50  
CQR - 2: 50  
CQV - 2: 50 | |
| AV, AVT, CAV | **Throttle and shut-off valve**  
- Single valve for pipe connection  
- Screw-in valve  
  - Tool adjustable, fixed  
  - Manual, adjustable | AV - 2: 500  
AV - 3: 400  
CAV - 1: 500  
CAV - 2: 500  
AVT - 6: 630  
AVT - 8: 630  
AVT - 10: 630  
AVT - 12: 630 | AV - 2: 40  
AV - 3: 100  
CAV - 1: 15  
CAV - 2: 25 | AVM - 8: 500  
AVM - 8L: 315 |
Flow valves

2.4 Flow control valve type SF, SD and SK

Flow control valves are a type of flow valve. They generate a set constant flow rate, largely independently of the load.

The flow control valve type SD, SF and SK can be freely adjusted with different mechanical actuations. The flow control valve type SD, SF and SK is available as a 2-way and 3-way flow control valve. For type SD, the adjustment is made using the adjusting knob; for type SF using the adjusting screw; and for type SK using the roller actuation. The flow control valve type SD, SF and SK is available as a single valve for pipe connection or as a manifold mounting valve.

Pressure-limiting valves and randomly switchable idle circulation valves are additional options. The flow control valve type SD, SF and SK controls the operating speed of the hydraulic consumers.

Features and benefits:
- Various actuation types
- Can also be combined with bypass check valves
- Precise setting

Intended applications:
- Construction machinery
- Machine tools
- General hydraulic systems

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>2-way flow control valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Individual valves for pipe mounting</td>
</tr>
<tr>
<td></td>
<td>Manifold mounting</td>
</tr>
<tr>
<td>Adjustment:</td>
<td>Mechanical</td>
</tr>
<tr>
<td></td>
<td>Adjusting knob</td>
</tr>
<tr>
<td></td>
<td>Roller actuation</td>
</tr>
<tr>
<td></td>
<td>Setting screw</td>
</tr>
<tr>
<td>$p_{max}$:</td>
<td>315 bar</td>
</tr>
<tr>
<td>$Q_{max}$:</td>
<td>130 l/min</td>
</tr>
</tbody>
</table>
Design and order coding example

SF 3 - 3 /15 - S - G24 - 120

Pressure setting [bar] of the pressure limiting valve (S)

- Solenoid voltage: G 12, G 24, WG 110 and WG 230
- Mounting and add. valve:
  - Pipe connection (no coding)
  - Manifold mounting (P)
  - Valve with bypass check valve (R, PR)
  - Check valve bridge circuit (B)
  - Pressure-limiting valve (S)
  - Pressure-limiting and circulation valve (S-WN1F, S-WN1D)

Volumetric flow:
- Flow steps via orifices \( Q_{\text{max}} \) : 3, 6, 15, 36, 50, 60, 70, 90, 130 lpm

Basic type, design, size:
- Type SF, with lock nut, fixed adjustment
- Type SD, with adjusting knob actuation
- Type SK, with roller actuation (open version)
- Type SKR, with roller actuation (closed version, not for manifold mounting)
- Version as 2-way (-2) and 3-way (3) flow control valves
- Size 3 to 5

Function

2-way, pipe connection

2-way, manifold mounting valve

Actuation:

- SF ...
- SD ...
- SK ...
- SKR ...

Set screw SW 10
- adjustment travel 5 mm

Adjusting knob,
- adjustment travel 3.8 turns

Roller actuation
- Unshielded version (SK), Shielded version (SKR)
- Actuation travel 15,5 ... 17 mm,
- Actuation force 30 ... 70 N
General parameters and dimensions

Version for pipe connection

1. Idle circulation valve
2. Pressure-limiting valve
3. Setting screw

Manifold mounting valve

<table>
<thead>
<tr>
<th>Ports</th>
<th>G 1/2</th>
<th>G 3/4</th>
<th>G 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-way</td>
<td>0.3 ... 60</td>
<td>0.3 ... 90</td>
<td>1.0 ... 130</td>
</tr>
<tr>
<td>3-way</td>
<td>G 1/2</td>
<td>G 3/4</td>
<td>G 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dimensions [mm]</th>
<th>H</th>
<th>H1</th>
<th>L</th>
<th>L1</th>
<th>B</th>
<th>B1</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-way S. 2-3</td>
<td>50</td>
<td>40</td>
<td>80</td>
<td>93</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>2-way S. 2-4</td>
<td>60</td>
<td>50</td>
<td>85</td>
<td>100</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>2-way S. 2-5</td>
<td>70</td>
<td>50</td>
<td>100</td>
<td>106</td>
<td>70</td>
<td>80</td>
</tr>
<tr>
<td>3-way S. 3-3</td>
<td>50</td>
<td>40</td>
<td>80</td>
<td>93</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>3-way S. 3-4</td>
<td>60</td>
<td>50</td>
<td>85</td>
<td>100</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>3-way S. 3-5</td>
<td>70</td>
<td>50</td>
<td>100</td>
<td>106</td>
<td>70</td>
<td>80</td>
</tr>
</tbody>
</table>

1) Different Q_{max} available, see Design and order coding example: "Orifice steps"
2) For pipe connection versions
3) Depending on actuations
### Associated technical data sheets:

- Flow control valve type SD, SF and SK: D 6233

### Similar products:

- Drop-rate braking valves type SB, SQ: [Page 210](#)
- Prop. flow control valves type SE, SEH: [Page 212](#)

### Male connectors:

- Line connector type MSD and others: D 7163

---

**Circuit example:**

<table>
<thead>
<tr>
<th>Position</th>
<th>Number</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2</td>
<td>SMK 20-G 1/4-PC</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>DG 364-35</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>SD 2-3/6P</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>20,201 H 00</td>
</tr>
</tbody>
</table>

![Circuit Diagram]

---

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209/299
Flow valves

2.4 Flow control valve (lowering brake valve) type SB, SQ, SJ and DSJ

Flow control valves are a type of flow valve. They generate a set constant flow rate, largely independently of the load.

The flow control valve type SB and SQ is available as a screw-in cartridge, a housing version with pipe connection or as a banjo screw version. Type SB has a slightly inclined characteristic curve for oscillation damping. Type SQ is largely independent of the load.

The freely movable sliding metering orifice enables greater flow in the opposite flow direction. No bypass check valve is therefore required. The flow control valve type SB and SQ is used to control the lowering speed of single-acting consumers.

Features and benefits:
- Oscillation damping and load-independent
- Compact screw-in valve

Intended applications:
- General hydraulic systems
- Industrial trucks
- Lifting equipment

Nomenclature:
- 2-way flow control valve (drop rate braking valve)

Design:
- Screw-in type with housing for in-line installation

Adjustment:
- Fixed (pre-set)
- Tool adjustable from outside

\[ p_{\text{max}}: \] 315 bar

\[ Q_{\text{max}}: \] 400 lpm

Design and order coding example

<table>
<thead>
<tr>
<th>SB 2 1 C - 30</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response flow [l/min]</strong> Desired factory set response flow within the respective range</td>
</tr>
<tr>
<td><strong>Design</strong> Adjustable or non adjustable version</td>
</tr>
<tr>
<td>- Screw-in version (C)</td>
</tr>
<tr>
<td>- Version with housing for pipe mounting (E, F, G)</td>
</tr>
<tr>
<td><strong>Additional versions</strong></td>
</tr>
<tr>
<td>- With metric of UNF-thread</td>
</tr>
<tr>
<td>- With thread adaptor</td>
</tr>
<tr>
<td>- As banjo bolt and/or with swiveling screw fitting</td>
</tr>
<tr>
<td><strong>Adjustment range</strong> Adjustable response flow</td>
</tr>
<tr>
<td><strong>Basic type, size</strong> Type SB, SQ and SJ, size</td>
</tr>
<tr>
<td>Type DSJ, flow control function in both directions for double-acting consumers</td>
</tr>
</tbody>
</table>
### Function

<table>
<thead>
<tr>
<th>SB, SQ</th>
<th>SJ</th>
<th>DSJ</th>
</tr>
</thead>
</table>

### General parameters and dimensions

#### Screw-in valve ...C

<table>
<thead>
<tr>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB 0</td>
<td>39</td>
<td>19</td>
</tr>
<tr>
<td>SJ 0</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>SB 1</td>
<td>2.5...4</td>
<td>1.6...2.5</td>
</tr>
<tr>
<td>SQ 1</td>
<td>16...21</td>
<td>21...28</td>
</tr>
<tr>
<td>SB 2</td>
<td>37...50</td>
<td>50...67</td>
</tr>
<tr>
<td>SQ 2</td>
<td>80...100</td>
<td>100...125</td>
</tr>
<tr>
<td>SB 3</td>
<td>170...200</td>
<td>200...236</td>
</tr>
<tr>
<td>DSJ 1</td>
<td>1.0...21.0</td>
<td>30</td>
</tr>
</tbody>
</table>

#### With housing...G

<table>
<thead>
<tr>
<th>Coding for adjustment range of the set response flow from ... to ... [lpm] below</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1...1.6</td>
<td>G 1/4 (A)</td>
<td>39</td>
<td>19</td>
</tr>
<tr>
<td>1.6...2.5</td>
<td></td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>2.5...4</td>
<td></td>
<td>43</td>
<td>22</td>
</tr>
<tr>
<td>4...6.3</td>
<td></td>
<td>49</td>
<td>23</td>
</tr>
<tr>
<td>6.3...10</td>
<td></td>
<td>49</td>
<td>23</td>
</tr>
<tr>
<td>10...16</td>
<td></td>
<td>78</td>
<td>13</td>
</tr>
<tr>
<td>16...25</td>
<td></td>
<td>82</td>
<td>22</td>
</tr>
<tr>
<td>25...35</td>
<td></td>
<td>96</td>
<td>27</td>
</tr>
<tr>
<td>2.5...4</td>
<td>G 3/8 (A)</td>
<td>43</td>
<td>22</td>
</tr>
<tr>
<td>4...6.3</td>
<td></td>
<td>82</td>
<td>22</td>
</tr>
<tr>
<td>6.3...10</td>
<td></td>
<td>96</td>
<td>27</td>
</tr>
<tr>
<td>10...16</td>
<td></td>
<td>106</td>
<td>32</td>
</tr>
<tr>
<td>16...25</td>
<td></td>
<td>106</td>
<td>32</td>
</tr>
<tr>
<td>25...35</td>
<td></td>
<td>145</td>
<td>41</td>
</tr>
<tr>
<td>2.5...4</td>
<td>G 1/2 (A)</td>
<td>49</td>
<td>23</td>
</tr>
<tr>
<td>4...6.3</td>
<td></td>
<td>96</td>
<td>27</td>
</tr>
<tr>
<td>6.3...10</td>
<td></td>
<td>145</td>
<td>41</td>
</tr>
<tr>
<td>10...16</td>
<td></td>
<td>150</td>
<td>60</td>
</tr>
<tr>
<td>16...25</td>
<td></td>
<td>41</td>
<td>150</td>
</tr>
<tr>
<td>25...35</td>
<td></td>
<td>60</td>
<td>150</td>
</tr>
<tr>
<td>3.0...21.0</td>
<td></td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

1) Type SJ 0 without coding: adjust. range 0.25 ... 1.2 l/min
2) Not for type SQ..
Proportional flow control valves are a type of flow valve. They generate a constant flow rate independent of the load which can be controlled in an electro-proportional and remote way.

The flow control valve type SE has a directly actuated metering orifice, which has an advantage of approximately $Q_{\text{min}}$ equal to zero in terms of the controllability. The flow control valve type SEH has a piloted metering orifice which is shown to be beneficial in dynamic systems with short reaction times. The flow control valve type SE and SEH is available as a single valve for pipe connection or as a manifold mounting valve.

Pressure-limiting valves and randomly switchable idle circulation valves are additional options. The flow control valve type SE and SEH controls the operating speed of hydraulic consumers.

**Features and benefits:**
- Electrical control of consumer operating speeds
- Automation of operating cycles

**Intended applications:**
- Construction machines
- Machine tools
- General hydraulic systems
- Mining machinery

**Design and order coding example**

<table>
<thead>
<tr>
<th>SE 2-3</th>
<th>/30F</th>
<th>- P</th>
<th>- G24</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solenoid voltage</strong></td>
<td>Prop. solenoid</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12 V DC, 24 V DC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controls via prop. amplifier or PLVC</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Design and port size</strong></td>
<td>Pipe connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manifold mounting (P)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Flow [lpm]</strong></td>
<td>Nom. flow of the metering orifice</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deenergized open</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deenergized closed (coding F)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orifice steps $Q_{\text{max}}$: 3, 6, 10, 15, 22, 30, 36, 50, 70, 90, 120 lpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Basic type, size</strong></td>
<td>Type SE, with non-piloted metering orifice, size 3, 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type SEH, with piloted metering orifice, size 2 to 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Available as 2- and 3-way flow control valve</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Technical data:**

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>2-way flow control valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Individual valve for pipe mounting or Screw-in valve</td>
</tr>
<tr>
<td>Adjustment:</td>
<td>Electro-proportional</td>
</tr>
<tr>
<td>$p_{\text{max}}$:</td>
<td>315 bar</td>
</tr>
<tr>
<td>$Q_{\text{max}}$:</td>
<td>120 lpm</td>
</tr>
</tbody>
</table>
Function

SE, SEH

2-way
Pipe connection

3-way
Pipe connection

2-way
Manifold mounting valve

3-way
Manifold mounting valve

1) No Z port with type SEH 3-2

Additional functions for flow control valves:

2-way flow control valve
- Version with bypass check valve
- Version with check valve in bridge circuit for free selection of the flow direction

3-way flow control valve
- Version with pressure-limiting valve
- Version with pressure-limiting valve and circulation valve (for pipe connection versions only)
- Version with compulsory closed position of the pressure compensator when not actuated type ...FO
- Version with automatic circulation type ...B 0.6
General parameters and dimensions

SEH
Version for pipe connection

<table>
<thead>
<tr>
<th>Basic type and size</th>
<th>( Q_{\text{max}} ) [lpm](^1)</th>
<th>( p_{\text{max}} ) [bar]</th>
<th>Ports(^2)</th>
<th>Dimensions [mm]</th>
<th>( m_{\text{max}} ) [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-way</td>
<td>3-way</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SE 2-3</td>
<td>SE 3-3</td>
<td>Directly actuated</td>
<td>0.3 ... 50</td>
<td>315</td>
<td>G 1/2</td>
</tr>
<tr>
<td>SE 2-4</td>
<td>SE 3-4</td>
<td></td>
<td>0.6 ... 90</td>
<td>315</td>
<td>G 3/4</td>
</tr>
<tr>
<td>SEH 2-2</td>
<td>SEH 3-2</td>
<td>Hydraulically</td>
<td>0.1 ... 36</td>
<td>315</td>
<td>G 3/8</td>
</tr>
<tr>
<td>SEH 2-3(^3)</td>
<td>SEH 3-3</td>
<td>piloted</td>
<td>0.3 ... 50</td>
<td>315</td>
<td>G 1/2</td>
</tr>
<tr>
<td>-</td>
<td>SEH 3-4</td>
<td></td>
<td>0.6 ... 90</td>
<td>315</td>
<td>G 3/4</td>
</tr>
<tr>
<td>-</td>
<td>SEH 3-5</td>
<td></td>
<td>1,0 ... 120</td>
<td>315</td>
<td>G 1</td>
</tr>
</tbody>
</table>

1) Different \( Q_{\text{max}} \) available, see Design and order coding example: “Orifice steps”
2) For pipe connection versions
3) For manifold mounting versions only
Circuit example

1. SEHD 3-3/30 FP-X 24
2. TQ 4 P-A 5/2
3. EM 31 V-X24
4. EMP 31 S-X 24
5. MVH 6 C
6. EM 31 S-X24
7. SWPN 2-G-X24

Associated technical data sheets:
- Proportional flow control valve type SE and SEH: Page 7557/1

Similar products:
- Flow control valves type SD and others: Page 206

Suitable accessories:
- Proportional amplifier type EV1M3: Page 272
- Proportional amplifier type EV2S: Page 274
- Proportional amplifier type EV1D: Page 272
Flow valves

2.4 Flow divider type TQ

Flow dividers are a type of metering valve. They divide or add together a total flow rate either evenly or using a fixed ratio. The consumer pressures have no effect. The flow divider type TQ is, due to its simple design, an economical solution for simple dividing tasks, e.g., if two hydraulic consumers with varying loads supplied from one pump are to be moved simultaneously without interaction.

Intended applications include mobile hydraulics and industrial hydraulics.

Features and benefits:
- Excellent dividing accuracy

Intended applications:
- Steering systems
- Synchronous cylinders

Nomenclature:
- Flow dividers

Design:
- Individual valve for pipe mounting
  - Manifold mounting

Adjustment:
- Non-adjustable

$p_{max}$: 350 bar

$q_{max}$: 200 lpm (nom. total flow)

Design and order coding example

<table>
<thead>
<tr>
<th>Coding Flow indicator</th>
<th>Design</th>
<th>Basic type, size</th>
</tr>
</thead>
<tbody>
<tr>
<td>TQ 32 - A - 2,3 - 3</td>
<td>A – equal division ratio</td>
<td>Pipe connection (no coding)</td>
</tr>
<tr>
<td></td>
<td>R - with bypass check valve</td>
<td>Manifold mounting (P)</td>
</tr>
</tbody>
</table>

Type TQ, size 2 to 5

Function

TQ
- Pipe connection

TQ.P
- Manifold mounting valve
## General parameters and dimensions

### TQ...
Pipe mounting

<table>
<thead>
<tr>
<th>Q_{max} [lpm]</th>
<th>P_{max} [bar]</th>
<th>Ports¹</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>TQ 2..</td>
<td>7.5 ... 70</td>
<td>350</td>
<td>G 1/4, G 3/8</td>
<td>G 1/4, G 3/8</td>
</tr>
<tr>
<td>TQ 3..</td>
<td>7.5 ... 70</td>
<td>350</td>
<td>G 3/8, G 1/2</td>
<td>G 3/8, G 1/2</td>
</tr>
<tr>
<td>TQ 3P</td>
<td>7.5 ... 70</td>
<td>350</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TQ 4</td>
<td>80 ... 120</td>
<td>350</td>
<td>G 1/2</td>
<td>G 1/2</td>
</tr>
<tr>
<td>TQ 4P</td>
<td>80 ... 120</td>
<td>350</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TQ 5</td>
<td>140 ... 200</td>
<td>350</td>
<td>G 3/4</td>
<td>G 3/4</td>
</tr>
<tr>
<td>TQ 5P</td>
<td>140 ... 200</td>
<td>350</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

¹ For pipe mounting versions only

### TQ ..P
Manifold mounting

**Associated technical data sheets:**
- Flow divider, type TQ: D 7381
Restrictors are a type of flow valve. They are used as a local flow resistance that suddenly reduces the line cross-section. The reduction in the cross-section is very short. As a result, the flow rate is only dependent on the pressure difference and not on the viscosity.

The restrictor check valve type BE and BC combines the function of a flow valve with a check valve. The valve is available as a perforated restrictor or as a slotted restrictor. It limits the flow during the switching of directional valves. E.g. it prevents excessively quick accumulator emptying.

The orifice insert type EB is primarily used in valves for manifold mounting. As such an additional intermediate plate is not necessary.

**Features and benefits:**
- Max. 700 bar
- Simple design and installation

**Intended applications:**
- General hydraulics
- Winch controls
- Hydraulic pilot systems

**Design and order coding example**

<table>
<thead>
<tr>
<th>Design with housing</th>
<th>For pipe connection, type BC, BE (E; F, G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orifice</td>
<td>Hole or slot type orifice, diameter in mm</td>
</tr>
<tr>
<td>Basic type, size</td>
<td>Type BC, size 1 to 3</td>
</tr>
<tr>
<td></td>
<td>Type BE, size 1 to 4</td>
</tr>
<tr>
<td></td>
<td>Type EB, size 0 to 4, Orifice insert</td>
</tr>
</tbody>
</table>

**Additional versions**
- Type BC and BE with metric thread

**Function**

- **BC**
  - Screw-in valve

- **BE**
  - Orifice insert

- **EB**
  - Orifice insert
General parameters and dimensions

**BC..**

Screw-in valve

![Diagram BC..]

**BE..**

Orifice insert

![Diagram BE..]

**EB..**

Insert check valves type RK, RB, RC, RE, ER

![Diagram EB..]

### Related technical data sheets:
- Restrictor check valve type BC: D 6969 B
- Restrictor check valve type BE: D 7555 B
- Orifice type EB: D 6465

### Similar products:
- Insert check valves type RK, RB, RC, RE, ER: [Page 232](#)

### General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>Q_{max} [l/min]</th>
<th>p_{max} [bar]</th>
<th>Ports</th>
<th>Dimensions</th>
<th>m [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>H [mm]</td>
<td>G / D</td>
<td></td>
</tr>
<tr>
<td>BC 1</td>
<td>20</td>
<td>700</td>
<td>G 1/4 A</td>
<td>13</td>
<td>G 1/4 A</td>
</tr>
<tr>
<td>BC 2</td>
<td>35</td>
<td>700</td>
<td>G 3/8 A</td>
<td>15</td>
<td>G 3/8 A</td>
</tr>
<tr>
<td>BC 3</td>
<td>60</td>
<td>500</td>
<td>G 1/2 A</td>
<td>18</td>
<td>G 1/2 A</td>
</tr>
<tr>
<td>BE 0</td>
<td>12</td>
<td>500</td>
<td>G 1/8 A</td>
<td>5</td>
<td>G 1/8 A</td>
</tr>
<tr>
<td>BE 1</td>
<td>25</td>
<td>500</td>
<td>G 1/4 A</td>
<td>6</td>
<td>G 1/4 A</td>
</tr>
<tr>
<td>BE 2</td>
<td>40</td>
<td>500</td>
<td>G 3/8 A</td>
<td>7</td>
<td>G 3/8 A</td>
</tr>
<tr>
<td>BE 3</td>
<td>80</td>
<td>450</td>
<td>G 1/2 A</td>
<td>7.5</td>
<td>G 1/2 A</td>
</tr>
<tr>
<td>BE 4</td>
<td>120</td>
<td>400</td>
<td>G 3/4 A</td>
<td>9</td>
<td>G 3/4 A</td>
</tr>
<tr>
<td>EB 0</td>
<td>6</td>
<td>500</td>
<td>-</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>EB 1</td>
<td>10</td>
<td>700</td>
<td>-</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>EB 2</td>
<td>40</td>
<td>700</td>
<td>-</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>EB 3</td>
<td>100</td>
<td>500</td>
<td>-</td>
<td>11.5</td>
<td></td>
</tr>
<tr>
<td>EB 4</td>
<td>120</td>
<td>500</td>
<td>-</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
Flow valves

2.4 Throttle valve type Q, QR, QV and FG

Throttle valves are a type of flow valve. They affect the flow rate for single and double-acting consumers.

The throttle valve type Q and the restrictor check valve type QR and QV are, as slotted throttles, insensitive to micro contamination. The precision throttle valve FG is a thread type throttle. It adjusts the switching time of directional valves, prevents switching surges and dampens oscillations. The restrictor check valve type QR, QV, FG1 and FG2 combines the function of a flow valve with a check valve. It regulates in one flow direction and permits free flow in the other direction.

The valve type Q, QR, QV and FG can be integrated into control blocks or into the pipework as a banjo screw version.

Features and benefits:
- Different installation options
- Simple design

Intended applications:
- General hydraulic systems

Design and order coding example

<table>
<thead>
<tr>
<th>QR 20</th>
<th>- H 6</th>
<th>K</th>
</tr>
</thead>
</table>

Version with housing
- Without labelling as a screw-in valve
- Available as a banjo bolt and/or with swivel fitting

Basic type, size, function
- Throttles type Q, type QR, type QV and precision throttles type FG, subdivided into 5 sizes
- Throttle direction and free flow direction function
- Slot-type throttles, available with or without built-in check valve

Diagram of devices:

<table>
<thead>
<tr>
<th>FG</th>
<th>Throttle screw</th>
<th>Banjo bolt</th>
<th>Swivel fitting</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Q</th>
<th>Throttle screw</th>
<th>Banjo bolt</th>
<th>Swivel fitting</th>
</tr>
</thead>
</table>

Nomenclature:
- Throttle
- Restrictor check valves

Design:
- Cartridge
- Individual valve for pipe mounting
- Corner housing
- Banjo bolt
- Swivel fitting

Adjustment:
- Tool adjustable

$p_{\text{max}}$: 400 bar

$Q_{\text{max}}$: 120 lpm
**Function**

<table>
<thead>
<tr>
<th>FG, Q</th>
<th>FG 1, QR</th>
<th>FG2, QV</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**General parameters and dimensions**

<table>
<thead>
<tr>
<th>Function</th>
<th>$Q_{\text{max}}$ [lpm]</th>
<th>$P_{\text{max}}$ [bar]</th>
<th>Dimensions</th>
<th>$m$ [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>FG, FG1, FG2</td>
<td>0.15</td>
<td>300</td>
<td>H [mm]</td>
<td>G</td>
</tr>
<tr>
<td>Q20, QR20, QV20</td>
<td>12</td>
<td>400</td>
<td>30</td>
<td>M 8</td>
</tr>
<tr>
<td>Q30, QR30, QV30</td>
<td>25</td>
<td>400</td>
<td>32</td>
<td>M 8 x 1</td>
</tr>
<tr>
<td>Q40, QR40, QV40</td>
<td>50</td>
<td>400</td>
<td>36</td>
<td>M 10 x 1</td>
</tr>
<tr>
<td>Q50, QR50, QV50</td>
<td>90</td>
<td>400</td>
<td>41</td>
<td>M 12 x 1.5</td>
</tr>
<tr>
<td>Q 60, QR60, QV60</td>
<td>120</td>
<td>315</td>
<td>46</td>
<td>M 14 x 1.5</td>
</tr>
</tbody>
</table>

1) The values apply to a fully opened valve (observe red marking) and a back pressure of approx. 50 bar (in a throttled direction)

**Associated technical data sheets:**
- Throttle valve and throttle check valve type Q, QR and QV: D 7730
- Throttle valve and throttle check valve type FG: D 7275
- Restrictor check valves and orifice inserts type EB, BE, BC: Page 218

**Similar products:**
- Throttle valves type CQ, CQR, COV: Page 224
- Throttle and restrictor check valves type ED, RD, RDF: Page 222
Flow valves

2.4 Throttle valve type ED, restrictor check valve type RD and RDF

Throttle valves are a type of flow valve. They affect the flow rate for single and double-acting consumers.

The restrictor check valve type RD and RDF combines the function of a flow valve with a check valve. It regulates in one flow direction and permits free flow in the other direction.

Types ED and RD are adjustable.

The valve type ED, RD and RDF can be integrated directly in the line.

**Features and benefits:**
- Sensitively adjustable
- Wear-resistant

**Intended applications:**
- General hydraulic systems

---

**Design and order coding example**

<table>
<thead>
<tr>
<th>RD 11</th>
<th>RDF 21 /1,0 - K</th>
</tr>
</thead>
</table>

**Adjustability**
- Type ED and RD only
- Without labelling = manually (wing bolt/lock nut)
- K = tool adjustable (setting spindle/lock nut)

**Fixed throttles Diameter in mm, type RDF**
- 0.4 - 0.6 (in increments of 0.1)
- 0.8 - 2.0 (in increments of 0.2)
- 2.5 - 5.5 (in increments of 0.5)

**Basic type, size**
- Type ED, type RD, type RDF, size 1 to 5
- Slot-type throttles, available with or without built-in check valve

---

**Function**

ED

[Diagram]

RD

[Diagram]

RDF

[Diagram]
### General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>$Q_{\text{max}}$ [lpm]$^{2)}$</th>
<th>$p_{\text{max}}$ [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>$m$ [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$H$</td>
<td>$B$</td>
</tr>
<tr>
<td>ED 11..</td>
<td>12</td>
<td>500</td>
<td>G 1/4</td>
<td>23.5</td>
<td>52</td>
</tr>
<tr>
<td>RD 21..</td>
<td>12</td>
<td>500</td>
<td>G 3/8</td>
<td>24</td>
<td>52</td>
</tr>
<tr>
<td>RDF 11/..</td>
<td>60</td>
<td>500</td>
<td>G 1/2</td>
<td>32.5</td>
<td>62</td>
</tr>
<tr>
<td>ED 41..</td>
<td>80</td>
<td>500</td>
<td>G 3/4</td>
<td>41</td>
<td>72</td>
</tr>
<tr>
<td>RDF 51/..</td>
<td>130</td>
<td>500</td>
<td>G 1</td>
<td>46.5</td>
<td>82</td>
</tr>
</tbody>
</table>

1) The throttle diameter with type RDF can be only altered by replacing the orifice. Depending on size, diameters between 0.6 and 4 mm are available.

2) These figures correspond to completely opened throttle and represent a back pressure of approx. 50 bar ( throttled direction of flow)

### Associated technical data sheets:
- Throttle and restrictor check valves
  - type ED, RD, RDF: [D 7540](#), [D 2570](#)

### Similar products:
- Throttle valves type Q, QR, QV, FG: [Page 220](#)
- Throttle valves type CQ, CQR, CQV: [Page 224](#)
- Restrictor check valves type EB, BE, BC: [Page 218](#)
Flow valves

2.4 Throttle valve and restrictor check valve type CQ, CQR and CQV

Throttle valves are a type of flow valve. They affect the flow rate for single and double-acting consumers.

The throttle valve type CQ and the restrictor check valve type CQR and CQV are, as slotted throttles, insensitive to micro contamination. The restrictor check valve type CQR and CQV combines the function of a flow valve with a check valve. It regulates in one flow direction and permits free flow in the other direction. The double spindle sealing enables leakage-free adjustment, even under pressure.

The valve type CQ, CQR and CQV can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make.

Features and benefits:
- Leak-free adjustment under pressure
- Operating pressure up to 700 bar

Intended applications:
- Speed regulation in hydraulic lifting devices

### Nomenclature:
- Throttle
- Restrictor check valves

### Design:
- Screw-in valve

### Adjustment:
- Tool adjustable
- Manually

<table>
<thead>
<tr>
<th>p_max</th>
<th>700 bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q_max</td>
<td>50 l/min</td>
</tr>
</tbody>
</table>

### Design and order coding example

<table>
<thead>
<tr>
<th>CQV 2</th>
<th>- D</th>
<th>~ 1/4</th>
</tr>
</thead>
</table>

#### Single connection blocks
- For pipe connection (1/4, 3/8)
- Manifold mounting (in combination with type CQ and CQV only)

#### Adjustability in operation
- Without labelling = Fixed
- D = Turn knob (with lock nut)
- D3 = Turn knob, diameter 35 mm (without lock nut)

#### Basic type, size
- Type CQ, type CQR, type CQV, size 2
- Slot-type throttles, available with or without built-in check valve
  - Version with precision control range (size 22)
  - Version with strong precision control range (size 23; only with turn knob D3)
  - Version with pressure compensator (flow control function)
Function

CQ 2, CQ 22, CQ 23
![Diagram of CQ 2, CQ 22, CQ 23]

CQR 2, CQR 22, CQR 23
![Diagram of CQR 2, CQR 22, CQR 23]

CQV 2, CQV 22, CQV 23
![Diagram of CQV 2, CQV 22, CQV 23]

CQ 2 - P - DW
![Diagram of CQ 2 - P - DW]

General parameters and dimensions

CQ 2., CQR 2., CQV 2.

<table>
<thead>
<tr>
<th>Q_{max} [lpm]</th>
<th>P_{max} [bar]</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 / 30 / 10</td>
<td>700</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- Throttle valve and throttle check valve type CQ, CQR and CQV: D 7713

Similar products:
- Throttle and restrictor check valves type ED, RD, RDF: Page 222
- Throttle valves type Q, QR, QV, FG: Page 220
Throttle and shut-off valves are a type of metering valve. With the aid of these valves a pressure drop can be established between the inlet and outlet side. In this way the velocity of cylinders in accumulator circuits and the flow rate in control circuits can be regulated or a consumer line completely shut-off (e.g. to protect a pressure gauge).

The throttle and shut-off valve type AV and AVT produces a throttle effect by means of an annular gap. The valve type CAV, as a slotted throttle, is insensitive to micro contamination.

The valve type AV is available as a screw-in valve or valve for pipe connection. The type AVT is mounted in a T-housing and commercially available pipe screw connections permit direct pipe connection. The valve type CAV can be screwed-in and can be integrated into manifolds. The necessary mounting holes are straightforward to make.

**Features and benefits:**
- Various configurations
- Sensitive adjustment and complete shut off possible

**Intended applications:**
- General hydraulic systems

---

**Design and order coding example**

<table>
<thead>
<tr>
<th>AV 3AVT 10</th>
<th>CAV 1V</th>
<th>- K</th>
<th>- 1/4</th>
</tr>
</thead>
</table>

**Thread size**
- Version with connection block for pipe connection (type CAV)

**Means of adjustment**
- Fixed
- Manually (adjustable)

**Basic type, size**
- Type AV, size 2, 3
- Type AVT, size 6... 12
- Type CAV, size 1, 2

**Function**

|--------------------|--------|-----------------------|

| 226/299 | HAWE Products - 04-2017-5.1 | © HAWE Hydraulik SE |
# General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>$Q_{\text{max}}$ [lpm]$^1$</th>
<th>$p_{\text{max}}$ [bar]</th>
<th>Port size</th>
<th>Dimensions [mm]</th>
<th>$m$ [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$G$</td>
<td>$H$</td>
<td>$H_1$</td>
<td>$H_2$</td>
<td>$B$</td>
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<tr>
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1) The values apply to a back pressure of approx. 10 bar (in a throttled direction)

## Associated technical data sheets:

- Shut-off valve type AVT and AVM: D 7690
- Throttle valve and shut-off valve type AV: D 4583
- Throttle valve and shut-off valve CAV: D 7711

## Similar products:

- Throttle and restrictor check valves type ED, RD, RDF: Page 222
- Throttle valves type Q, QR, QV, FG: Page 220
## Valves

### 2.5 Check valves

<table>
<thead>
<tr>
<th>Type</th>
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<tr>
<td>Check valve type RK, RB, RC, RE and ER</td>
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<tr>
<td>Check valve type CRK and CRB</td>
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<td>Check valve type B</td>
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<tr>
<td>Releasable check valve type CRH and RHC</td>
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<td>Releasable check valve type RH and DRH</td>
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<td>Check valve and pre-fill valve type F</td>
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<td>Line rupture protection valve type LB</td>
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<td>Shuttle valve type WV and WVC</td>
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*Check valve type RK, RB, RC, RE and ER

*Check valve and pre-fill valve type F*
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### Pre-fill valves

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### Line rupture protection valve, shuttle valves

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Check valves

Check valve type RK, RB, RC, RE and ER

Check valves are a type of non-return valve. They block the oil flow in one direction and open in the opposite direction. In the closed state they have zero leakage. The check valve type RK, RB, RC and RE can be screwed-in, type ER can be plugged-in. The spring-loaded ball check valve type RK, RB and ER is very robust and insensitive to soiling. The spring-loaded plate valve type RC can be screwed-in in any direction and is particularly suitable for fast switching sequences. Type RE is a plate valve without a spring. Type ER can be integrated directly in valves for manifold mounting. As such an additional intermediate plate is not necessary for the check valve function. Type RE is suitable for isolating pressurising loads or as a foot valve for a pump suction line.

**Features and benefits:**
- Operating pressures
- Easily machined mounting holes
- Sturdy
- Type RK, RB also available with different pre-load pressures

**Intended applications:**
- General hydraulic systems
- Hydraulic pre-loading

---

**Design and order coding example**

**RC 2 - E**

**Design with housing**  For pipe connection (E, F, G), type RK, RB and RC

**Basic type, size**
- Plug-in check valve
- Type RK, RB, size 0 ... 7
- Type RC, size 1 ... 3
- Type RE, size 0 ... 4
- Type RE, ER (check valve insert), size 0 to 4

**Additional versions:**
- Type RK with increased open-up pressure
- Type ER, stainless (size 01 ... 31)
- Type RK, RB, RC and RE with metric thread
- Type RK, RB with UNF thread

---

**Function**

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<td>B</td>
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### General parameters and dimensions

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<th>p&lt;sub&gt;max&lt;/sub&gt; [bar]</th>
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<th>Dimensions [mm]</th>
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<td>700</td>
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<td>500</td>
<td>G 1 A</td>
<td>22</td>
</tr>
<tr>
<td>RK 6</td>
<td>400</td>
<td>420</td>
<td>G 1 1/4 A</td>
<td>27.5</td>
</tr>
<tr>
<td>RK 7</td>
<td>620</td>
<td>420</td>
<td>G 1 1/2 A</td>
<td>35</td>
</tr>
<tr>
<td>RC 1</td>
<td>20</td>
<td>700</td>
<td>G 1/4 A</td>
<td>13</td>
</tr>
<tr>
<td>RC 2</td>
<td>35</td>
<td>700</td>
<td>G 3/8 A</td>
<td>15</td>
</tr>
<tr>
<td>RC 3</td>
<td>60</td>
<td>500</td>
<td>G 1/2 A</td>
<td>18</td>
</tr>
<tr>
<td>RE 0</td>
<td>12</td>
<td>500</td>
<td>G 1/8 A</td>
<td>5</td>
</tr>
<tr>
<td>RE 1</td>
<td>25</td>
<td>500</td>
<td>G 1/4 A</td>
<td>6</td>
</tr>
<tr>
<td>RE 2</td>
<td>40</td>
<td>500</td>
<td>G 3/8 A</td>
<td>7</td>
</tr>
<tr>
<td>RE 3</td>
<td>70</td>
<td>450</td>
<td>G 1/2 A</td>
<td>7.5</td>
</tr>
<tr>
<td>RE 4</td>
<td>120</td>
<td>400</td>
<td>G 3/4 A</td>
<td>9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L</th>
<th>D/D1</th>
<th>m [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER 0</td>
<td>6</td>
<td>500</td>
</tr>
<tr>
<td>ER 1</td>
<td>12</td>
<td>500</td>
</tr>
<tr>
<td>ER 2</td>
<td>30</td>
<td>500</td>
</tr>
<tr>
<td>ER 3</td>
<td>65</td>
<td>500</td>
</tr>
<tr>
<td>ER 4</td>
<td>120</td>
<td>400</td>
</tr>
</tbody>
</table>

**Associated technical data sheets:**
- Check valve type ER and EK: D 7325
- Check valve type RE: D 7555 R
- Check valves, type RC: D 6969 R
- Check valve type RK and RB: D 7445

**Similar products:**
- Check valves type CRK, CRB: Page 234
- Check valves type B: Page 236

*Restrictor check valves type EB, BE, BC: Page 218*
Check valves are a type of non-return valve. They block the oil flow in one direction and open in the opposite direction. In the closed state they have zero leakage.

**Features and benefits:**
- Screw-in valves

**Intended applications:**
- General hydraulic systems

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>Check valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Screw-in valve</td>
</tr>
<tr>
<td>$p_{\text{max}}$:</td>
<td>500 bar</td>
</tr>
<tr>
<td>$Q_{\text{max}}$:</td>
<td>80 l/min</td>
</tr>
</tbody>
</table>

**Design and order coding example**

- **CRK 2** - 1/4
  - **Individual connection block for pipe connection**
  - **Basic type**
    - Check valves type CRK and CRB, size 1 to 3
    - With/without tapped plug
    - With/without tapped blockage/plug combination
### Function

<table>
<thead>
<tr>
<th>CRK 1 / CRB 1</th>
<th>CRK 2 / CRB 2</th>
<th>CRK 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>500</td>
<td>500</td>
<td></td>
</tr>
</tbody>
</table>

### General parameters and dimensions

**CRK, CRB**

<table>
<thead>
<tr>
<th>Function</th>
<th>CRK 1 / CRB 1</th>
<th>CRK 2 / CRB 2</th>
<th>CRK 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ports</strong></td>
<td>G</td>
<td>H [mm]</td>
<td>SW 1</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>M 16 x 1.5</td>
<td>31</td>
<td>SW 22</td>
</tr>
<tr>
<td><strong>m [g]</strong></td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>m [g]</strong></td>
<td></td>
<td>110</td>
<td></td>
</tr>
<tr>
<td><strong>m [g]</strong></td>
<td></td>
<td>125</td>
<td></td>
</tr>
</tbody>
</table>

**Associated technical data sheets:**
- Check valve type CRK, CRB and CRH: D 7712

**Similar products:**
- Check valves RK, RB, RC, RE: Page 232
Check valves

2.5 Check valve type B

Check valves are a type of non-return valve. They block the oil flow in one direction and open in the opposite direction. In the closed state they have zero leakage.

The check valve type B is available in different housing forms and is suitable for direct in-line installation.

The check valve type B is suitable for usage as a foot valve for a pump suction line due to the low opening pressure.

Features and benefits:
- Flow up to 160 l/min
- Pipe installation

Intended applications:
- General hydraulic systems

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Check valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Individual valve for in-line installation</td>
</tr>
<tr>
<td>$p_{\text{max}}$</td>
<td>500 bar</td>
</tr>
<tr>
<td>$Q_{\text{max}}$</td>
<td>160 lpm</td>
</tr>
</tbody>
</table>

Design and order coding example

B 1 - 2

Basic type, with housing, size Check valve type B, version with housing 1 to 3, size 1 to 7

Additional versions:
- Open-up pressure 3 bar
Function

B

General parameters and dimensions

<table>
<thead>
<tr>
<th>Basic type</th>
<th>Size</th>
<th>( Q_{\text{max}} ) [lpm]</th>
<th>( p_{\text{max}} ) [bar]</th>
<th>Ports</th>
<th>Dimensions</th>
<th>( m ) [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>( G )</td>
<td>( G_1 )</td>
<td>( L ) [mm]</td>
</tr>
<tr>
<td>B 1</td>
<td>-1</td>
<td>15</td>
<td>500</td>
<td>G 1/4</td>
<td>G 1/4 A</td>
<td>50 ... 60</td>
</tr>
<tr>
<td>B 2</td>
<td>-2</td>
<td>20</td>
<td></td>
<td>G 3/8</td>
<td>G 3/8 A</td>
<td>58 ... 67</td>
</tr>
<tr>
<td>B 3</td>
<td>-3</td>
<td>30</td>
<td></td>
<td>G 1/2</td>
<td>G 1/2 A</td>
<td>60 ... 66</td>
</tr>
<tr>
<td></td>
<td>-4</td>
<td>45</td>
<td></td>
<td>G 3/4</td>
<td>G 3/4 A</td>
<td>70 ... 78</td>
</tr>
<tr>
<td></td>
<td>-5</td>
<td>75</td>
<td></td>
<td>G 1</td>
<td>G 1 A</td>
<td>94 ... 114</td>
</tr>
<tr>
<td></td>
<td>-6</td>
<td>120</td>
<td></td>
<td>G 1 1/4</td>
<td>G 1 1/4 A</td>
<td>110 ... 130</td>
</tr>
<tr>
<td></td>
<td>-7</td>
<td>160</td>
<td></td>
<td>G 1 1/2</td>
<td>G 1 1/2 A</td>
<td>115 ... 136</td>
</tr>
</tbody>
</table>

**Associated technical data sheets:**
- Check valves, type B: D 1191

**Similar products:**
- Check valves type RK, RB, RC, RE, ER: Page 232
Check valves

2.5 Releasable check valve type CRH and RHC

Check valves with hydraulic release are a type of check valve. They block one or both hydraulic consumer lines or are used as a hydraulically actuated drain or circulation valve. Check valve type CRH and RHC has zero leakage when closed. It can be screwed-in and can be integrated into control blocks. The necessary mounting holes are straightforward to make. Check valve type CRH and RHC is available with hydraulic release. Hydraulic release suppresses relief surges that can occur at high pressure and with a large consumer volume.

Features and benefits:
- Screw-in valve
- Pressures up to 700 bar
- Flows up to 200 l/min
- Sturdy

Intended applications:
- Industrial hydraulics
- Construction machines

| Nomenclature: | Check valve with hydraulic release |
| Design: | Valve insert Screw-in valve |
| Actuation: | Hydraulic |
| $p_{\text{max}}$: | 700 bar |
| $Q_{\text{max}}$: | 200 l/min |

Design and order coding example

<table>
<thead>
<tr>
<th>CRH 3</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Without pre-release (-) With pre-release (V)</td>
</tr>
<tr>
<td>Basic type, size</td>
<td>Releasable check valve type CRH, size 1 to 3 and type RHC, size 1 to 6</td>
</tr>
</tbody>
</table>

Additional versions:
- With higher pilot ratio (approx. 4.5 : 1)
- With sealed tapped journal and control piston
- With hydraulic relieve of the control piston (type RHCE)
# Function

**CRH, RHC**

![Diagram of CRH and RHC]

## General parameters and dimensions

### CRH

<table>
<thead>
<tr>
<th>CRH</th>
<th>Q_{max} [lpm]</th>
<th>p_{max} [bar]</th>
<th>p_r / p_z</th>
<th>Ports (BSPP)</th>
<th>Dimensions</th>
<th>m [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRH 1</td>
<td>30</td>
<td>500</td>
<td>2.6</td>
<td>M 16 x 1.5</td>
<td>47</td>
<td>SW 8</td>
</tr>
<tr>
<td>CRH 2</td>
<td>50</td>
<td>500</td>
<td>2.6</td>
<td>M 20 x 1.5</td>
<td>53</td>
<td>SW 10</td>
</tr>
<tr>
<td>CRH 3</td>
<td>80</td>
<td>500</td>
<td>2.5</td>
<td>M 24 x 1.5</td>
<td>61</td>
<td>SW 12</td>
</tr>
<tr>
<td>RHC 1</td>
<td>15</td>
<td>700</td>
<td>2.6</td>
<td>M 16 x 1.5</td>
<td>32</td>
<td>SW 6</td>
</tr>
<tr>
<td>RHC 2</td>
<td>25</td>
<td>700</td>
<td>2.6</td>
<td>M 20 x 1.5</td>
<td>37.5</td>
<td>SW 8</td>
</tr>
<tr>
<td>RHC 3</td>
<td>55</td>
<td>700</td>
<td>2.5</td>
<td>M 24 x 1.5</td>
<td>47</td>
<td>SW 10</td>
</tr>
<tr>
<td>RHC 4</td>
<td>100</td>
<td>500</td>
<td>2.5</td>
<td>M 30 x 1.5</td>
<td>56</td>
<td>SW 12</td>
</tr>
<tr>
<td>RHC 5</td>
<td>150</td>
<td>500</td>
<td>2.8</td>
<td>M 36 x 1.5</td>
<td>67.5</td>
<td>SW 14</td>
</tr>
<tr>
<td>RHC 6</td>
<td>200</td>
<td>500</td>
<td>2.5</td>
<td>M 42 x 1.5</td>
<td>97</td>
<td>SW 19</td>
</tr>
</tbody>
</table>

### RHC

<table>
<thead>
<tr>
<th>RHC</th>
<th>Q_{max} [lpm]</th>
<th>p_{max} [bar]</th>
<th>p_r / p_z</th>
<th>Ports (BSPP)</th>
<th>Dimensions</th>
<th>m [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>RHC 1</td>
<td>15</td>
<td>700</td>
<td>2.6</td>
<td>M 16 x 1.5</td>
<td>32</td>
<td>SW 6</td>
</tr>
<tr>
<td>RHC 2</td>
<td>25</td>
<td>700</td>
<td>2.6</td>
<td>M 20 x 1.5</td>
<td>37.5</td>
<td>SW 8</td>
</tr>
<tr>
<td>RHC 3</td>
<td>55</td>
<td>700</td>
<td>2.5</td>
<td>M 24 x 1.5</td>
<td>47</td>
<td>SW 10</td>
</tr>
<tr>
<td>RHC 4</td>
<td>100</td>
<td>500</td>
<td>2.5</td>
<td>M 30 x 1.5</td>
<td>56</td>
<td>SW 12</td>
</tr>
<tr>
<td>RHC 5</td>
<td>150</td>
<td>500</td>
<td>2.8</td>
<td>M 36 x 1.5</td>
<td>67.5</td>
<td>SW 14</td>
</tr>
<tr>
<td>RHC 6</td>
<td>200</td>
<td>500</td>
<td>2.5</td>
<td>M 42 x 1.5</td>
<td>97</td>
<td>SW 19</td>
</tr>
</tbody>
</table>

**Associated technical data sheets:**

- Releasable check valves:
  - Check valve type CRK, CRB and CRH: D 7712
  - Releasable check valve type RHC and RHCE: D 7165

**Similar products:**

- Type HRP: Page 240
- Type RH: Page 242
Check valves

2.5 Releasable check valve type HRP

Check valves with hydraulic release are a type of check valve. They block one or both hydraulic consumer lines or are used as a hydraulically actuated drain or circulation valve. In the closed state the check valve type HRP has zero leakage. A leakage line relieves the rear of the control piston. Due to this separate relief the control behaviour of the valve is independent of the pressure in the return.

A solenoid valve can be optionally flange-mounted to arbitrarily control the check valve with the load pressure on the consumer side. The check valve type HRP is available with a hydraulic release. Hydraulic release suppresses relief surges that can occur at high pressure and with a large consumer volume.

Features and benefits:
- Manifold mounting valve for pressures up to 700 bar
- Flows up to 400 lpm
- Electrically controlled
- With hydraulic release for smooth switching

Intended applications:
- Industrial and mobile hydraulics

Design and order coding example

<table>
<thead>
<tr>
<th>Design</th>
<th>Order code</th>
<th>Function</th>
<th>Intended application</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRP 4</td>
<td>V - B 0,4 - WH 1 H B 0,4-G24</td>
<td>Without pre-release (-)</td>
<td>For arbitrary open-up or for use as 2/2-way directional seated valve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>With pre-release (V)</td>
<td>For preventing decompression surges</td>
</tr>
</tbody>
</table>

Nomenclature:
- Check valve with hydraulic release

Design:
- Manifold mounting valve

Actuation:
- Hydraulic
- Electro-hydraulic

$p_{max}$: 700 bar
$Q_{max}$: 400 l/min

Basic type, size: Check valve with hydraulic release HRP, size 1 to 7
Function

**HRP**

![Diagram](image)

**General parameters and dimensions**

![Diagram](image)

1. **Flange-mounted 3/2-way solenoid valve**

<table>
<thead>
<tr>
<th></th>
<th>$Q_{\text{max}}$ [lpm]</th>
<th>$p_{\text{max}}$ [bar]</th>
<th>$p_A / p_Z$</th>
<th>$H$</th>
<th>$B$</th>
<th>$L$</th>
<th>$m$ [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRP 1</td>
<td>20</td>
<td>700</td>
<td>2.9</td>
<td>20</td>
<td>25</td>
<td>74.5</td>
<td>0.25</td>
</tr>
<tr>
<td>HRP 2</td>
<td>35</td>
<td>700</td>
<td>3.9</td>
<td>25</td>
<td>30</td>
<td>78</td>
<td>0.4</td>
</tr>
<tr>
<td>HRP 3</td>
<td>50</td>
<td>500</td>
<td>4.3</td>
<td>35</td>
<td>35</td>
<td>83</td>
<td>0.7</td>
</tr>
<tr>
<td>HRP 4</td>
<td>80</td>
<td>500</td>
<td>3.8</td>
<td>35</td>
<td>50</td>
<td>103.5</td>
<td>1.2</td>
</tr>
<tr>
<td>HRP 5</td>
<td>140</td>
<td>500</td>
<td>4.0</td>
<td>40</td>
<td>60</td>
<td>120.5</td>
<td>1.9</td>
</tr>
<tr>
<td>HRP 7 V</td>
<td>400</td>
<td>500</td>
<td>3.0</td>
<td>63</td>
<td>100</td>
<td>190</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- [Releasable check valve type HRP: D 5116](#)

Similar products:
- Releasable check valves type RH: [Page 242](#)
- Releasable check valve type RHV: D 3056
- Releasable check valves type CRH, RHC: [Page 238](#)
- Releasable twin check valves type DRH: [Page 242](#)
Check valves with hydraulic release are a type of check valve. They block one or both hydraulic consumer lines or are used as a hydraulically actuated drain or circulation valve. In the closed state the check valve type RH and DRH has zero leakage. The type DRH is a twin check valve for double-acting consumers.

The check valve type RH and DRH is available with a hydraulic release. Hydraulic release suppresses relief surges that can occur at high pressure and with a large consumer volume.

Features and benefits:
- Pressures up to bar
- with hydraulic release for smooth switching

Intended applications:
- Blocking of leak-free hydraulic cylinders
- Return flow relief
- Hydraulically actuated drain or circulation valve

Nomenclature:
- Check valve with hydraulic release
- or twin check valve

Design:
- Individual valve for
  - Pipe connection
  - Manifold mounting

Adjustment:
- Hydraulic

\[ \begin{align*}
  \text{max pressure} & : 700 \text{ bar} \\
  \text{max flow} & : 160 \text{ l/min}
\end{align*} \]

Design and order coding example

RH 3 V

Function
- Without pre-release (-)
- With pre-release (V)

Basic type, size
- Releasable check valve RH, size 1 to 5

DRH 3 LSS - 30 /100

Pre-charge pressure [bar]
- 30 bar

Pressure setting [bar]
- 100 bar

Basic type, size, function
- Releasable double check valve DRH, size 1 to 5

Additional versions:
- With pre-release (one or both sides)
- With shock valves (for hydraulic motors)
- With safety valve preventing slow pressure rises
- With leakage port preventing unintended open-up when pressure migrated from the control side
- Manifold mounting version (type DRH3P)
## Function

<table>
<thead>
<tr>
<th></th>
<th>RH</th>
<th>DRH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

## General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>RH..</th>
<th>DRH..</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
<td></td>
</tr>
</tbody>
</table>

### Associated technical data sheets:
- Releasable check valve type RH: D 6105
- Releasable twin check valve type DRH: D 6110

### Similar products:
- Releasable check valve type RHV: D 3056
- Type CRH and RHC: Page 234
- Type HRP: Page 240

<table>
<thead>
<tr>
<th>Q_{\text{max}} [lpm]</th>
<th>P_{\text{max}} [bar]</th>
<th>Release ratio (p_{A(B)}/p_{Z})</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A, B, C, D</td>
<td>Z</td>
<td>L a b SW = a/f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RH 1</td>
<td>15 700 2.7 G 1/4</td>
<td>84 31.5 27 SW 24 0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RH 2</td>
<td>35 700 3 G 3/8</td>
<td>90 32 28.5 SW 27 0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RH 3</td>
<td>55 500 2.4 G 1/2 G 1/4</td>
<td>100 36.5 31 SW 32 0.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RH 4</td>
<td>100 500 2.4 G 3/4</td>
<td>126 45 35.5 SW 41 1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RH 5</td>
<td>160 500 3 G 1</td>
<td>143 52 38 SW 46 1.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRH 1</td>
<td>16 500 2.5 G 1/4</td>
<td>70 45 20 8 0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRH 2</td>
<td>30 500 G 3/8</td>
<td>89 60 30 10 1.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRH 3</td>
<td>60 500 2.5 G 1/2</td>
<td>115 60 30 13 1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRH 4</td>
<td>90 400 G 3/4</td>
<td>150 70 40 15.5 2.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DRH 5</td>
<td>140 400 G 1</td>
<td>195 80 50 17 5.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Check valves and pre-fill valve type F

Check valves and pre-fill valves are a type of non-return valve. Check valves block the oil flow in one direction and open in the other direction. Pre-fill valves are check valves with hydraulic release. They are used, e.g. in top ram presses for suction and emptying the press cylinder on rapid closing and opening.

The check valve and pre-fill valve type F is a spring-loaded disk valve and has zero leakage in the closed state. The valve is attached directly to the cylinder and clamped between the base of the cylinder and the welding-neck flange. Alternatively the valve is installed in the line between the front faces of the welding-neck flanges.

The valves type F25 - F80 are available with hydraulic release. Hydraulic release suppresses relief surges that can occur at high pressure and with a large consumer volume.

Features and benefits:
- Wafer design
- Extremely large flows, up to 7000 l/min

Intended applications:
- Press control systems
- Injection moulding machines

Design and order coding example

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F25</td>
<td>Check valve type F, size 25 to 200</td>
</tr>
<tr>
<td>F81B-36 V</td>
<td>Pre-fill valves type F, size 25 to 200</td>
</tr>
<tr>
<td></td>
<td>Additional versions: Without pre-release (-)</td>
</tr>
<tr>
<td></td>
<td>With pre-release (V), size 25 to 80</td>
</tr>
</tbody>
</table>

Additional functions
- With holes in the mounting flange (B)

Function

Check valve

Pre-fill valve
### General parameters and dimensions

**Check valve**

<table>
<thead>
<tr>
<th>Model</th>
<th>Pre-fill valve</th>
<th>$Q_{\text{max}}$ [lpm]</th>
<th>$p_{\text{max}}$ [bar]</th>
<th>$p_x / p_z$</th>
<th>$D$ [mm]</th>
<th>$H1$ [mm]</th>
<th>$H2$ [mm]</th>
<th>$H3$ [mm]</th>
<th>$m$ [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>F 25</td>
<td>F 25-12</td>
<td>100</td>
<td>4.3</td>
<td>83</td>
<td>26</td>
<td>36</td>
<td>43</td>
<td>1</td>
<td>1.1</td>
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<tr>
<td>F 32</td>
<td>F 32-16</td>
<td>160</td>
<td>3.6</td>
<td>93</td>
<td>27</td>
<td>45</td>
<td>55</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>F 40</td>
<td>F 40-20</td>
<td>250</td>
<td>3.9</td>
<td>108</td>
<td>28</td>
<td>48.5</td>
<td>60</td>
<td>1.4</td>
<td>1.7</td>
</tr>
<tr>
<td>F 50</td>
<td>F 50-25</td>
<td>400</td>
<td>4.2</td>
<td>128</td>
<td>29</td>
<td>59</td>
<td>72</td>
<td>2</td>
<td>2.4</td>
</tr>
<tr>
<td>F 63</td>
<td>F 63-30</td>
<td>630</td>
<td>4.2</td>
<td>143</td>
<td>33.5</td>
<td>69</td>
<td>83</td>
<td>2.8</td>
<td>3.4</td>
</tr>
<tr>
<td>F 64</td>
<td>F 64 B-30</td>
<td>760</td>
<td>4.2</td>
<td>143</td>
<td>33.5</td>
<td>69</td>
<td>83</td>
<td>2.8</td>
<td>3.4</td>
</tr>
<tr>
<td>F 80</td>
<td>F 80-36</td>
<td>1000</td>
<td>4.5</td>
<td>169</td>
<td>38.5</td>
<td>83</td>
<td>97.5</td>
<td>4.4</td>
<td>5.2</td>
</tr>
<tr>
<td>F 81</td>
<td>F 81 B-36</td>
<td>1200</td>
<td>4.5</td>
<td>169</td>
<td>38.5</td>
<td>83</td>
<td>97.5</td>
<td>4.4</td>
<td>5.2</td>
</tr>
<tr>
<td>F 100</td>
<td>F 100-45</td>
<td>1600</td>
<td>4.3</td>
<td>212</td>
<td>44</td>
<td>97</td>
<td>118</td>
<td>9.9</td>
<td>11.7</td>
</tr>
<tr>
<td>F 101</td>
<td>F 101 B-45</td>
<td>1920</td>
<td>4.3</td>
<td>212</td>
<td>44</td>
<td>97</td>
<td>118</td>
<td>9.9</td>
<td>11.7</td>
</tr>
<tr>
<td>F 125</td>
<td>F 125-60</td>
<td>2500</td>
<td>4.3</td>
<td>248</td>
<td>51</td>
<td>127</td>
<td>155</td>
<td>15.8</td>
<td>19.6</td>
</tr>
<tr>
<td>F 126</td>
<td>F 126 B-60</td>
<td>3000</td>
<td>4.3</td>
<td>248</td>
<td>65</td>
<td>-</td>
<td>175</td>
<td>-</td>
<td>19.7</td>
</tr>
<tr>
<td>F 160</td>
<td>F 160-76</td>
<td>4000</td>
<td>4.3</td>
<td>310</td>
<td>70</td>
<td>182</td>
<td>233</td>
<td>43</td>
<td>50</td>
</tr>
<tr>
<td>F 161</td>
<td>F 161 B-76</td>
<td>4800</td>
<td>4.3</td>
<td>310</td>
<td>85</td>
<td>-</td>
<td>245</td>
<td>-</td>
<td>44</td>
</tr>
<tr>
<td>F 200</td>
<td>F 200-100</td>
<td>7000</td>
<td>4.0</td>
<td>420</td>
<td>150</td>
<td>250</td>
<td>300</td>
<td>114</td>
<td>120</td>
</tr>
</tbody>
</table>

**Pre-fill valve**

**Associated technical data sheets:**

- Check valve and pre-fill valve type F: D 6960
Line rupture protection valves, also called pipe rupture protection valves are a type of check valve. The valves are normally mounted directly on the cylinder. They prevent uncontrolled cylinder movement in the event of a pipe rupture or hose break. The line rupture protection valve type LB offers a high level of safety in the event of pressure peaks. It features reproducibly accurate and secure closing at the pre-set trigger flow rate. Higher flow rates cause a plate raised from the valve seat by a spring to be pressed onto the housing seat by the flow forces and cause the valve to close. A variant with orifice bore in the valve plate permits a low flow rate in the locking direction. Type LB is available as a screw-in valve or in a housing version for in-line installation. The line rupture protection valve type LB is used in industrial vehicles, lifting platforms and lifting equipment.

**Features and benefits:**
- Pressures up to 500 bar

**Intended applications:**
- Industrial trucks
- Lifting devices

**Design and order coding example**

<table>
<thead>
<tr>
<th>LB</th>
<th>G</th>
<th>Q&lt;sub&gt;max&lt;/sub&gt;</th>
<th>p&lt;sub&gt;max&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>G</td>
<td>160 l/min</td>
<td>500 bar</td>
</tr>
</tbody>
</table>

- **Response flow [lpm]**
- **Trigger volumetric flow Q<sub>A</sub> in l/min**
- **With/without orifice**
- Orifice diameter 0.5 / 0.8 / 1.0 / 1.2 / 1.5 / 2 (dep. on type and size)
- **Design**
  - Screw-in valve (C)
  - Design with housing (F, G)
  - Fitting
- **Basic type, size:** Line rupture safety valve type LB, size 2 to 4
  - Version with imperial thread
  - Version with metric thread
  - Design with UNF thread

**Function**

- **LB**
  - Simplified Series
  - With orifice
  - Detailed

© HAWE Hydraulik SE
**General parameters and dimensions**

**LB ..C**  
Screw-in valve

**LB ..G**  
Valve with housing

**LB ..F**

<table>
<thead>
<tr>
<th></th>
<th>Q&lt;sub&gt;max&lt;/sub&gt; [lpm]</th>
<th>p&lt;sub&gt;max&lt;/sub&gt; [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>m [g]&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LB 1 (C, G, F)</strong></td>
<td>4 ... 25</td>
<td>500</td>
<td>G 1/4 (A)</td>
<td>-</td>
<td>17.5 48 50</td>
</tr>
<tr>
<td><strong>LB 11 C</strong></td>
<td>4 ... 25</td>
<td>700</td>
<td>G 1/4 (A)</td>
<td>-</td>
<td>17.5 - -</td>
</tr>
<tr>
<td><strong>LB 2 (C, G, F)</strong></td>
<td>6.3 ... 50</td>
<td>500</td>
<td>G 3/8 (A)</td>
<td>-</td>
<td>21 52 58</td>
</tr>
<tr>
<td><strong>LB 21 C</strong></td>
<td>6.3 ... 45</td>
<td>700</td>
<td>G 3/8 (A)</td>
<td>-</td>
<td>25 - -</td>
</tr>
<tr>
<td><strong>LB 3 (C, G, F)</strong></td>
<td>16 ... 80</td>
<td>500</td>
<td>G 1/2 (A)</td>
<td>-</td>
<td>25 60 65</td>
</tr>
<tr>
<td><strong>LB 4 (C, G, F)</strong></td>
<td>25 ... 160</td>
<td>500</td>
<td>G 3/4 (A)</td>
<td>-</td>
<td>30.5 72 78</td>
</tr>
<tr>
<td><strong>LB 3 E</strong></td>
<td>4 ... 160</td>
<td>500</td>
<td>G 1/4 A - G 3/4 A</td>
<td>M18x1.5 - M36x2</td>
<td>- - 46.8 - 64.4</td>
</tr>
<tr>
<td><strong>LB 4 E</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>LB 5</strong></td>
<td>80 ... 200</td>
<td>300</td>
<td>G 1</td>
<td>-</td>
<td>38 - -</td>
</tr>
</tbody>
</table>

1) Mounting thread, additionally sealed  
2) Dimensions for insert valve and/or housing version

**Associated technical data sheets:**  
- Line rapture protection valves, type LB: D 6990  
- Line rupture safety valves type LB.E  
as a screw joint: Sk 6990 E
Shuttle valves are a type of check valve. They have two inlets and one outlet. As soon as a pressure signal is present on at least one of the two inlets, an outlet signal is generated. The inlet with the higher pressure is automatically connected to the outlet. The other inlet with lower pressure is blocked by a ball (OR operator).

The shuttle valve type WV is integrated in a T-fitting for pipe connection. The type WVC is a screw-in valve. The shuttle valves can withstand pressures up to 700 bar and have low flow resistances. They can be used for transmitting control pressures or control and operating volumetric flows.

**Features and benefits:**
- Pressures up to 700 bar
- Insert and housing versions

**Intended applications:**
- In load-sensing systems
- Construction and construction materials machinery
- Cranes and lifting equipment
- Road vehicle
- General mobile hydraulics

---

**Design and order coding example**

**WV 10**

<table>
<thead>
<tr>
<th>Design</th>
<th>High pressure version (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low pressure version (L)</td>
<td></td>
</tr>
</tbody>
</table>

**Basic type, size**

Type WV for pipe connection, size 6 to 18
Type WVC as screw-in valve, size 1
Type WVE as screw-in valve, size 11

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>Shuttle valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Individual valve for pipe mounting</td>
</tr>
<tr>
<td></td>
<td>Valve insert</td>
</tr>
<tr>
<td></td>
<td>Screw-in valve</td>
</tr>
<tr>
<td>$p_{\text{max}}$:</td>
<td>700 bar</td>
</tr>
<tr>
<td>$Q_{\text{max}}$:</td>
<td>160 l/min</td>
</tr>
</tbody>
</table>
Function

1 Inlet
2 Outlet

General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>Q_{\text{max}} [lpm]</th>
<th>p_{\text{max}} [bar]</th>
<th>External pipe (\varnothing) [mm]</th>
<th>Mounting thread</th>
<th>Dimensions [mm]</th>
<th>m [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>WV 6 - S</td>
<td>6</td>
<td>700</td>
<td>6</td>
<td>G</td>
<td>62</td>
<td>31</td>
</tr>
<tr>
<td>WV 8 - S</td>
<td>15</td>
<td>8</td>
<td>12</td>
<td>--</td>
<td>64</td>
<td>32</td>
</tr>
<tr>
<td>WV 10 - S</td>
<td>25</td>
<td>500</td>
<td>10</td>
<td>--</td>
<td>68</td>
<td>34</td>
</tr>
<tr>
<td>WV 12 - S</td>
<td>40</td>
<td>14</td>
<td>16</td>
<td>--</td>
<td>76</td>
<td>38</td>
</tr>
<tr>
<td>WV 14 - S</td>
<td>60</td>
<td>16</td>
<td>--</td>
<td>G</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>WV 16 - S</td>
<td>100</td>
<td>18</td>
<td>--</td>
<td>L</td>
<td>86</td>
<td>43</td>
</tr>
<tr>
<td>WV 18 - L</td>
<td>150</td>
<td>315</td>
<td>--</td>
<td>H</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>WVC 1</td>
<td>6</td>
<td>--</td>
<td>M 10 x 1</td>
<td>SW = a/f</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>WVH 1</td>
<td>3</td>
<td>700</td>
<td>--</td>
<td>M 10 x 1</td>
<td>28.5</td>
<td>14</td>
</tr>
<tr>
<td>WVE 11</td>
<td>25</td>
<td>500</td>
<td>--</td>
<td>M 18 x 1</td>
<td>26</td>
<td>10</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- Shuttle valve type WV and WVC: D 7016

Similar products:
- Shuttle valves type WVH: Sk 7962
- Shuttle valves type WVE: Sk 7088 050
<table>
<thead>
<tr>
<th>Product Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic clamps type HSE and HSA</td>
<td>252</td>
</tr>
<tr>
<td>Axial piston motor type M60N</td>
<td>254</td>
</tr>
</tbody>
</table>
### Hydraulic cylinders

<table>
<thead>
<tr>
<th>Type</th>
<th>Nomenclature / design</th>
<th>(p_{\text{max}}) (bar)</th>
<th>(H_{\text{stroke}}) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSE, HSA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Hydraulic clamps</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Screw-in version</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Manifold mounting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HSE - 12: 500</td>
<td></td>
<td>HSE - 12: 8</td>
<td></td>
</tr>
<tr>
<td>HSE - 16: 500</td>
<td></td>
<td>HSE - 16: 12</td>
<td></td>
</tr>
<tr>
<td>HSE - 20: 500</td>
<td></td>
<td>HSE - 20: 20</td>
<td></td>
</tr>
<tr>
<td>HSE - 24: 500</td>
<td></td>
<td>HSE - 24: 20</td>
<td></td>
</tr>
<tr>
<td>HSA - 32: 500</td>
<td></td>
<td>HSA - 32: 20</td>
<td></td>
</tr>
<tr>
<td>HSA - 40: 500</td>
<td></td>
<td>HSA - 40: 25</td>
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</tbody>
</table>

### Hydraulic motors

<table>
<thead>
<tr>
<th>Type</th>
<th>Nomenclature / design</th>
<th>(p_{\text{max}}) (bar)</th>
<th>(V_{\text{max}}) (cm³/rev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M60N</td>
<td><strong>Axial piston fixed motor</strong></td>
<td></td>
<td>Operation/peak:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>012: 350/400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>017: 350/400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>025: 350/400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>034: 350/400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>047: 350/400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>064: 350/400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>084: 350/400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>108: 350/400</td>
</tr>
</tbody>
</table>

**Intended applications:**
- Machines for forestry and agricultural purposes
- Fan drives
- Construction machines
- Municipal trucks

**Features and benefits:**
- Optimised power-to-weight ratio
- Rotation speed
- Different shaft and flange versions
Hydraulic cylinders

3 Hydraulic clamps type HSE and HSA

Hydraulic clamping cylinder generate a pressure-controlled clamping force at the piston. Without pressure the clamping pistons return to their initial position. The clamping cylinder type HSE is a screw-in cylinder. The type HSA is a screw-on cylinder. Very high forces can be transmitted in a very small space in fixtures. The clamping cylinder type HSE and HSA is used in machine tools, machining centres and chucks for clamping, fasten, lock or fix workpieces, tools or machine structures.

Features and benefits:
- Compact design
- Operating pressure up to 500 bar

Intended applications:
- Clamping systems
- Securing systems
- Machine tools

Nomenclature:
- Hydraulic clamps
-design:
- Screw-in version
- Manifold mounting

<table>
<thead>
<tr>
<th>p_max</th>
<th>500 bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>F_max</td>
<td>60000 N</td>
</tr>
</tbody>
</table>

Design and order coding example

HSE 24 - 15

Stroke [mm] Stroke H
Basic type, piston diameter [mm] Screw-in version type HSE
Manifold mounting version type HSA
Function

HSE, HSA

General parameters and dimensions

HSE ..
Hydraulic screw-in clamps

HSA ..
Manifold mounting hydraulic clamps

<table>
<thead>
<tr>
<th></th>
<th>$Q_{\text{max}}$ [lpm]</th>
<th>Stroke [mm]</th>
<th>$F_{\text{max}}$ [N]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
<th>$m$ [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>H</td>
<td>H1</td>
<td>SW = a/f</td>
<td>A</td>
</tr>
<tr>
<td>with 500 bar</td>
<td></td>
<td></td>
<td>H</td>
<td>H1</td>
<td>SW = a/f</td>
<td>A</td>
</tr>
<tr>
<td>HSE 12</td>
<td>500</td>
<td>2 ... 8</td>
<td>5500</td>
<td>M 20 x 1.5</td>
<td>20.5 ... 32.5</td>
<td>SW 24</td>
</tr>
<tr>
<td>HSE 16</td>
<td>3 ... 12</td>
<td>10000</td>
<td>M 24 x 1.5</td>
<td>26.5 ... 41.5</td>
<td>SW 24</td>
<td>0.08 ... 0.12</td>
</tr>
<tr>
<td>HSE 20</td>
<td>4 ... 20</td>
<td>15000</td>
<td>M 30 x 1.5</td>
<td>28.5 ... 56</td>
<td>SW 30</td>
<td>0.14 ... 0.3</td>
</tr>
<tr>
<td>HSE 24</td>
<td>5 ... 20</td>
<td>23000</td>
<td>M 36 x 1.5</td>
<td>34 ... 65</td>
<td>SW 36</td>
<td>0.25 ... 0.5</td>
</tr>
<tr>
<td>HSA 32</td>
<td>20</td>
<td>40000</td>
<td>-</td>
<td>-</td>
<td>71</td>
<td>60</td>
</tr>
<tr>
<td>HSA 40</td>
<td>25</td>
<td>60000</td>
<td>-</td>
<td>-</td>
<td>85</td>
<td>70</td>
</tr>
</tbody>
</table>

Associated technical data sheets:
- [Hydraulic clamps type HSE and HSA: D 4711](#)
Axial piston motors are constant motors. They have a constant displacement and therefore generate a fixed rotation speed dependent on the flow rate.

The axial piston motor type M60N is designed for open and closed circuits and operates based on the bent axis principle.

The motor is particularly suitable for usage in mobile applications.

Features and benefits:
- Optimized power-to-weight ratio
- Rotation speed
- Different shaft and flange versions

Intended applications:
- Machines for forestry and agricultural purposes
- Fan drives
- Construction machines
- Municipal trucks

Nomenclature: Axial piston fixed motor
Design: Individual motor

\( p_{\text{max}}: 400 \text{ bar} \)
\( V_{g\text{max}}: 130 \text{ cm}^3/\text{rev} \)

### Design and order coding example

<table>
<thead>
<tr>
<th>M60N</th>
<th>-</th>
<th>064</th>
<th>B</th>
<th>S</th>
<th>F</th>
<th>N</th>
<th>-</th>
<th>S1</th>
<th>00</th>
<th>-</th>
<th>G</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Ports</th>
<th>With/without speed sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed sensor</td>
<td>Axial version</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Seals</th>
<th>NBR (N), FKM (V), HNBR (H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flange version</td>
<td>Flange ISO 7653 - 1985</td>
</tr>
<tr>
<td></td>
<td>Flange SAE J744</td>
</tr>
<tr>
<td></td>
<td>Flange ISO 3019 - 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shaft version</th>
<th>ISO 14 parallel key splined shaft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SAE J744 parallel key</td>
</tr>
<tr>
<td></td>
<td>SAE J744 spline shaft and flange</td>
</tr>
<tr>
<td></td>
<td>DIN 6885 parallel key</td>
</tr>
</tbody>
</table>

| Rotating direction | Any (B) |

| Nominal size | Basic type |
## General parameters and dimensions

### Parameters

<table>
<thead>
<tr>
<th>Geom. displacement</th>
<th>Nom. pressure</th>
<th>Max. speed</th>
<th>Dimensions [mm]</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_g$ [cm³/rev]</td>
<td>$p_{nom}$ (p$_{max}$) [bar]</td>
<td>$n$ [rpm]</td>
<td>L</td>
<td>L1</td>
</tr>
<tr>
<td>M60N- 012</td>
<td>12,6</td>
<td>350</td>
<td>7500</td>
<td>206</td>
</tr>
<tr>
<td>M60N- 017</td>
<td>17,0</td>
<td>350</td>
<td>7500</td>
<td>206</td>
</tr>
<tr>
<td>M60N- 025</td>
<td>25,4</td>
<td>350</td>
<td>5900</td>
<td>206</td>
</tr>
<tr>
<td>M60N- 034</td>
<td>34,2</td>
<td>350</td>
<td>5900</td>
<td>206</td>
</tr>
<tr>
<td>M60N- 040</td>
<td>41,2</td>
<td>350</td>
<td>5300</td>
<td>242</td>
</tr>
<tr>
<td>M60N- 047</td>
<td>47,1</td>
<td>350</td>
<td>5300</td>
<td>242</td>
</tr>
<tr>
<td>M60N- 056</td>
<td>56,7</td>
<td>350</td>
<td>5300</td>
<td>242</td>
</tr>
<tr>
<td>M60N- 064</td>
<td>63,5</td>
<td>350</td>
<td>5300</td>
<td>242</td>
</tr>
<tr>
<td>M60N- 084</td>
<td>83,6</td>
<td>350</td>
<td>4400</td>
<td>264</td>
</tr>
<tr>
<td>M60N- 090</td>
<td>90,7</td>
<td>350</td>
<td>4400</td>
<td>264</td>
</tr>
<tr>
<td>M60N- 108</td>
<td>108,0</td>
<td>350</td>
<td>4400</td>
<td>264</td>
</tr>
<tr>
<td>M60N- 130</td>
<td>130,0</td>
<td>350</td>
<td>4200</td>
<td>264</td>
</tr>
</tbody>
</table>

### Associated technical data sheets:
- Axial piston motors type M60N: D 7960 M

### Similar products:
- Fixed displacement axial piston pumps type K60N: Page 30

### Suitable proportional directional spool valve:
- Type EDL: Page 82
- Type PSL/PSV size 2, 3 and 5: Page 90
- Type PSLF/PSVF size 3, 5 and 7: Page 96

### Suitable load-holding valves:
- Type LHK, LHDV, LHT: Page 198
## Hydraulic accessories

<table>
<thead>
<tr>
<th>Component</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diaphragm accumulator type AC</td>
<td>258</td>
</tr>
<tr>
<td>Piston type accumulator type HPS</td>
<td>260</td>
</tr>
<tr>
<td>Pressure switch type DG, electronic pressure transducer type DT</td>
<td>262</td>
</tr>
<tr>
<td>Pressure filter type PFM</td>
<td>264</td>
</tr>
<tr>
<td>Fittings</td>
<td>266</td>
</tr>
</tbody>
</table>

Pressure switches type DG and analogous electronic pressure transducers
### Hydraulic accumulators

<table>
<thead>
<tr>
<th>Type</th>
<th>Design / piston diameter</th>
<th>$p_{\text{max}}$ (bar)</th>
<th>Nominal volume (dm³)</th>
</tr>
</thead>
</table>
| AC   | **Hydraulic accumulators**  
- Screw-in version | 13: 500  
40: 400  
202: 250  
603: 330  
725: 250  
1002: 210  
1035: 350  
1414: 140  
2001: 100  
2002: 250  
2035: 350  
2825: 250  
3225: 210 | 13: 0.01  
40: 0.04  
202: 0.16  
603: 0.60  
725: 0.08  
1002: 1.00  
1035: 1.00  
1414: 1.40  
2001: 1.95  
2002: 1.90  
2035: 1.95  
2825: 2.80  
3225: 0.32 |
| HPS  | **Piston type accumulator**  
- In-line installation  
  - 50 ... 180 mm | 350 | 0.1 ... 40.00 |

### Hydraulic accessories

<table>
<thead>
<tr>
<th>Type</th>
<th>Nomenclature / design</th>
<th>Features</th>
<th>$p_{\text{max}}$ (bar)</th>
</tr>
</thead>
</table>
| DG   | Spring-loaded piston-type pressure switch, electronic pressure switch  
- Manifold mounting  
- Screw-in version  
- Version for pipe connection  
- Electronic (analogue) pressure transducers | Features and benefits:  
- Compact design  
- Option of integration into the HAWE modular system  
- Operating pressures up to 1000 bar | 1, 5E: 600  
3: 700  
6: 400 |
| PFM  | Pressure filter  
- Pressure filter | 250 |
| Fittings | Reducing connector, connection fitting, screen filter, filter element, pressure gauge  
- Screw-in version  
- Version for pipe connection | Features and benefits:  
- Compact design  
- Option of integration into the HAWE modular system  
- Operating pressures up to 700 bar | 350 ... 700 |
Diaphragm accumulators are a type of hydraulic accumulator. A diaphragm separates the compressible gas cushion from the hydraulic fluid.

The diaphragm accumulator type AC is used as a source of pressurized oil. It supports or increases the pump delivery flow or stores pressure energy, e.g. for an accumulator charge circuit.

It is used in clamping hydraulics to compensate for volume changes in the event of temperature fluctuations, to cover any leakage losses or for oscillation damping.

With the aid of different fittings the hydraulic accumulator type AC can be integrated into a hydraulic system. Different installation orientations and installation positions are possible.

**Features and benefits:**
- Compact design
- Option of integration into the HAWE modular system
- Operating pressures up to 500 bar

**Intended applications:**
- Clamping systems
- Jigs
- Accumulator charging systems

### Design and order coding example

<table>
<thead>
<tr>
<th>Basic type, size</th>
<th>Hydraulic accumulator type AC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AC 2001</strong></td>
<td>/90</td>
</tr>
<tr>
<td></td>
<td>3A</td>
</tr>
<tr>
<td><strong>Connection thread (hydraulic side)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Gas pre-charge pressure [bar]</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Setting shut-off valve [bar]**

<table>
<thead>
<tr>
<th>Basic type, nom. volume</th>
<th>Hydraulic miniature accumulator type AC and type ACS with shut-off valve, nom. volume in cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AC 40</strong></td>
<td>- 1/4</td>
</tr>
<tr>
<td><strong>ACS 13</strong></td>
<td>- 1/4</td>
</tr>
<tr>
<td></td>
<td>- 200</td>
</tr>
<tr>
<td></td>
<td>- 50</td>
</tr>
<tr>
<td></td>
<td>/110</td>
</tr>
</tbody>
</table>

**Design and order coding example**

<table>
<thead>
<tr>
<th>Nomenclature:</th>
<th>Hydro-pneumatic accumulator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design:</td>
<td>Screw-in version</td>
</tr>
<tr>
<td>$p_{\text{max}}$:</td>
<td>500 bar</td>
</tr>
<tr>
<td>$V_{\text{max}}$:</td>
<td>3.5 dm³</td>
</tr>
</tbody>
</table>

**Function**

![Function Diagram]
General parameters and dimensions

### AC(S) 13 - 1/4

- **Shut-off valve**

### AC 40 - 1/4

### AC 0725, AC 202, AC 322, AC 1414

### AC 603, AC 1002, AC 2002, AC 2825

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>H</td>
<td>H₁</td>
<td>H₂</td>
</tr>
</tbody>
</table>

#### Hydraulic miniature accumulator

- **AC 13-1/4**
  - V₀: 0.013
  - p_max: 500
  - p₀: 250
  - Ports: G 1/4 A
  - Dimensions: H: 81, H₁: 26.5, H₂: 12, D: 64
  - m: 0.6

- **AC 13-1/4**
  - V₀: 0.013
  - p_max: 500
  - p₀: 250
  - Ports: G 1/4 A
  - Dimensions: H: 81, H₁: 26.5, H₂: 12, D: 64
  - m: 0.6

- **AC 40-1/4**
  - V₀: 0.040
  - p_max: 400
  - p₀: 250
  - Ports: G 1/4 A
  - Dimensions: H: 81, H₁: 26.5, H₂: 12, D: 64
  - m: 0.65

#### Hydraulic accumulator

- **AC 0725/1A**
  - V₀: 0.075
  - p_max: 250
  - p₀: 130
  - Ports: G 1/4 A
  - Dimensions: H: 81, H₁: 26.5, H₂: 12, D: 64
  - m: 0.6

- **AC 202/2A**
  - V₀: 0.16
  - p_max: 250
  - p₀: 130
  - Ports: G 3/8 A
  - Dimensions: H: 102, H₁: 26.5, H₂: -
  - m: 0.8

- **AC 322/2A**
  - V₀: 0.32
  - p_max: 210
  - p₀: 130
  - Ports: G 3/8 A
  - Dimensions: H: 101.5, H₁: 25, H₂: 12, D: 92.5
  - m: 1.4

- **AC 603/3**
  - V₀: 0.6
  - p_max: 330
  - p₀: 130
  - Ports: G 1/2
  - Dimensions: H: 149, H₁: 23, H₂: -
  - m: 3.3

- **AC 1002/22**
  - V₀: 1.0
  - p_max: 210
  - p₀: 130
  - Ports: M 22 x 1.5
  - Dimensions: H: 151, H₁: 25, H₂: 18, D: 136
  - m: 3.5

- **AC 1414/2A**
  - V₀: 1.4
  - p_max: 140
  - p₀: 130
  - Ports: G 3/8 A
  - Dimensions: H: 162, H₁: 25, H₂: 18, D: 147
  - m: 4.2

- **AC 2002/4**
  - V₀: 1.95
  - p_max: 250
  - p₀: 130
  - Ports: G 3/4
  - Dimensions: H: 229, H₁: 25, H₂: -
  - m: 7.5

- **AC 2825/3**
  - V₀: 2.8
  - p_max: 250
  - p₀: 130
  - Ports: G 1/2
  - m: 8.2

Associated technical data sheets:
- Miniature hydraulic accumulators, type AC: D 7571
- Diaphragm accumulator type AC: D 7969

Hydraulic accessories:
- Fittings type X84: Page 266

Similar products:
- Piston type accumulator type HPS: Page 260
Piston type accumulators are a type of hydraulic accumulator. A freely moving piston separates the compressible gas cushion from the hydraulic fluid. The piston type accumulator type HPS supports or increases the pump delivery flow or stores pressure energy. It is used in clamping hydraulics to compensate for volume changes in the event of temperature fluctuations, to cover any leakage losses or to dampen oscillations.

The piston type accumulator type HPS can be installed in different situations with the aid of suitable fastening clips.

**Features and benefits:**
- Compact design
- Option of integration into the HAWE modular system

**Intended applications:**
- Accumulator charging systems
- Construction machines
- Wind power plants
- Machine tools

**Nomenclature:**
- Piston accumulator

**Operation pressure:** 350 bar

**Nominal volume:** 0.1 - 40 dm³

**Internal piston diameter:** 50 - 180 mm

**Design and order coding example**

```
HPS 10 - 350 - 160 - 0050
```

- **Nom. volume:** \( V_0 \) [dm³]
- **Int. diameter [mm]:**
- **max. operating pressure [bar]:** 350 bar

**Basic type:** Piston type hydraulic accumulator type HPS

**Function**

[Diagram of piston accumulator type HPS]
## General parameters and dimensions

1 Gas-filling valve

<table>
<thead>
<tr>
<th>Model</th>
<th>Nominal volume $V_0$ [dm³]</th>
<th>$p_{\text{max}}$ [bar]</th>
<th>Ports</th>
<th>Dimensions [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPS 10 - 350 - 050</td>
<td>0.1 ... 1.0</td>
<td>350</td>
<td>G 3/4</td>
<td>60 ... 588</td>
</tr>
<tr>
<td>HPS 10 - 350 - 080</td>
<td>0.4 ... 4.0</td>
<td></td>
<td>G 3/4</td>
<td>95 ... 883</td>
</tr>
<tr>
<td>HPS 10 - 350 - 100</td>
<td>2.0 ... 10.0</td>
<td></td>
<td>G 1</td>
<td>115 ... 1400</td>
</tr>
<tr>
<td>HPS 10 - 350 - 140</td>
<td>4.0 ... 25.0</td>
<td></td>
<td>G 1 1/2</td>
<td>160 ... 1783</td>
</tr>
<tr>
<td>HPS 10 - 350 - 160</td>
<td>6.0 ... 30.0</td>
<td></td>
<td>G 1 1/2</td>
<td>180 ... 1684</td>
</tr>
<tr>
<td>HPS 10 - 350 - 180</td>
<td>8.0 ... 40.0</td>
<td></td>
<td>G 1 1/2</td>
<td>205 ... 1754</td>
</tr>
</tbody>
</table>

- The data listed represent only a selection of the various differing versions

### Associated technical data sheets:
- Piston type accumulators, type HPS: D 7969 HPS

### Similar products:
- Diaphragm accumulator type AC: Page 258
Pressure switches are hydraulic accessories. They close or open electrical contacts when under pressure. They are used to issue an electrical switching command or signal for further work steps when a predefined pressure value is reached.

The pressure switch type DG 51 E works with a metallic thin-film cell. Two independent switching points can be programmed. Pushbuttons or IO-Link can be used to carry out the setting.

**Features and benefits:**
- Compact design
- Option of integration into the HAWE modular system
- Operating pressures up to 1000 bar

**Intended applications:**
- General hydraulic systems
- Machine tools

---

**Design and order coding example**

<table>
<thead>
<tr>
<th>DG 51 E</th>
<th>-A</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pressure classification</strong></td>
<td>Table 2 Pressure stages</td>
<td></td>
</tr>
<tr>
<td><strong>Hydraulic connection</strong></td>
<td>Table 1 Hydraulic connection</td>
<td></td>
</tr>
<tr>
<td><strong>Basic type</strong></td>
<td>Pressure switch type DG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type DG 1, 3 (spring-loaded piston-type pressure switch)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type DG 51, DG 6 (electrical pressure switch with two switch points)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type DT (analogue electronic pressure transducer)</td>
<td></td>
</tr>
</tbody>
</table>

**Function**

- **DG 1**
- **DG 3**
- **DT**

---

**Version:**
- Screw-in version
- Manifold mounting
- Designed for pipe connection

**P_{max}** 1000 bar

---

**Nomenclature:**
- Spring-loaded piston-type pressure switch
- Electronic pressure switch
- Electronic pressure transducer

---

**Table 1 Hydraulic connection**

**Table 2 Pressure stages**
**General parameters and dimensions**

**DG 1 R**
- Four-digit 10-segment display, alphanumeric

**DG 3**
- Compact design as manifold mounting, pressure setting via set screw
- Ports: G 1/4 or G 1/4 A

**DG 51 E**
- Electronic pressure switch with two switch points
- Ports: G 1/4 or M 5

**DG 6**
- Electronic pressure switch with two switch points
- Pressure setting: 0 ... 400

**DT 11**
- Analogue electronic pressure transducer
- Pressure setting: 0 ... 1000
- Ports: G 1/4

**DT 2**
- Analogue electronic pressure transducer
- Pressure setting: 0 ... 600

---

**Brief description**

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Pressure setting</th>
<th>Ports</th>
<th>m [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DG 1 R</td>
<td>Adjustment via knob at pressure selection scale</td>
<td>20 to 600 (^1)</td>
<td>G 1/2 or G 1/4 A</td>
<td>1.3</td>
</tr>
<tr>
<td>DG 3</td>
<td>Compact design as manifold mounting, pressure setting via set screw</td>
<td>4 to 700 (^1)</td>
<td>G 1/4 or G 1/4 A (^2)</td>
<td>0.3</td>
</tr>
<tr>
<td>DG 51 E</td>
<td>Electronic pressure switch with two switch points</td>
<td>0 ... 600</td>
<td>G 1/4 A</td>
<td>0.25</td>
</tr>
<tr>
<td>DG 6</td>
<td>Electronic pressure switch with two switch points</td>
<td>0 ... 400</td>
<td>G 1/4 A or M 5</td>
<td>0.08</td>
</tr>
<tr>
<td>DT 11</td>
<td>Analogue electronic pressure transducer</td>
<td>0 ... 1000</td>
<td>G 1/4</td>
<td>0.08</td>
</tr>
<tr>
<td>DT 2</td>
<td>Analogue electronic pressure transducer</td>
<td>0 ... 600</td>
<td>G 1/4</td>
<td>0.7</td>
</tr>
</tbody>
</table>

\(^1\) The max. operating pressure of 700 bar is not influenced by the max. possible set pressure
\(^2\) For versions with adapter only

---

**Associated technical data sheets:**
- Pressure switch type DG: D 5440
- Electronic pressure switch type DG 6: D 5440 F
- Electronic pressure switch type DG 5: D 5440 E/1
- Electronic pressure transducer type DT 11: D 5440 T/2

**Similar products:**
- Electronic pressure transducer type DT 11: D 5440 T/2
- Electronic pressure transducer type DT 2: D 5440 T/1

**Hydraulic accessories:**
- Fittings type X, X 84: [Page 266](#)
Pressure filters protect downstream hydraulic components against soiling. They are installed in the high-pressure line typically after the pump. The pressure filter type PFM contains a filter element through which the fluid flows from the inside to the outside. It can be replaced without drips or soiling using standard tools. The ratio of size to performance is optimal, for this reason the filter has low pressure losses even after absorbing a large amount of soiling. The pressure filter type PFM is used in machine tools, industrial trucks, lifting platforms and in general in oil hydraulics.

- Energy-efficient thanks to low back pressure
- Long change intervals due to high dirt-holding nominal volume
- Filter element replacement is simple and clean

**Intended applications:**
- Machine tools
- Industrial trucks
- Lifting platforms
- General oil hydraulics

**Nomenclature:**
- Pressure filter
- **Version:** In-line installation
  - Can be flanged
- **p<sub>max</sub>**: 250 bar
- **Q<sub>max</sub>**: 90 l/min

---

**Design and order coding example**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFM4</td>
<td>Basic type</td>
</tr>
<tr>
<td>-4</td>
<td>Seal</td>
</tr>
<tr>
<td>8</td>
<td>Visual clogging display</td>
</tr>
<tr>
<td>10</td>
<td>Installation position</td>
</tr>
<tr>
<td>-R4</td>
<td>By-pass valve</td>
</tr>
<tr>
<td>T</td>
<td>Filter fineness</td>
</tr>
<tr>
<td>-V0</td>
<td>Volumetric flow</td>
</tr>
<tr>
<td>-</td>
<td>Port</td>
</tr>
</tbody>
</table>

**Seal:**
- without = series
- KB = cold-resistant

**Visual clogging display:**
- VE = electrically 12/24V
- VO = visually
- VX = retrofittable
- = without

**Installation position:**
- T = vertical
- D = suspended

**By-pass valve:**
- R4 = 4 bar
- X = without

**Filter fineness:**
- 10 μm

**Volumetric flow:**
- 5 = less than 40 l/min
- 8 = less than 90 l/min

**Port:**
- 4 = in-line installation
- UNF3 = in-line installation 7/8-14 UNF
- F = flange design

**Basic type:**
- PFM4

---

**Function**
General parameters and dimensions

Associated technical data sheets:
- Pressure filter type PFM: D 8040
Various fittings are available for hydraulic accessories, which are used to connect these hydraulic devices to the pressure lines of HAWE hydraulic power packs and valves in various assembly situations.

Reducing connectors can be used to combine devices. Additional accessory parts such as screen filters and filter elements safeguard the hydraulic devices against larger, stray impurities which may occasionally occur.

The following hydraulic accessories are available for use in hydraulic systems:
- Measurement devices, e.g. pressure gauges, monitor the pressure
- Command devices, e.g. use pressure switches for pressure-controlled switching
- Hydraulic accumulators are also available

Features and benefits:
- Compact design
- Option of integration into the HAWE modular system
- Operating pressures up to 700 bar

Intended applications:
- General hydraulic systems

Nomenclature:
- Reducing connector
- Connection fitting
- Screen filter
- Filter element
- Pressure gauge

Version:
- Screw-in version for pipe connection

$P_{\text{max}}$: 700 bar

Design and order coding example

Reducing connectors (various dimensions)

**G - g**
- Internal thread - external thread
- Inch thread - metric thread
- Inch thread - inch thread
- Metric thread - metric thread
- Metric thread - inch thread
- Inch thread - JIS thread

Adapter $G 1/4 - G 1/4$ JIS

Example: $G 1/2 - M 16 \times 1.5$

Example: $G 1/2 - G 1A$

Fittings

- Connection fitting with tapped journal $G 1/4$
- Connection fitting with fastening nut and internal thread connection $G 1/4$
- Connecting pieces for attaching the cutting ring for external pipe diameters 6 to 20 mm
- Straight screw-in fitting
- Swivel fitting
- L-fitting

Example: Straight fitting type $X \ldots G$

Example: Elbow fitting type $X \ldots V$

Example: Swivel fitting type $X \ldots S$

Circuit symbol:
**Fitting combinations**

**Consisting of:**
- Connecting piece
- Straight screw-in fitting
- Swivel fitting
- L-connecting piece
- Elbow fitting
- Shut-off valve AVM 8
- Locking element

**Screen filters and filter elements**

**Title?**
- Inch thread
- Metric thread
- Screw-in strainer disc type HFC (hole $\varnothing 0.63$ mm)
- Screw-in wire mesh filter disc type HFC.. F (filter fineness approx. 100 $\mu$m)
- Also in housing version

**Example HFE 3/8**
- Housing version with perforated strainer (hole $\varnothing$ approx. 0.5 mm)
- Connection thread G 3/8(A)

**Example:**

---

**Associated technical data sheets:**
- Reducing connector type G: D 845
- Fitting type X: D 7065
- Fitting type X 84: D 7077
- High-pressure screen filter type HF: D 7235
- Shut-off valves type AVM 8: Page 226
<table>
<thead>
<tr>
<th>Product Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line connector with economy circuit type MSD and others</td>
<td>270</td>
</tr>
<tr>
<td>Proportional amplifier type EV</td>
<td>272</td>
</tr>
<tr>
<td>Proportional amplifier type EV2S</td>
<td>274</td>
</tr>
<tr>
<td>Programmable logic valve control type PLVC, CAN-I0</td>
<td>276</td>
</tr>
</tbody>
</table>
### General electronic additional components

<table>
<thead>
<tr>
<th>Type</th>
<th>Nomenclature / design</th>
<th>Features and benefits:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSD etc.</td>
<td>Line connector</td>
<td>■ Compact design</td>
</tr>
<tr>
<td></td>
<td>– With rectifier circuit</td>
<td>■ Functions tailored to HAWE products</td>
</tr>
<tr>
<td></td>
<td>– With clamp diode</td>
<td>■ Simple installation</td>
</tr>
<tr>
<td></td>
<td>– With LED</td>
<td>■ Energy savings during continuous operation</td>
</tr>
<tr>
<td></td>
<td>– With economy circuit</td>
<td></td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>Power supply units</td>
<td></td>
</tr>
</tbody>
</table>

### Proportional amplifiers

<table>
<thead>
<tr>
<th>Type</th>
<th>Nomenclature / design</th>
<th>Features and benefits:</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV</td>
<td>Module, Card</td>
<td>■ Compact design</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Easy commissioning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Functions tailored to HAWE products</td>
</tr>
<tr>
<td>EV2S-CAN, EV2S-BT</td>
<td>Line connector</td>
<td>■ CAN bus interface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Functions and settings tailored to HAWE products</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Precise current-controlled outputs</td>
</tr>
</tbody>
</table>

### Electronic controls

<table>
<thead>
<tr>
<th>Type</th>
<th>Nomenclature / design</th>
<th>Features and benefits:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLVC, CAN-I0</td>
<td>Programmable logic control</td>
<td>■ Modular systems with expansion and enhancement modules</td>
</tr>
<tr>
<td></td>
<td>– Modular system with</td>
<td>(Basic and expansion module)</td>
</tr>
<tr>
<td></td>
<td>- Basic modules</td>
<td>■ Flexible programming</td>
</tr>
<tr>
<td></td>
<td>- Expansion modules</td>
<td>■ Different interfaces</td>
</tr>
<tr>
<td></td>
<td>- CAN bus nodes-</td>
<td>(RS 232, CAN bus, Profinbus)</td>
</tr>
<tr>
<td></td>
<td>- Software</td>
<td>■ All output parameters can be customised</td>
</tr>
<tr>
<td></td>
<td></td>
<td>■ Software function modules</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(PLC programs)</td>
</tr>
</tbody>
</table>
General electronic additional components

A selection of additional electronic components is available for use in hydraulic systems. Line connectors with and without additional functions, e.g. LEDs for switching position monitoring and protective circuits. Line connectors with economy circuit, e.g. to minimise the temperature at the solenoid and to save energy.

Power supply units for installation in switch cabinets.

Features and benefits:
- Compact design
- Functions tailored to HAWE products
- Simple installation
- Energy savings during continuous operation

Intended applications:
- Hydraulic systems
- Mobile machines and in the industry sector

Nomenclature:
- Line connector with no special feature (standard)
- With rectifier circuit
- With clamp diode
- With LED
- With economy circuit
- Power supply units

Version:
- Line connector
- Modules with screw terminals

General parameters and dimensions

<table>
<thead>
<tr>
<th>Male connector for solenoid valves (single and twin solenoid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brief description</td>
</tr>
<tr>
<td>No special feature (standard)</td>
</tr>
<tr>
<td>Version with LED</td>
</tr>
<tr>
<td>Version with clamp diode</td>
</tr>
<tr>
<td>Version with economy circuit</td>
</tr>
<tr>
<td>Version with rectifier circuit</td>
</tr>
</tbody>
</table>

Male connectors with no special feature (DC voltage supply) or the version with rectifier circuit for supply voltage of 110V AC, 230V AC are included as standard in the scope of delivery of the solenoid valve.

Power supply units for solenoid valves

<table>
<thead>
<tr>
<th>Type</th>
<th>Brief description</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>MNG</td>
<td>Power supply unit for input voltage 230V AC and output voltage 24V DC, load capacity 5A</td>
<td>Power supply for solenoid-actuated hydraulic valves or electrical amplifiers for proportional solenoids</td>
</tr>
</tbody>
</table>
Example: Line connector form A in accordance with DIN EN 175 301-803

Associated technical data sheets:
- Line connector type MSD and others: D 7163
- DIN-plug with economy circuit type MSD 4 ECO for 24 V DC: D 7833/1
- Economy circuit plug type MSE 28026 with adjustable economy voltage: D 7832
- Power supply unit type MNG: D 7835

Additional electrical components:
- Proportional amplifier type EV, EV2S: Page 272, Page 274
- Programmable logic valve control type PLVC and CAN node type CAN-IO: Page 276
- For more about electronic accessories, see "Electronics"

1 Cable fitting Pg 9
2 Flat seal
Proportional amplifiers actuate proportional solenoid valves by converting an input signal into a corresponding control current. The proportional amplifier type EV is available as a module for top-hat rail mounting or, alternatively, as a card for a card holder. Highly precise functions are possible thanks to the feedback measurement at the valve outputs. The control parameters (Imin, Imax, dither, ramp times) are configured using either pushbuttons or a potentiometer.

Features and benefits:
- Compact design
- Easy commissioning
- Functions tailored to HAWE products

Intended applications:
- For controlling proportional valves
- Switch cabinet installation in an industrial environment

| Nomenclature: | Amplifier units for proportional solenoids |
| Version: | Modules with screw terminals |
| Card version with terminal block |

General parameters and dimensions

<table>
<thead>
<tr>
<th>Type</th>
<th>Brief description</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>EV 1 M 3</td>
<td>Version as a module (analogue adjustment)</td>
<td>Use in switch cabinets</td>
</tr>
<tr>
<td>EV 1 D</td>
<td>Version as a module (digital adjustment)</td>
<td></td>
</tr>
<tr>
<td>EV 22 K 5</td>
<td>Card version</td>
<td>Card suitable for control of two twin proportional solenoids. Use in card holder for one, or in a module rack for max. 3 amplifier cards</td>
</tr>
</tbody>
</table>

EV1M3

![Ev1M3 Diagram](image)

1 Standardized support bars

EV1D

![Ev1D Diagram](image)

1 Standard support rails
1 Female multipoint connector according to DIN EN 60603-2

**Associated technical data sheets:**
- Proportional amplifier type EV1M3: D 7831/2
- Proportional amplifier type EV1D: D 7831 D
- Proportional amplifier type EV22K5: D 7817/2

**Additional electronic components:**
- Line connector with economy circuit type MSD and others: Page 270
- Programmable logic valve control type PLVC: Page 276
- CAN node type CAN-IO: Page 276
- For more about electronic accessories, see "Electronics"
Electronic amplifiers

Proportional amplifier type EV2S

Proportional amplifiers actuate proportional solenoid valves by converting an input signal into a corresponding control current. Valve controls control and regulate complex mobile or stationary hydraulic systems.

The proportional amplifier type EV2S-CAN is a plug amplifier designed to be fitted directly on a proportional single-action or twin solenoid. Parameters can be configured either using the pushbuttons and an integrated display or via CAN bus using computer software. The proportional amplifier type EV2S-BT can be set using a smartphone and the HAWE eControl app via Bluetooth.

Features and benefits:
- CAN bus interface
- Functions and settings tailored to HAWE products
- Precise current-controlled outputs

Intended applications:
- Mobile machines and in the industry sector
- Connection of analogue proportional valves in CAN bus networks
- Closed control circuits
- Simple expansion of existing systems

General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>EV2S-CAN</th>
<th>EV2S-BT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of inputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analogue</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Number of outputs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analogue (PWM)</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Interfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAN bus</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Bluetooth</td>
<td>--</td>
<td>x</td>
</tr>
<tr>
<td>Buttons and display</td>
<td>x</td>
<td>--</td>
</tr>
<tr>
<td>Power supply</td>
<td>10 to 30 V DC</td>
<td>10 to 30 V DC</td>
</tr>
<tr>
<td>Output current</td>
<td>2 A</td>
<td>1.6 A</td>
</tr>
</tbody>
</table>
Associated technical data sheets:
- Proportional amplifier type EV2S: Page 272
- Programmable logic valve control type PLVC: Page 276
- CAN node type CAN-IO: Page 276
- For more about electronic accessories, see “Electronics”

Additional electronic components:
- Proportional amplifier type EV: Page 272
- Programmable logic valve control type PLVC: Page 276
- CAN node type CAN-IO: Page 276
- For more about electronic accessories, see “Electronics”
Electronic controls

5 Programmable logic valve control type PLVC, CAN-IO

Valve controls control and regulate complex mobile or stationary hydraulic systems. The programmable valve controllers type PLVC and CAN-IO 14 are freely programmable PLC with integrated proportional amplifiers. Highly precise functions are possible thanks to the feedback measurement at the valve outputs. The number of digital and analogue inputs and outputs can be configured variably.

The valve control type PLVC is of modular design and can be expanded to suit the application. It can be very straightforwardly integrated into existing systems due to the existing interfaces.

Features and benefits:
- Modular systems with expansion and enhancement modules (Basic and expansion module)
- Flexible programming
- Different interfaces (RS 232, CAN bus, Profinbus)
- All output parameters can be customised
- Software function modules (PLC programs)

Intended applications:
- Construction machines
- Crane systems
- Complex lifting devices
- Machines for forestry purposes
- Machine tool and press construction

General parameters and dimensions

<table>
<thead>
<tr>
<th></th>
<th>PLVC 21</th>
<th>PLVC 41</th>
<th>PLVC 8</th>
<th>CAN ID 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of inputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital</td>
<td>13 (5 / 8)</td>
<td>27 (3 / 24)</td>
<td>17 (10 / 7)</td>
<td>1</td>
</tr>
<tr>
<td>Analogue</td>
<td>12 (4 / 8)</td>
<td>28 (4 / 24)</td>
<td>23 (11 / 12)</td>
<td>6 (10)</td>
</tr>
<tr>
<td>Frequency</td>
<td>3 (3 / -)</td>
<td>3 (3 / -)</td>
<td>3 (3 / -)</td>
<td></td>
</tr>
<tr>
<td>Emergency stop</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Number of outputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital</td>
<td>16 (8 / 8)</td>
<td>16 (- / 16)</td>
<td>13 (- / 13)</td>
<td>4</td>
</tr>
<tr>
<td>Analogue (PWM)</td>
<td>4 (4 / -)</td>
<td>16 (4 / 16)</td>
<td>16 (16 / -)</td>
<td>4</td>
</tr>
<tr>
<td>Analogue (0 to 10V)</td>
<td>--</td>
<td>1 (1/-)</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Relay</td>
<td>4 (- / 4)</td>
<td>8 (3 / 8)</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Auxiliary voltage</td>
<td>--</td>
<td>1 (5V DC)</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Interfaces</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS 232</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>CAN bus</td>
<td>x (x / x)</td>
<td>x</td>
<td>x (x / x)</td>
<td>x</td>
</tr>
<tr>
<td>Profinbus</td>
<td>x</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Power supply (10 to 30V DC)</td>
<td>10 (5 / 5)</td>
<td>45 (8 / 37)</td>
<td>32 (16 / 16)</td>
<td>10 to 30 V DC</td>
</tr>
<tr>
<td>Output current</td>
<td></td>
<td></td>
<td></td>
<td>2 A (max. 10 in total)</td>
</tr>
</tbody>
</table>

1) Max. number of inputs and outputs for each, values in brackets apply to basic module and expansion modules
Software function modules (examples):

- Position measurement
- CAN bus communication
- Position and flow rate control
- Fault detection
- Controller for closed control circuits
- Ganging
- Electronic flow rate distribution
- Stability
- Limit load control
- Pressure reduction

Advantage: PLC programming using a structured text (ST) (see above) – The customer can customise the control at any time.

Associated technical data sheets:

- Programmable logic valve control with Profinet type PLVC 21: D 7845-21
- Programmable logical valve control type PLVC 41: D 7845-41
- Programmable logic valve control type PLVC 8: D 7845 M
- CAN node type CAN-IO: D 7845-IO 14

Additional electronic components:

- Proportional amplifier type EV, EV2S: Page 272, Page 274
- For more about electronic accessories, see "Electronics"
The performance of a hydraulic system depends to a large extent on the quality of the hydraulic fluid used. The hydraulic fluid should essentially be selected according to the operating conditions, such as:

- Temperature (see viscosity classes)
- Nomenclature (possible ban on certain hydraulic fluids due to undesired reactions with metals, seals, etc.)
- Usage type (e.g. environmentally compatible hydraulic fluids)
- Surroundings (use of existing hydraulic fluids)

### Overview of temperature and viscosity

| Temperature range: | Surrounding area: -40 to +80°C  
Exception:  
air-powered pumps type LP (+5 to +80°C)  
Hydraulic fluid: -25...+80°C  
Please observe viscosity range and any additional restrictions. |
|-------------------|---------------------------------------------------------------|
| Start temperature:| Down to -40°C permissible  
Observe start viscosities as long as the steady-state temperature is at least 20K higher for subsequent operation!  
Biologically degradable or fire inhibiting pressure fluids generally not over max. +60...70°C. |
| Viscosity range:   | Min. approx. 4 mm²/s,  
Max. approx. 1500 mm²/s  
Optimal operating range approx. 10...500 mm²/s |
### Mineral oils

#### Characteristics

<table>
<thead>
<tr>
<th>Hydraulic fluid</th>
<th>Characteristics</th>
<th>Unusual features / restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic oils HLP (DIN 51524-2)</td>
<td>Mineral oil with additives improving corrosion, oxidation and wear protection</td>
<td>Common hydraulic fluid</td>
</tr>
<tr>
<td>Hydraulic oils HL (DIN 51524-1)</td>
<td>Mineral oil without wear protecting additives</td>
<td>Not suitable for any types of gear pump due to the lack of wear protection additives.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ No pumps and power packs with gear pumps type RZ, Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ No compact hydraulic power packs HC, KA, MP, MPN, HK, HKL</td>
</tr>
<tr>
<td>Hydraulic oils HVLP (DIN 51524-3)</td>
<td>Mineral oil with same additives as HLP, but with increased viscosity index for use in higher temperature ranges</td>
<td>The viscosity index correctors have a negative effect on the shear strength (viscosity loss approx. 30% when loaded), demulsifying behaviour and air release characteristics, for example. Only use if required due to temperature range. Oil manufacturer must be consulted!</td>
</tr>
<tr>
<td>Unalloyed oils H, e.g. - Lubricating oils (DIN 51524-1) - White oils (e.g. NSF H1)</td>
<td>Mineral oil without additives</td>
<td>Due to lack of additives only suitable for systems in the standby mode (S2 or S3 mode) (low lubricity). White oils are mostly used in systems with possible contact with foodstuffs.</td>
</tr>
<tr>
<td>Hydraulic oils PAO (tested for compliance with DIN 51524-1 and DIN 51524-2)</td>
<td>Mineral oil with additives improving corrosion, oxidation and wear protection</td>
<td>See information on hydraulic oils HVLP</td>
</tr>
<tr>
<td>Special fluids in the aviation sector (MIL H-5606) in the marine sector (NATO H 540)</td>
<td>Mineral oils are based as a rule on naphtenic oil with wide temperature range</td>
<td>Seals made of fluor rubber FPM might be required, depending on hydraulic fluid. Consult the oil manufacturer!</td>
</tr>
<tr>
<td>Other mineral oils Engine oils HD ATF automatic transmission fluid (AQ A, suffix A) Diesel Test oil for diesel injection pump test</td>
<td>Mineral oils which basically were developed for other application purposes</td>
<td>More or less suitable hydraulic fluids. Pay attention to the presence of oxidation and corrosion protection as well as material compatibility (above all in relation to the seals). Attention: increased leakage with directional spool valves. Oil manufacturer must be consulted!</td>
</tr>
</tbody>
</table>
## Environmentally compatible hydraulic fluids ISO 15380

<table>
<thead>
<tr>
<th>Hydraulic fluid</th>
<th>Characteristics</th>
<th>Unusual features / restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed oil type HETG</td>
<td>Fluids based on seed oils e.g. rape or sunflower with additives show only low temperature resistance (&lt; 60...70°C)</td>
<td>Not suitable for compact power packs type HC, KA, MP, MPN, HK, HKL, all valves with wet armature solenoids as well as control systems utilizing many throttles. HETG fluid show a tendency to gum, ageing, and sticking at higher temperatures (&gt; 60...70°C). Their use should be avoided!</td>
</tr>
<tr>
<td>Polyethyleneglycol HEPG</td>
<td>Fluids based on polyethylene glycol (PEG) Properties similar to mineral oil with regard to lifetime, lubricity and pressure resistance</td>
<td>No restrictions with regard to the operation behavior, but it</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Is harmful to standard enamel (does not apply to two-pot enamel)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Will clog cellulose filters (use only glass fiber or metallic filters)!</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shows bad lubrication characteristic with material pairings steel / light alloy or brass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No pumps and power packs with gear pumps type RZ and Z</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Do not use compact hydraulic power packs type HC, KA, MP, MPN, HK, HKL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No connection blocks with return line filter type A.F., AF, BF, EF, FF</td>
</tr>
<tr>
<td>Synthetical ester HEES</td>
<td>Similar qualities i.e. lifetime, lubricating characteristics and pressure resistance, like mineral oil</td>
<td>No restrictions with regard to the operation behavior. Contact with PVC should be avoided.</td>
</tr>
<tr>
<td>(carbon acid ester, diester, polyester)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Flame-resistant hydraulic fluids ISO 12922

<table>
<thead>
<tr>
<th>Hydraulic fluid</th>
<th>Characteristics</th>
<th>Unusual features / restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HFA</strong> (pressurized water, emulsions)</td>
<td>Oil in water emulsion, (water content &gt; 80%) max. temp. range approx. 60°C</td>
<td>There is the danger of corrosion and cavitation due to the high water content, only use devices specially constructed for this purpose (radial piston pumps type R, directional seated valves type G) Max. pump pressure 50...60% (danger of cavitation) minimum content of mineral oil &gt; 4%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Do not use compact hydraulic power packs HC, KA, MP, MPN, HK, HKL – risk of short circuit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ No paper filters – risk of blockage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ No connection blocks with return line filter type A.F., AF, BF, EF, FF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Incompatible with zinc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ No paper filters – risk of blockage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Will clog cellulose filters (use only glass fiber or metallic filters)!</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Shows bad lubrication characteristic with material pairings steel/light alloy or brass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ No compact hydraulic power packs HC, KA, MP, MPN, HK, HKL</td>
</tr>
<tr>
<td><strong>HFC</strong></td>
<td>Diluted (poly) glycol solution (water content &gt; 35%) max. temp. range up to approx. 60°C</td>
<td>No restrictions with regard to the operation behavior, but it</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Incompatible with zinc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ No paper filters – risk of blockage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ No connection blocks with return line filter type A.F., AF, BF, EF, FF</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Will clog cellulose filters (use only glass fiber or metallic filters)!</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Shows bad lubrication characteristic with material pairings steel/light alloy or brass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ No compact hydraulic power packs HC, KA, MP, MPN, HK, HKL</td>
</tr>
<tr>
<td><strong>HFD</strong></td>
<td>Fluids without water content, properties similar to mineral oil</td>
<td>Normal operation possible</td>
</tr>
<tr>
<td>HFDR phosphoric ester</td>
<td></td>
<td>Restrictions:</td>
</tr>
<tr>
<td>HFDU polyolester</td>
<td></td>
<td>▪ Requires seals out of FPM (FKM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(see also section “Seals”)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Oil manufacturer must be consulted!</td>
</tr>
</tbody>
</table>

### Special fluids

<table>
<thead>
<tr>
<th>Hydraulic fluid</th>
<th>Characteristics</th>
<th>Unusual features / restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AT-Brake fluid</strong></td>
<td>Brake fluid based on glycol (DOT 4)</td>
<td>No restrictions with regard to the operation behaviour, but devices must be equipped with EPDM or SBR seals (see “Seals” section)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No compact hydraulic power packs type HC, KA, MP, MPN, HK, HKL</td>
</tr>
</tbody>
</table>
Viscosity grade selection

From the 18 viscosity classes (ISO VG) listed in the standard “ISO viscosity classification for liquid lubricants” (DIN ISO 3448), the ranges ISO VG10 to ISO VG68 are relevant for hydraulic systems. The number after “ISO VG” corresponds to the nominal viscosity at a reference temperature of 40°C. The temperature behaviour displayed in the diagram corresponds to that of mineral hydraulic oils. The characteristic curve increase of HVLP and the environmentally compatible hydraulic fluids is flatter, indicating that the temperature effect is lower.

Due to manufacturer-related differences, the following benchmark figures are to be clarified and compared with the permissible viscosity ranges:

- Viscosity at 40°C
- Viscosity at the lowest (estimated or demanded) temperature
- Viscosity at the highest (presumed, required) temperature  
  (to guarantee a good seal life ≤ 80°C!)

Temperature / viscosity curve

Guide lines for selection

- VG10, VG15  
  Systems intended for short time operation or use in the open or for clamping devices.
  Systems intended for continuous operation  
  (for use in the open, operation in winter only)
- VG22, VG32  
  General use  
  (when used outside, only summer operation)
- VG46, VG68  
  Systems in closed rooms at ambient temperatures up to 40°C or tropical conditions

1 Optimum range
2 Reference temperature

DIN ISO 3448
Hydraulic fluid filtration

Fine contamination (e.g. debris and dust) or contamination in the macro range (e.g. wear debris, rubber particles from hoses and seals) may significantly impair the function of a hydraulic system.

Maintain the following hydraulic fluid purities (assuming a thorough flushing has taken place prior to the date of commissioning):

<table>
<thead>
<tr>
<th>Recommended purity of the hydraulic fluid</th>
<th>Recommended filter fineness</th>
<th>Devices</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 4406</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21/18/15...19/17/13 β₁₆...₂₅ ≥ 75</td>
<td>Radial piston and gear pumps, valves, cylinders (use in general mechanical engineering)</td>
<td>The purity degree of the hydraulic fluid is especially important for the repeatability accuracy with proportional valves.</td>
<td></td>
</tr>
<tr>
<td>20/17/14...18/15/12 β₁₆...₁₆ ≥ 75</td>
<td>Prop. pressure and flow control valves</td>
<td>It should be noted that new hydraulic fluid “from the barrel” does not necessarily fulfill the highest cleanliness requirements.</td>
<td></td>
</tr>
<tr>
<td>19/17/14</td>
<td>Variable displacement axial piston pumps</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lower limits must be applied for pressure above 250 bar

Service life of the hydraulic fluid

The aging of hydraulic fluids is caused by shearing processes, cracking induced by high temperatures (gumming), mixing with (condensed) water or reaction with other materials (e.g. metal) in the system (sludging). A major factor for the service life of the fluid is beside the anti-shear additives of the fluid the lay-out of the system e.g. tank size, operation temperature, number and design of throttling sections.

Besides the properties of the hydraulic fluid itself (e.g. due to additives for high shear stability), the design of the hydraulic control system (e.g. tank size, steady-state temperature, number and type of throttling points) has a major influence on this.

The following points are to be noted:

- Service temperature in the tank < 80°C 
  (mineral oils, hydraulic fluids with low water content) Avoid higher temperatures – Service life reduction – (+10K corresponds to half service life)
- Rotational conditions of hydraulic fluid $\frac{Q_{\text{pump}}}{V_{\text{System}}}$ (Reference values)
  - Approx. 0.2...0.4/min for conventional hydraulic power packs
  - Approx. ...1/min in mobile hydraulics
  - Approx. ...4/min for compact hydraulic power packs in standby or load/no load operation
- Control of the hydraulic fluid on a regular base (fluid level, contamination, coloring index, neutralization value etc.)
- Change of the hydraulic fluid on a regular base (depending on fluid type and application conditions)
  Guideline:
  - approx. 4000 ... 8000 h (mineral oil)
  - approx. 2000 h (other hydraulic fluids)
  - or at least annually
  Take into account notes of the fluid manufacturer!
Changing the hydraulic fluid

Do not mix different types of hydraulic fluids! This may lead to undesirable chemical reactions causing sludge, resinification etc. The relevant manufacturers should be consulted when switching between different hydraulic fluids. In all cases, the whole hydraulic system should be thoroughly flushed.

Interaction with seals

Any question about the compatibility with seal material should be settled with the fluid manufacturer always before using a certain hydraulic fluid (except mineral oil and synthetic esters). A rough overview is given in the table at the start of this section. HAWE utilizes seals made of the following materials as standard:

- NBR (acrylonitrile rubber, e.g. Bunan, Perbunan) or HNBR (hydrated NBR).

Some devices are available on request with seals made of:

- FPM (also FKM, fluor rubber) e.g. for fluids type HFD
  - The coding ...-PYD should be added to the coding for HAWE devices, e.g. WN1H-G24-PYD
- EPDM (ethylene propylene rubber) or SBR (styrene-butadiene rubber)
  - The coding ...-AT should be added to the coding for HAWE devices, e.g. WN1H-G24-AT (for brake fluid)

Storing hydraulic fluids and hydraulic components

Storage conditions for hydraulic components depend primarily on the following factors:

- seals utilised, moistening with oil during the factory functional test

The storability of rubber materials is generally influenced by the following factors:

- Warmth, light, humidity, oxygen, ozone

As far as possible, components should be de-energised and without deformation when stored. A storage temperature range of 15 to 20°C is optimum. Relative humidity approx. 65% (+-10%). Exposure to direct sunlight or a light source with strong UV rays should be avoided. Ozone-producing equipment (electric motors, high-voltage equipment) among other things must not be present in the storage room.

If seals are packaged in plastic bags, these should not contain any plasticisers and, if necessary, should be impermeable to UV light.

Details on storage of elastomers are also available in the following standards:

Hydraulic fluids can be stored for an unlimited period in sealed containers supplied by the manufacturer, as no chemical reactions take place. The presence of atmospheric oxygen, dust and moisture can lead to more or less rapid oxidation and resinification, depending on the type of oil and its additives.

A dark room with virtually constant temperature and humidity is recommended for storage of hydraulic components. The parts should be kept in a plastic bag to protect them from dust and continuous air exchange.

A functional test (manual override, dry switching) should be carried out at least once a year to ensure operation.

Safety-related components: A six-monthly functional test on site and a regular factory inspection including seal replacement every 2 years.

When the hydraulic components are stored as described above, the risk of corrosion is low. Most external parts of HAWE components are coated with a protective layer (galvanised, nitrided) and moistened with oil.
Formulas and units

Hydraulic systems planning must be carried out taking a variety of factors into consideration, whereby the hydraulic elements are selected according to the desired functional processes.

The most important condition for this is the definition or specification of relevant consumer variables, such as the loads (load forces, load torques or turning torques), motion functions (travel, speeds, rotational speeds, timing) etc.

Only then is it possible to determine hydraulic consumers (hydraulic motors, hydraulic cylinders), drive units (pumps with drives), control and regulating devices (valve types with actuations) as well as connecting elements (lines, branch points).

Other factors that have an influence on the choice of hydraulic systems and components include noise emission values and thermal budget considerations.

The following formulae and tables are non-binding and are intended to make producing the rough design for a hydraulic system easier.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Formulas and description</th>
</tr>
</thead>
<tbody>
<tr>
<td>General information</td>
<td><strong>Basic equations (static, without any loss)</strong></td>
</tr>
<tr>
<td></td>
<td>$Q = \frac{V}{t}$</td>
</tr>
<tr>
<td></td>
<td>$V = A \cdot s$</td>
</tr>
<tr>
<td></td>
<td>$F = p \cdot A$</td>
</tr>
<tr>
<td></td>
<td>$p = \frac{F}{A}$</td>
</tr>
<tr>
<td></td>
<td>$Q = A \cdot v$</td>
</tr>
<tr>
<td></td>
<td>$M = \frac{V \cdot p}{2 \pi}$</td>
</tr>
<tr>
<td></td>
<td>$v = \frac{s}{t}$</td>
</tr>
<tr>
<td>Hydraulic cylinders</td>
<td><strong>Single acting</strong></td>
</tr>
<tr>
<td></td>
<td>$A = \frac{\pi}{4} \cdot d^2 , [\text{mm}^2]$</td>
</tr>
<tr>
<td></td>
<td>$v = \frac{s}{1000 \cdot t} , [\text{mm}^s] \left( \frac{\pi}{4} \cdot d^2 \right)$</td>
</tr>
<tr>
<td></td>
<td>$F_{\text{res}}[\text{N}] = 0.19 \cdot p_{\text{op}}[\text{bar}] \cdot A[m^2]$</td>
</tr>
<tr>
<td></td>
<td>$p_{\text{gl}}[\text{bar}] = \frac{A_{\text{p}}[\text{mm}^2]}{A_{\text{s}}[\text{mm}^2]}$</td>
</tr>
<tr>
<td></td>
<td>$Q_{\text{in}}[\text{l/min}] = 0.06 \cdot A[m^2] \cdot \frac{\pi}{4} \cdot d^2$</td>
</tr>
<tr>
<td></td>
<td>$d$: piston diameter ([\text{mm}])</td>
</tr>
<tr>
<td></td>
<td>$A$: piston area ([\text{mm}^2])</td>
</tr>
<tr>
<td></td>
<td>$F_{\text{op}}$: force ([\text{N}])</td>
</tr>
<tr>
<td></td>
<td>$p_{\text{op}}$: operating pressure ([\text{bar}])</td>
</tr>
<tr>
<td></td>
<td>$v$: Piston speed ([\frac{\text{mm}}{\text{s}}])</td>
</tr>
<tr>
<td></td>
<td>$Q_{\text{in}}$: inflow ([\text{lpm}])</td>
</tr>
<tr>
<td></td>
<td>$s$: stroke ([\text{mm}])</td>
</tr>
<tr>
<td></td>
<td>$t$: time ([\text{s}])</td>
</tr>
</tbody>
</table>

**Extending**

Basic equations (balance of forces):

$A_{\text{p}} = \frac{d_1^2}{4}$

$A_{\text{s}} = \frac{d_2^2}{4}$

$p_{\text{op}} - p_{\text{op}} = A_{\text{p}}[m^2] - A_{\text{s}}[m^2]$

$Q_{\text{in}} = \frac{A_{\text{p}}}{A_{\text{s}}} \cdot v$

$Q_{\text{out}} = A_{\text{p}} \cdot v$

**Retracting**

Basic equations (balance of forces):

$p_{\text{op}} - A_{\text{p}} = A_{\text{s}}[m^2]$  \(10\)

$p_{\text{op}} - A_{\text{s}} = A_{\text{p}}[m^2]$  \(10\)

$Q_{\text{in}} = A_{\text{p}} \cdot v$

$Q_{\text{out}} = A_{\text{p}} \cdot v$

**Double acting**

Extending

Basic equations (balance of forces):

$p_{\text{op}} = A_{\text{p}}[m^2] - 10F[\text{N}]$

$p_{\text{op}} = A_{\text{s}}[m^2] + 10F[\text{N}]$

Retracting

Basic equations (balance of forces):

$p_{\text{op}} = A_{\text{p}}[m^2] - 10F[\text{N}]$

$p_{\text{op}} = A_{\text{s}}[m^2] + 10F[\text{N}]$

$p_{\text{op}}$ result of flow resistance from pipes and valves for $Q_{\text{out}}$

Attention: note possible pressure intensification!

Simplified:

$p_{\text{op}} = \frac{A_{\text{p}}[m^2]}{A_{\text{s}}[m^2]} - 10F[\text{N}]$

$p_{\text{op}} = \frac{A_{\text{s}}[m^2]}{A_{\text{p}}[m^2]} + 10F[\text{N}]$

$Q_{\text{in}}$: inflow \([\text{lpm}]\) |

$Q_{\text{out}}$: outflow \([\text{lpm}]\) |

$p_{\text{op}}$: pressure, piston side \([\text{bar}]\) |

$p_{\text{op}}$: pressure, rod side \([\text{bar}]\) |

$s$: stroke, travel \([\text{mm}]\)
<table>
<thead>
<tr>
<th>Equipment</th>
<th>Formulas and description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hydraulic pumps / hydraulic motors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic equations:</td>
<td>( \Delta p = p_o - p_i )</td>
<td></td>
</tr>
<tr>
<td>Geometric volume per revolution (piston pumps):</td>
<td>( V = A \cdot h )</td>
<td></td>
</tr>
<tr>
<td>Volumetric flow:</td>
<td>( Q = V \cdot n )</td>
<td></td>
</tr>
<tr>
<td>Middle torque:</td>
<td>( M = \frac{V \cdot \Delta p}{2 \pi} )</td>
<td></td>
</tr>
<tr>
<td>Power:</td>
<td>( P_{\text{hyd}} = \frac{\Delta p \cdot Q}{62} )</td>
<td></td>
</tr>
<tr>
<td>Power rating (motor):</td>
<td>( P_{\text{mech}} = \frac{\Delta p \cdot Q}{612} )</td>
<td></td>
</tr>
<tr>
<td>Power output (pump):</td>
<td>( P_{\text{max}} = \Delta p \cdot \eta \cdot M \cdot 2 \pi \cdot n )</td>
<td></td>
</tr>
<tr>
<td>V: displacement ([\text{cm}^3])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A: effective piston area ([\text{mm}^2])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h: double stroke ([\text{mm}])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n: rev. rating ([\text{rpm}])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M: middle torque ([\text{Nm}])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p: pressure ([\text{bar}])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta p ): effective pressure ([\text{bar}])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q: volumetric flow ([\text{lpm}])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( P_{\text{hyd}} ): hydraulic performance ([\text{kW}])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( P_{\text{mech}} ): mechanical performance ([\text{kW}])</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \eta ): total efficiency (including volumetric and mechanical losses)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guideline:</td>
<td>A power rating of 1 kW for the drive is necessary to achieve a delivery volumetric flow of Q = 1 lpm with operating pressure p = 500 bar!</td>
<td></td>
</tr>
</tbody>
</table>

1) \( p_o \) is calculated from line and valve resistance
2) incl. degree of efficiency \( \eta = 0.82 \)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Formulas and description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valves</strong></td>
<td>Losses of pressure by streaming fluid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The pressure loss in hydraulic systems consists of:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Flow resistance of valves</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Flow resistance of pipes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Flow resistance due to geometric shape (elbows etc.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure losses ( \Delta p ) in the valves that are caused by the volumetric flow of fluid can be found in the ( \Delta p \cdot Q ) characteristics of the relevant documentation. For the purposes of an initial rough design, a performance loss of approx. 20... 30% in the overall control system can generally be expected.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Examples:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Directional valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure limiting valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flow control valve</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Releasable check valve</td>
<td></td>
</tr>
</tbody>
</table>

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### Orifices
(ideally, sharp edged) e.g. orifice inserts type EB; by-pass check valves type BC, BE

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Formulas and description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orifices</td>
<td>Basic equation: $Q = \alpha \cdot \frac{A}{2} \cdot \sqrt{2 \cdot \Delta p}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$Q$: volumetric flow [lpm]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\Delta p$: flow resistance between A and B [bar]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$d$: orifice diameter [mm]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$p$: density (approx. 0.9 g/cm$^3$)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\alpha$: flow coefficient (approx. 0.78)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simplified: $Q = 0.55d^2[mm] \cdot \sqrt{\Delta p[bar]}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$d = 1.35 \sqrt{\frac{Q[1/l]}{\Delta p[bar]}}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\Delta p = \left(1.82 \cdot \frac{Q[1/l]}{d^2[mm]}\right)^2$</td>
<td></td>
</tr>
</tbody>
</table>

### Pipes / hoses
The diameter of pipes and/or hoses should be selected in such a way that flow resistance is minimized.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Formulas and description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes / hoses</td>
<td>Basic equations: $Re = \frac{v \cdot d}{\nu}$ $\lambda = \frac{\Delta p}{l \cdot \rho \cdot \frac{Q^2}{d^4}}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\lambda$: pipe flow resistance coefficient</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\Delta p$: flow resistance [bar]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$l$: pipe length [m]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$d$: pipe diameter [mm]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\nu$: cinematic viscosity [mm$^2$/s]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$Q$: volumetric flow [lpm]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$Re$: Reynolds No. (&lt; 2300)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\rho$: density (approx. 0.9 g/cm$^3$)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simplified: $Q[1/l/min] \leq 0.108 \cdot d[mm] \cdot \frac{v[mm^2/s]}{\nu}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$d[mm] \geq 6.1 \cdot \frac{Q[1/l]}{\nu} \cdot \frac{l[1]}{\Delta p[bar]}$</td>
<td></td>
</tr>
</tbody>
</table>

### Flow resistance due to geometric shape (elbows etc.)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Formulas and description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow resistance due to geometric shape (elbows etc.)</td>
<td>Basic equations: $\Delta p \cdot \frac{\xi}{2} = \frac{Q^2[1/l]}{d^4[mm]}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$90^\circ$ elbow $\xi = 0,15$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>straight pipe fitting $\xi = 0,5$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>elbow fitting $\xi = 1,0$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simplified: $\Delta p[bar] \cdot 2,2 \cdot \xi = \frac{Q^2[1/l]}{d^4[mm]}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\xi$: flow resistance coefficient</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$d$: pipe diameter [mm]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\nu$: cinematic viscosity [mm$^2$/s]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$Q$: volumetric flow [lpm]</td>
<td></td>
</tr>
</tbody>
</table>

### Leakage losses
(by concentric ($\varepsilon = 0$) and eccentric gaps)

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Formulas and description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage losses (by concentric ($\varepsilon = 0$) and eccentric gaps)</td>
<td>Basic equation: $Q_i = \frac{\pi d^2 \Delta r^2}{12} \cdot \frac{\Delta p}{l} \cdot (1,5 \cdot \varepsilon^2)$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$e$: eccentricity [mm]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\Delta r$: gap [mm]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\Delta p$: Pressure difference [bar]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$d$: diameter [mm]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\nu$: cinematic viscosity [mm$^2$/s]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$l$: gap length [mm]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\rho$: density (approx. 0.9 g/cm$^3$)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Simplified: $Q_i = 1,84 \cdot \frac{d^2 \cdot \varepsilon^3 \cdot \Delta p}{l} \cdot (1,1,5 \cdot \varepsilon^2)$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\varepsilon = \frac{e}{\Delta r}$</td>
<td></td>
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</tbody>
</table>
### Equipment Formulas and Description

#### Volumetric losses (due to pressure increase)

**Basic equation:**
\[ \Delta V = \beta_p \cdot V_0 \cdot \Delta p \]

with \( \Delta p = p_2 - p_1 \)

\( p_1 \): pressure, start [bar]
\( p_2 \): pressure, end [bar]
\( V_0 \): initial volume [l]
\( \Delta V \): change in volume [l]
\( \beta_p \): compressibility

**Simplified:**
\[ \Delta V = 0.7 \cdot 10^{-4} \cdot V_0 \cdot \Delta p \]

(with \( \beta_p = 0.7 \cdot 10^{-4} \cdot \frac{1}{\text{bar}} \))

#### Volumetric losses (due to temperature rise)

**Basic equation:**
\[ \Delta V = \beta_T \cdot V_0 \cdot \Delta \theta \]

with \( \Delta \theta = \theta_2 - \theta_1 \)

\( \theta_1 \): temperature, start [°C]
\( \theta_2 \): temperature, end [°C]
\( \Delta \theta \): temperature, difference [K]
\( V_0 \): initial volume [l]
\( \Delta V \): volume alternation [l]
\( \beta_T \): expansion coefficient

**Simplified:**
\[ \Delta V = 0.7 \cdot 10^{-3} \cdot V_0 \cdot \Delta \theta \]

(with \( \beta_T = 0.7 \cdot 10^{-3} \cdot \frac{1}{K} \))

#### Pressure increase caused by temperature rise (without volumetric compensation)

\[ \Delta V = 0.7 \cdot 10^{-6} \cdot \Delta p = 0.7 \cdot 10^{-3} \cdot \Delta \theta \]

i.e. \( \Delta \theta = 1 \text{K} \Rightarrow \Delta p = 10 \text{ bar} \)

**Note:** A temperature rise of trapped oil volume will cause a pressure increase! (i.e. a pressure limiting valve will be required sometimes)

**Guideline:** The pressure will rise by approx. 10 bar for 1 K of temperature increase.

#### Hydraulic accumulators

Hydraulic accumulators are intended for the supply of pressurized fluid during sudden demands (quick, adiabatic pressure alternations), compensation of leakage losses or to dampen oscillations (slow, isotherm pressure alternations).

**Basic equations:**

- **isotherm (slow)**
  \[ \Delta V = V_0 \cdot \left( 1 - \frac{p_2}{p_1} \right) \]

- **adiabatic (quick)**
  \[ \Delta V = V_0 \cdot \left( 1 - \left( \frac{p_2}{p_1} \right)^{0.71} \right) \]

\( p_1 \): filling pressure for the gas [bar]
\( p_2 \): lower operating pressure [bar]
\( p_3 \): upper operating pressure [bar]
\( V_0 \): initial volume [l]
\( \Delta V \): volume alternation [l]
Cavitation
Approx. 9 % (volumetric) air are solved in oil at atmospheric pressure. There is the danger of bubble cavitation during atmospheric pressure below 0.2 bar. These situations can occur, accompanied by sudden noise, during suction process of pumps and cylinders as well as at extreme throttle sections. The hydraulic components where this occurs will show increased wear.

Equipment Formulas and description

Thermal level
Dissipation power and oil temperature
The hydraulic power losses in a hydraulic system result in a temperature rise of the fluid and the equipment which is partly radiated to the surroundings via the surface of the system. They roughly amount 20 - 30% of the induced performance. The induced and the radiated heat will balance at some point after the warm-up of the system.

Basic equations:
\[ P \nu = 0.3 \cdot P_{\text{hydr}} \cdot \vartheta_{\text{oil, max}} - \vartheta_{\text{Ung}} + C \cdot \frac{P_v}{A} \]

Simplified:
\[ \vartheta_{\text{oil, max}} = \vartheta_{\text{Ung}} + C \cdot \frac{0.3 \cdot P_{\text{hydr}} [\text{KW}]}{A [\text{m}^2]} \]

Conversion table

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<thead>
<tr>
<th>Marking</th>
<th>Unit</th>
<th>Factor X</th>
<th>Unit</th>
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<td>Pressure</td>
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<td>( \frac{N}{\text{mm}^2} )</td>
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</tr>
<tr>
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<td></td>
<td>1 MPa</td>
<td>10</td>
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<tr>
<td></td>
<td></td>
<td>( \frac{\text{kgf}}{\text{cm}^2} )</td>
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<tr>
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<tr>
<td></td>
<td></td>
<td>1 lbf</td>
<td>4.45</td>
</tr>
<tr>
<td>Length, travel, stroke</td>
<td>l, s, h</td>
<td>1 in</td>
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</tr>
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<td></td>
<td></td>
<td>1 in(^3)</td>
<td>1.64 \times 10^{-2}</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 UK gal</td>
<td>4.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 US gal</td>
<td>3.79</td>
</tr>
<tr>
<td>Temperatures</td>
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</tr>
<tr>
<td>Weight</td>
<td>m</td>
<td>1 lb</td>
<td>0.45</td>
</tr>
<tr>
<td>Cinematic viscosity</td>
<td>\nu</td>
<td>1 cST</td>
<td>1</td>
</tr>
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