Proportional Directional Valves pilot operated, with electrical position feedback, type HD-4WRK(E)
Proportional directional valve, pilot operated with electrical position feedback Type HD-4WRKE

- Pilot operated 2-stage proportional directional valve
- For subplate mounting
- Valve for the control of the size and direction of a flow
- Actuation via proportional solenoids
- Spring centred main spool
- Electrical position feedback
- Single stage proportional directional valve pilot control
- Main stage with closed loop position control
- Integrated control electronics

Type H D-4WRKE 10 ...-3X/6EG24...K31/ ... D3...
with integrated control electronics

Function, section

Pilot control valve type HD-4WRAP 6 W7.3X/G24... (1st stage)
The pilot control valve is a direct operated proportional valve. The control edge geometrics were designed and optimised for the use as a pilot control valve for the proportional directional valves type HD-4WRKE.
The proportional solenoids are pressure tight, oil-immersed DC solenoids with removable coil. They convert an electrical current proportionally into a mechanical force. An increase in the current strength causes an appropriately higher solenoid force. The set solenoid force remains constant over the entire control stroke.
The pilot control valve basically consists of the housing (1), proportional solenoids (2 and 3), valve spool (4) and springs (5 and 6).
In the de-energised condition both actuator ports are connected to tank. If one of the two solenoids (2 or 3) is energised, then the solenoid force moves the valve spool (4) against the spring (6 or 5).
Once the overlap area is overcome, the connection to tank of one of the two actuator ports is blocked and the connection to the pressure chamber is established. There is flow from P to the control chamber of the main stage.
The type HD-4WRKE valves are 2-stage proportional directional control valves. They control the size and direction of a flow. The main stage is closed loop position controlled so that the spool position is also independent of flow forces at larger flows.

The valves basically consists of the pilot control valve (1), housing(8), main spool (7), covers (5 and 6), centering spring (4), inductive position transducer (9) and the pressure reducing valve (3).

If no input signal is being applied then the main spool (7) is held in the centre position by the centering spring (4). The two control chambers in the covers (5 and 6) are connected via the valve spool(2) to tank.

The main spool (7) is connected to suitable control electronics via the inductive position transducer (9). The positional change of the main spool (7) as well as the alteration of the command value at the summation point of the amplifier produces a differential voltage.

With the command value/actual value comparison a possible control deviation is recognised via the electronics and an electrical current is applied to the proportional solenoid of the pilot valve (1).

The current induces, within the solenoid, a force which is passed on to the solenoid pin which in turn actuates the control spool. The flow which is provided via the control cross sections causes the main spool to move.

The main spool (7) with the attached core of the inductive position transducer (9) is moved until the actual value is equal to the command value. In the controlled condition the main spool (7) is force balanced and is held in this controlled position.

Spool stroke and control opening change in proportion to the command value.

The control electronics are integrated into the valve. By matching the valve and the electronics the model variation of the units is kept low.
Symbols (detailed)

Example:
1. Pilot control valve type HD-4WRKE...
2. Main valve
3. Pressure reducing valve type
   ZDR 6 DPO-4X/40YM

Symbols (simplified)

Type HD-4WRKE... - 3X...

Type HD-4WRKE...-3X/...ET.

Type HD-4WRKE...-3X/...E.

Type HD-4WRKE...-3X/...T.
### Ordering details

<table>
<thead>
<tr>
<th>HD</th>
<th>4WRKE</th>
<th>3X</th>
<th>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology of Beijing Huade Hydraulic</td>
<td>= HD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrically operated 2-stage proportional directional valve of 4-way design with integrated electronics</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>35</td>
<td>35</td>
</tr>
</tbody>
</table>

Symbols

- **A** = 0
- **B** = 1

### Electrical connections

- **K31** = Without plug-in connector
- **G24** = 24 V DC

**Supply voltage**

**Proportional solenoid with removable coil**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Pilot oil supply external,</td>
</tr>
<tr>
<td>E1</td>
<td>Pilot oil drain external</td>
</tr>
<tr>
<td>E3</td>
<td>Pilot oil supply internal,</td>
</tr>
<tr>
<td>W6</td>
<td>Pilot oil drain external</td>
</tr>
<tr>
<td>T</td>
<td>Pilot oil supply external,</td>
</tr>
<tr>
<td>R</td>
<td>Pilot oil drain internal</td>
</tr>
</tbody>
</table>

### Characteristic curve form

<table>
<thead>
<tr>
<th>L</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>Linear with fine control range</td>
</tr>
</tbody>
</table>

### Nominal flow in L/min at 1MPa valve pressure differential

<table>
<thead>
<tr>
<th>Value</th>
<th>Flow Rate (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>125</td>
<td>200</td>
</tr>
<tr>
<td>220</td>
<td>350</td>
</tr>
<tr>
<td>400</td>
<td>600</td>
</tr>
<tr>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>

*Note:*

- With the spools W6/W8 and R3 there is a connection from A to T and B to T in the zero position with approx. 2% of the applicable nominal crosssection.
### Technical data

#### Hydraulic

<table>
<thead>
<tr>
<th>Size</th>
<th>10</th>
<th>16</th>
<th>25</th>
<th>32</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating pressure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Main valve, ports P, A, B (MPa)</strong></td>
<td>31.5</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td><strong>Return pressure (MPa)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pilot control valve (MPa)</strong></td>
<td>2.5~31.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pilot oil supply</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pilot oil drain, external</strong></td>
<td>31.5</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td><strong>Pilot oil drain, internal</strong></td>
<td>&lt;1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Port Y</strong></td>
<td>&lt;1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nominal flow ( q ) ± 10% at ( \Delta p = 1 \text{N/P} ) (L/min)</strong></td>
<td>25</td>
<td>50</td>
<td>90</td>
<td>125</td>
<td>180</td>
</tr>
<tr>
<td><strong>Flow of main valve (max. permissible) (L/min)</strong></td>
<td>170</td>
<td>400</td>
<td>870</td>
<td>1600</td>
<td>3000</td>
</tr>
<tr>
<td><strong>Pilot oil flow at port X or Y with a step form of input signal from 0 to 100% (L/min)</strong></td>
<td>4.1</td>
<td>8.5</td>
<td>11.7</td>
<td>13.0</td>
<td>13.0</td>
</tr>
<tr>
<td><strong>Hysteresis (%)</strong></td>
<td>&lt;1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Response sensitivity (%)</strong></td>
<td>&lt;0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Filtering precision (μm)</strong></td>
<td>&lt;20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pressure fluid</strong></td>
<td>Mineral oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phosphate ester</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Medium viscosity (mm²/s)</strong></td>
<td>20~380</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pressure fluid temperature range (°C)</strong></td>
<td>-20~+70</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight (Kg)</strong></td>
<td>8.7</td>
<td>11.2</td>
<td>16.8</td>
<td>31.5</td>
<td>34</td>
</tr>
</tbody>
</table>

#### Electrical data

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valve protection to DIN 40 060</strong></td>
<td>IP65</td>
</tr>
<tr>
<td><strong>Voltage type</strong></td>
<td>DC</td>
</tr>
<tr>
<td><strong>Signal type</strong></td>
<td>Analogue</td>
</tr>
<tr>
<td><strong>Power, max. (W)</strong></td>
<td>72 (average = 24 W)</td>
</tr>
<tr>
<td><strong>Electrical connection</strong></td>
<td>With component plug to E DIN 43 563-AM6 Plug-in connector to E DIN 43 563-BF6-3</td>
</tr>
<tr>
<td><strong>Control electronics</strong></td>
<td>Integrated into the valve</td>
</tr>
</tbody>
</table>
Pilot oil supply

Pilot oil supply, throttle insert (example: NS10)

1. Pilot oil supply external
   Pilot oil drain external
   In this type the pilot oil supply is from a separate pilot pressure circuit (external).
   The pilot oil drain is not into the T port of the main valve but separately into tank via port Y (external).

2. Pilot oil supply internal
   Pilot oil drain external
   In this type the pilot oil supply is from the P port of the main valve (internal).
   The pilot oil drain is not into the T port of the main valve but separately into tank via port Y (external).
   Port X must be plugged in the subplate.

3. Pilot oil supply internal
   Pilot oil drain internal
   In this type the pilot oil supply is from the P port of the main valve (internal).
   The pilot oil drain is directly into the T port of the main valve (internal).
   Port X and Y must be plugged in the subplate.

4. Pilot oil supply external
   Pilot oil drain internal
   In this type the pilot oil supply is from a separate pilot pressure circuit (external).
   The pilot oil drain is directly into the T port of the main valve (internal).
   Port Y must be plugged in the subplate.
Electrical connections, plug-in connector

Plug-in connector
Plug-in connector to E DIN 43 563-9F6-3
Separate order, plastic version

Component plug allocation

<table>
<thead>
<tr>
<th>Contact</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td>Ref. (actual value)</td>
<td>C</td>
</tr>
<tr>
<td>Differential amplifier input (command value)</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td>E</td>
</tr>
<tr>
<td>Measurement output (act. value)</td>
<td>F</td>
</tr>
<tr>
<td>PE</td>
<td>Connected with cooling body and valve housing</td>
</tr>
</tbody>
</table>

Command value: Reference potential at E and a positive command value at D results in a flow from P to A and B to T.
Reference potential at E and a negative command value at D results in a flow from P to B and A to T.

Connection cable: Recommendation: – Up to 25 m cable length type LIYCY 7 x 0.75 mm²
– Up to 50 m cable length type LIYCY 7 x 1.0 mm²

External diameter: – 6.5 to 11 mm (plastic plug-in connection)

Connect screen to \( \perp \) only on supply side.

Note: Electrical signals (e.g. actual value or feedback signals) taken via valve electronics must not be used to switch off the machine safety functions!
Characteristic curves (measured at 1MPa valve pressure differential or 0.5MPa per control land)

Spool symbols E, W or R

Spool with characteristic curve L

Spool with characteristic curve P
Characteristic curves ($P=10$ MPa, $v=36 \times 10^{-6} \text{m}^2/\text{s}$, $t=40^\circ C \pm 5^\circ C$)

Transient function with a step form of electrical input signal

Signal change in %

![Graph showing signal change over time in %](image)

Time in ms

Flow load function at maximum valve opening (tolerance $\pm 10\%$)

![Graph showing flow load vs. valve pressure differential](image)

$1 = \text{Recommended flow limitation}$

(flow velocity $30 \text{ m/s}$)
Characteristic curves ($P=10 \text{ MPa}$, $v=36 \times 10^{-6} \text{ m}^2/\text{s}$, $t=40^\circ\text{C} \pm 5^\circ\text{C}$)

**Transient function with a step form of electrical input signal**

Signal change in %

Stroke in %

Time in ms →

**Flow load function at maximum valve opening**
(tolerance $\pm 10\%$)

Flow in L/min

Valve pressure differential in MPa →

1 = Recommended flow limitation
(flow velocity 30 m/s)
Transient function with a step form of electrical input signal

Signal change in %

![Graph showing signal change in % over time in ms](image)

Flow load function at maximum valve opening (tolerance ± 10 %)

Flow in L/min

Valve pressure differential in MPa

![Graph showing flow load function](image)
Characteristic curves (P=10 MPa, v=36×10^{-6} m^2/s, t=40°C ± 5°C)

Transient function with a step form of electrical input signal

Signal change in %

Flow load function at maximum valve opening
(tolerance ± 10 %)

Valve pressure differential in MPa →
Characteristic curves (P=10 MPa, v=36×10^{-6} m^2/s, t=40°C ± 5°C)

Transient function with a step form of electrical input signal

Signal change in %

Flow load function at maximum valve opening
(tolerance ± 10 %)

Valve pressure differential in MPa
Unit dimensions: NS 10

1. Pilot control valve
2. Plug-in connector "B", colour black
3. Plug-in connector "A", colour grey
4. Space required to remove the plug-in connector
5. Cable
6. Plug-in connector (plastic version, separate order)
7. Pressure reducing valve
8. Nameplate
9. Main valve
10. Integrated control electronics
11. O-ring 12 x 2 (for ports A,B,P,T)
12. O-ring 10.82 x 1.78 (for ports X and Y)
13. Machined valve mounting surface, position of the ports

Valve fixing screws: 4-M6 x 45 (GB/T70.1), Mₐ = 14 Nm
1  Pilot control valve
2  Plug-in connector "B", colour black
3  Plug-in connector "A", colour grey
4  Space required to remove the plug-in connector
5  Cable
6  Plug-in connector (plastic version, separate order)
7  Pressure reducing valve
8  Nameplate
9  Main valve
10 Integrated control electronics
11 O-ring 12x2 (for ports A, B, P, T)
12 O-ring 22x2.5 (for ports X and Y)
13 Machined valve mounting surface, position of the ports

Valve fixing screws: 2 - M6x60 (GB/T70.1) $M_p = 14\, \text{Nm}$
4 - M10x60 (GB/T70.1) $M_p = 68\, \text{Nm}$
Unit dimensions: NS 25

1. Pilot control valve
2. Plug-in connector "B", colour black
3. Plug-in connector "A", colour grey
4. Space required to remove the plug-in connector
5. Cable
6. Plug-in connector (plastic version, separate order)
7. Pressure reducing valve
8. Nameplate
9. Main valve
10. Integrated control electronics
11. O-ring 19x3 (for ports A,B,P,T)
12. O-ring 27x3 (for ports X and Y)
13. Machined valve mounting surface, position of the ports

Valve fixing screws: 6 -M12X50(GB/T70.1) Mₘₘₜₐₓ=130Nm
Unit dimensions: NS 32

6 Plug-in connector
(plastic version, separate order)
7 Pressure reducing valve
8 Nameplate
9 Main valve
10 Integrated control electronics
11 O-ring 19x3 (for ports A, B, P, T)
12 O-ring 42x3 (for ports X and Y)
13 Machined valve mounting surface, position of the ports

Valve fixing screws: 6 - M20X80 (GB/T70.1) M₆ₐₙₜ=430Nm

Required surface finish of mating piece

Huade América
Unit dimensions: NS 35  

(Dimensions in mm)

1. Pilot control valve
2. Plug-in connector “B”, colour black
3. Plug-in connector “A”, colour grey
4. Space required to remove the plug-in connector
5. Cable
6. Plug-in connector (plastic version, separate order)
7. Pressure reducing valve
8. Name plate
9. Main valve
10. Integrated control electronics
11. O-ring 19 x 3 (for ports A, B, P, T)
12. O-ring 42 x 3 (for ports X and Y)
13. Machined valve mounting surface, position of the ports

Valve fixing screws: 6 - M20X100(GB/T70.1)  Mₜₐₜ=430N.m

Required surface finish of mating piece

Huade América