

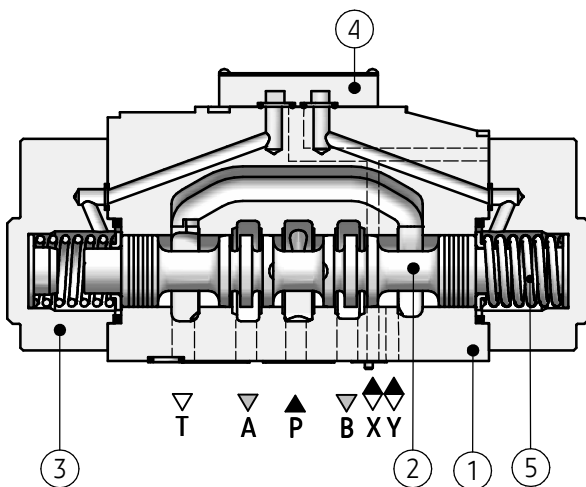
APPLICATION

Directional spool valve type **WH16...** is intended for change in direction of fluid flow in a hydraulic system and thus it allows to change direction of movement of a receiver - mostly piston rod of a cylinder or hydraulic motor as well to use functions: *on* and *off*. This directional spool valve is used for subplate mounting in any position in a hydraulic system.

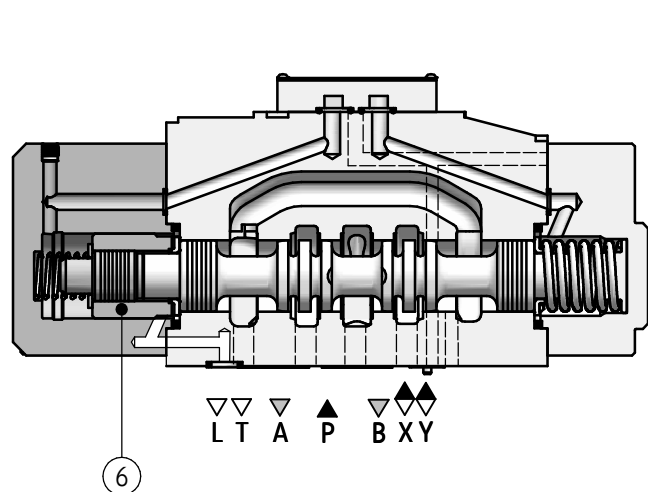


DESCRIPTION OF OPERATION

H-4WH16E 72



H-4WH16HE 72



Main bore and annular ports **P, T, A, B** are made in the housing (1) and connected to its subplate connection. Directional valve is switched by shifting the spool (2) into one end position. Various control functions are dependent on the spool (2) which affects the configuration of connections among ports **P, T, A, B** in the housing (1).

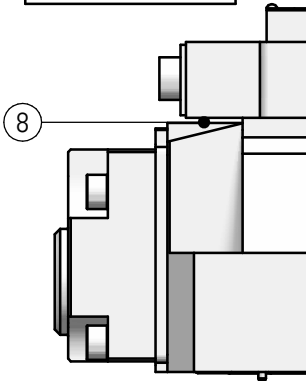
The spool (2) is shifted from its neutral position by affecting pressure of hydraulic fluid supplied to one chamber of caps (3). The chambers are connected to control ports by means of cap (4) – adequately one

chamber with port **X** and the other chamber – with port **Y**. The spool (2) is centered in neutral position by means of springs (5) – versions WH16.../... or hydraulically by means of fluid pressure affecting both spool surfaces (2) – versions WH16H.../... - the centering for 3-position spools is secured by the sleeve (6).

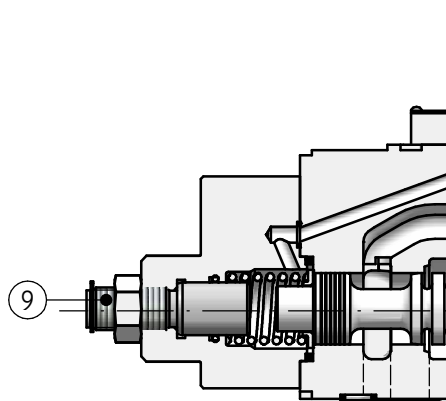
Sealing of the directional valve to a subplate is secured by sealing rings.

DESCRIPTION OF OPERATION

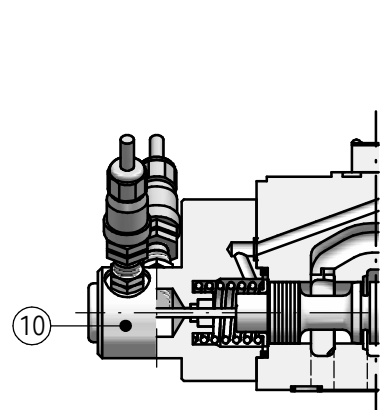
...WH16E 72/...S...



...WH16E 72/...11...



...WH16E 72/... 18...



Directional spool valves may be provided with the pilot choke adjustment (8), stroke limiter of the spool (9), end position monitor of the spool (10).

Accessories may be mounted depending version of directional spool valve like given on pages 3 to 5 and 8 to 13.

TECHNICAL DATA

Hydraulic fluid	
Hydraulic fluid	mineral oil
Nominal fluid viscosity	37 mm ² /s at temperature 55 °C
Viscosity range	2,8 up to 380 mm ² /s
Fluid temperature range (in a tank)	recommended 40 °C up to 55 °C
Ambient temperature range	max -20 °C up to +70 °C
Required filtration	up to 16 µm
Recommended filtration	up to 10 µm
Max operating pressure	
ports P, A, B:	
• version H-4 WH 16.../...	35 MPa
• version 4 WH 16.../...	28 MPa
port T	25 MPa
Max control pressure	25 MPa
Min control pressure	
• 3-position directional valve	0,8 MPa
• 2-position directional valve spring centered	1,0 MPa
• 2-position directional valve hydraulically centered	0,5 MPa
Fluid capacity	
<u>3-position directional valve spring centered</u>	5,75 cm ³
<u>3-position directional valve hydraulically centered</u>	
• from 0 (neutral) to operated position a	2,85 cm ³
• from 0 (neutral) to operated position b	5,75 cm ³
• from operated position a to 0 (neutral) position	2,9 cm ³
• from operated position b to 0 (neutral) position	2,3 cm ³
2-position directional spool valve	11,5 cm ³

TECHNICAL DATA

Inductive spool position sensors	
Type of sensors	two PNP inductive proximity sensors: normally closed - NC (contact breaker) + normally opened - NO (contact maker)
Supply voltage	10 - 30V DC
Max load current	200 mA
Connection type of sensor	sensor with M12x1 external thread, male connection
Connection type of conductor	plug with M12 x 1 internal thread, female plug configuration of connection according to PN - EN-61076 -2-101
External diameter of conductor	φ 2,5 - 6,5 mm (PG7)
Degree of protection	IP 67
Weight	7,5 kg

ACCESSORIES FOR STANDARD DIRECTIONAL VALVE

Pilot choke adjustment

versions: ...4WH16...72 S...
...4WH16...72/S2...

Directional spool valves type ...WH16... may be optionally provided with pilot choke adjustment (throttle check valve type Z2FS6... according to data sheet WK 450 232) which allows to adjust switching time of directional valve.

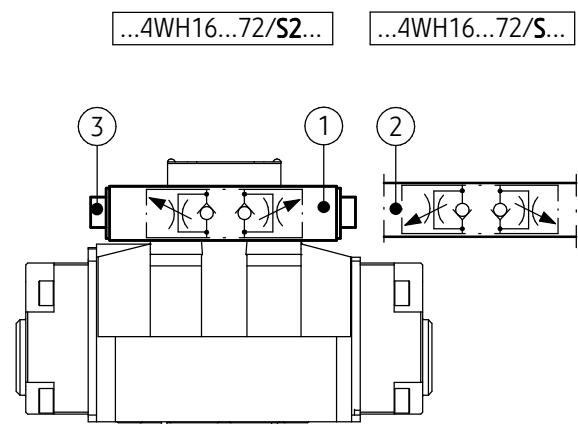
The change of adjustment method of switching time (flow throttling):

- on inlet - version ...WH16...72/S...
- on outlet - version ...WH16...72/S2...

is made while mounting by rotating the pilot choke adjustment (1) by 180 degrees around its longitudinal axis.

Rotation of the adjusting screw (3) to the right increases and to the left decreases switching time of the valve.

The pilot choke adjustment is fixed by means of bolts M5 x 40 - 10.9 - 4 pcs/kit in accordance with PN - EN ISO 4762 with tightening torque of Md = 5 Nm.



- 1 - Pilot choke adjustment with adjustment of switching time on outlet
- 2 - Assembly method of pilot choke adjustment with adjustment of switching time on inlet
- 3 - Adjusting screw

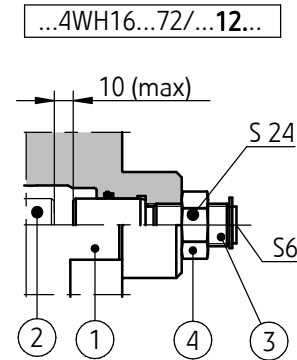
OPTIONAL ACCESSORIES FOR DIRECTIONAL VALVE

Stroke limiter

Stroke limiter of the spool may be mounted:

- stroke limiter at the **A** and **B** side
version ...4WH16...72/...10...
- stroke limiter at the **A** side
version ...4WH16...72/...11...
- stroke limiter at the **B** side
version ...4WH16...72/...12...

Adjustment of the stroke of the spool is by rotating the pin (3) and securing with locknut (4). Rotating the pin (3) to the right reduces the stroke of the spool. While adjusting the stroke the control chamber must be at zero pressure.



- 1 - Stroke limiter body (at the **B** side)
- 2 - Spool of main directional spool valve
- 3 - Pin
- 4 - Locknut

End position monitor

End position monitor may be mounted:

- at the **A** side
versions: ...4WH16.../...18... (contact breaker)
 ...4WH16.../...22... (contact maker)
- at the **B** side
versions: ...4WH16.../...19... (contact breaker)
 ...4WH16.../...23... (contact maker)

Directional valves type ...4WH16... may be equipped with spool end position monitor, optionally contact maker or contact breaker, mounted depending on the version, in main valve cover at the **A** or **B** side - overall dimensions on pages 10, 11.

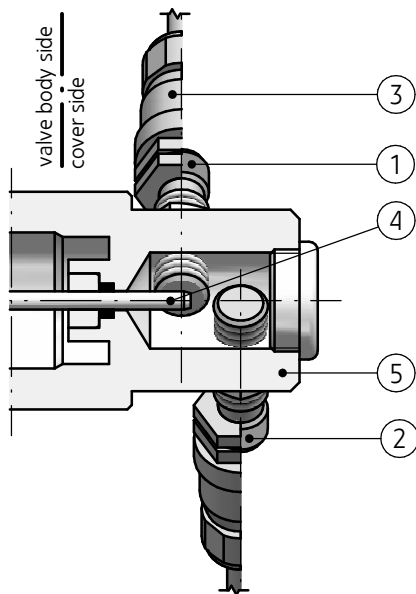
Detailed information concerning proximity sensors and plug-in connectors given on page 3.

sensor position	signal level					
	end position monitor with contact breakers (versions 4WH16.../...18...; ...19...)			end position monitor with contact makers (versions 4WH16.../...22...; ...23...)		
	spool position			spool position		
	valve body side	central	cover side	valve body side	central	cover side
sensor ① valve body side	0	1	1	1	0	0
sensor ② cover side	1	1	0	0	0	1

OPTIONAL ACCESSORIES FOR DIRECTIONAL VALVE

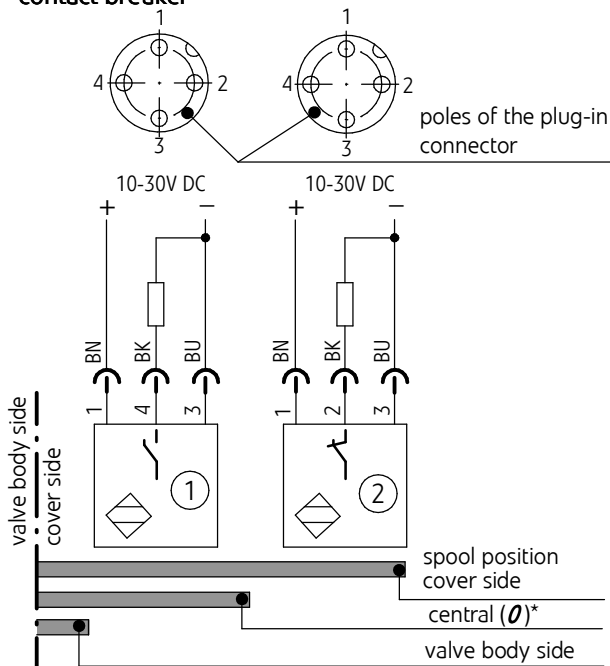
End position monitor

...4WH16...72/...19...



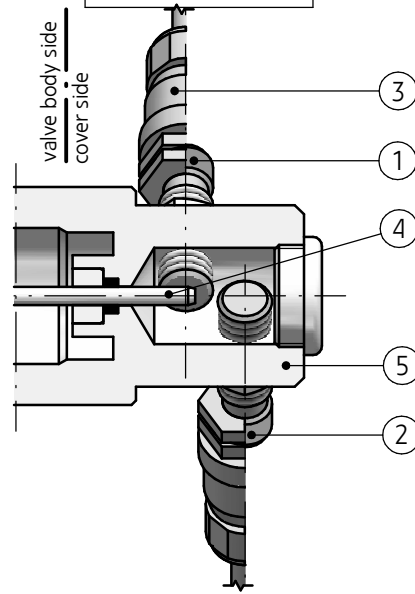
- 1 - Inductive sensor contact maker **PNP NO** according to page 4
- 2 - Inductive sensor contact breaker **PNP NC** according to page 4
- 3 - Plug-in cable connector (straight, female plug-in connectors - according to page 3, 2 pcs delivered with the valve
- 4 - Mandrel of the main spool
- 5 - Sensors cover

diagram of electrical connection of sensors set contact breaker



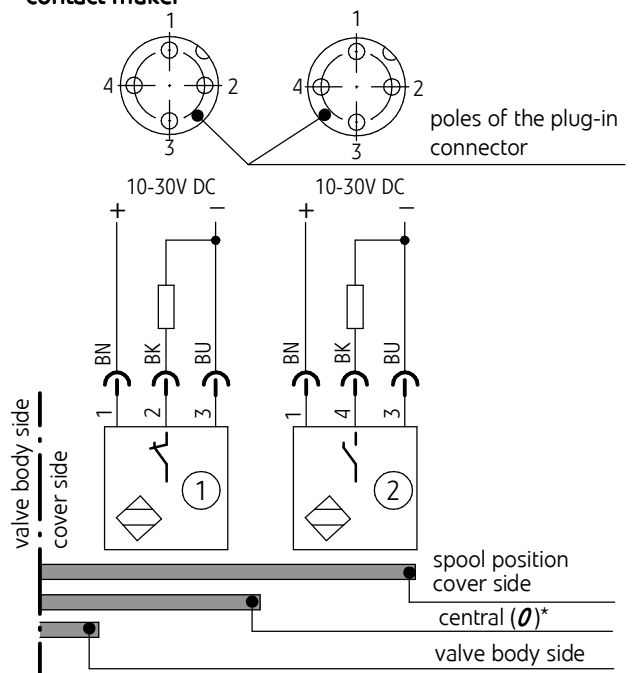
NOTE:
(*) - Only for 3-position directional valves

...4WEH16...72/...23...



- 1 - Inductive sensor contact breaker **PNP NC** according to page 4
- 2 - Inductive sensor contact maker **PNP NO** according to page 4
- 3 - Plug-in cable connector (straight, female plug-in connectors - according to page 3, 2 pcs delivered with the valve
- 4 - Mandrel of the main spool
- 5 - Sensors cover

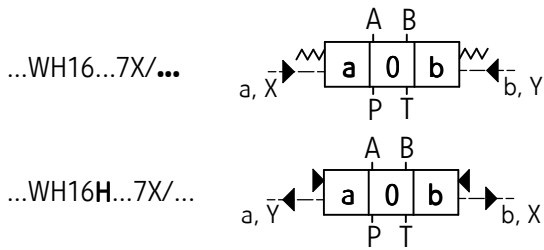
diagram of electrical connection of sensors set contact maker



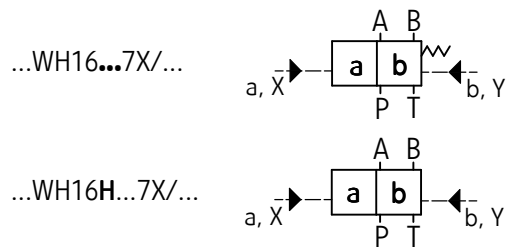
NOTE:
(*) - Only for 3-position directional valves

DIAGRAMS

Graphic symbols of 3- position directional spool valves

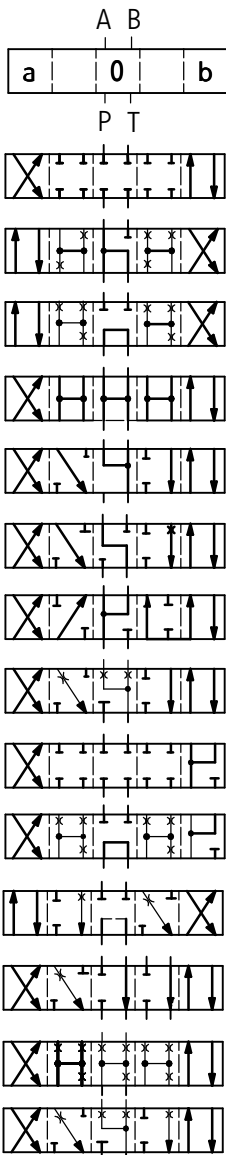


Graphic symbols of 2- position directional spool valves

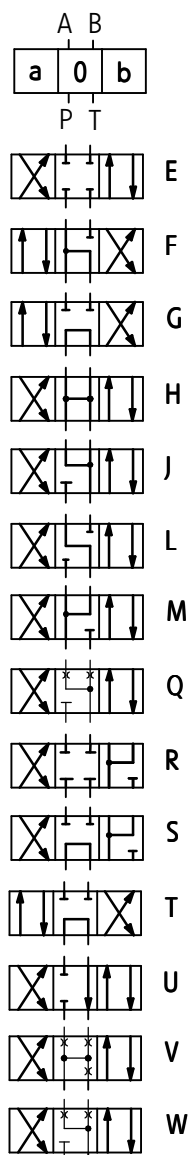


Graphic symbols for spools

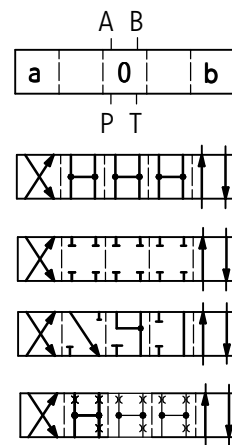
working and indirect positions



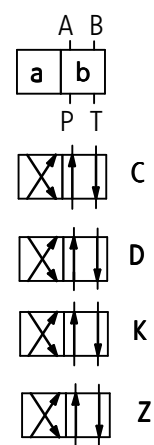
working positions



working and indirect positions

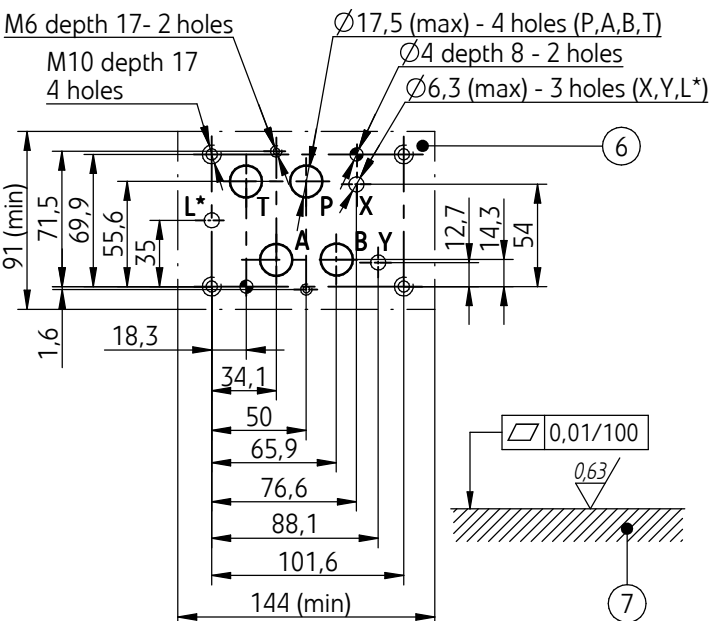
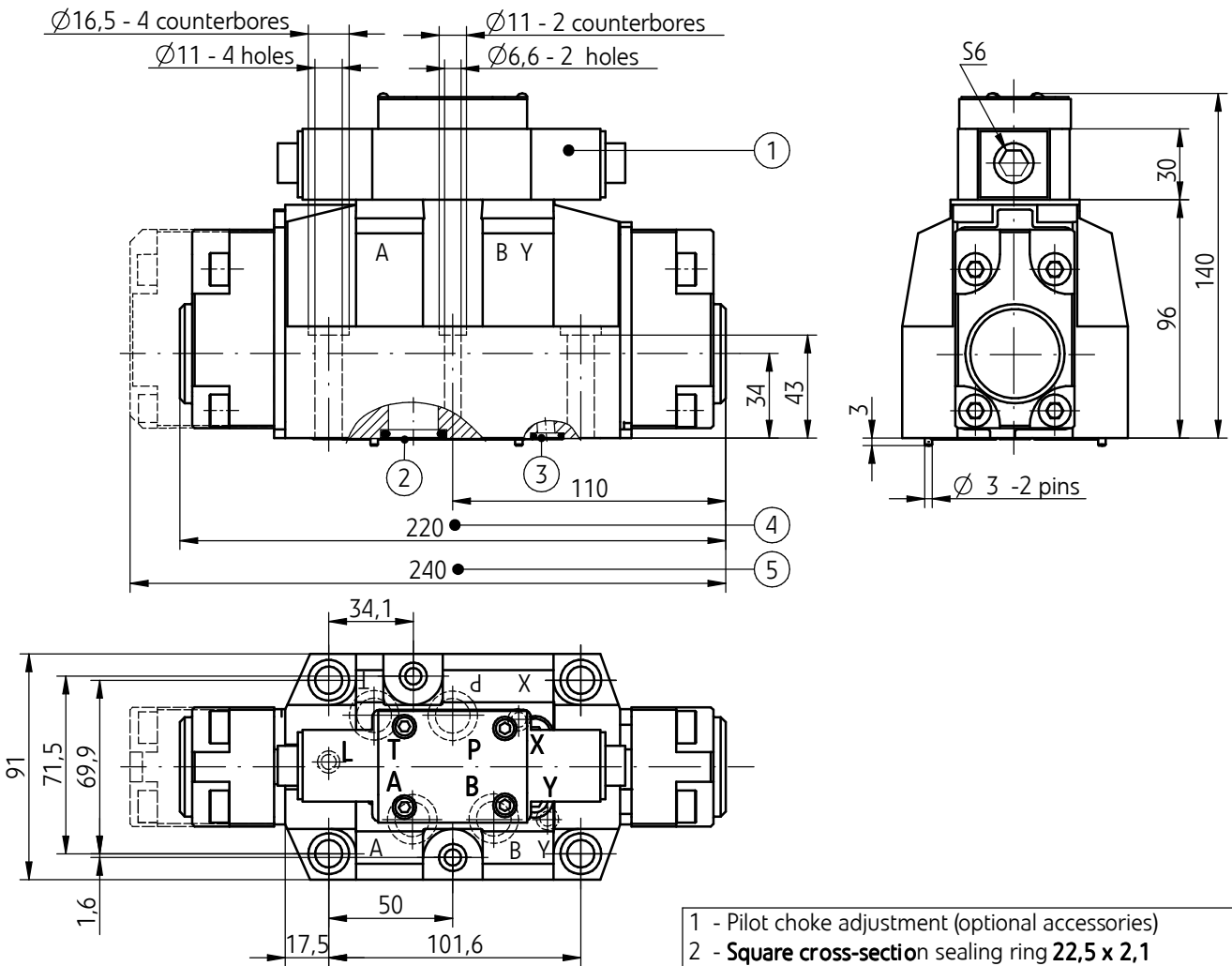


working positions



OVERALL AND CONNECTION DIMENSIONS

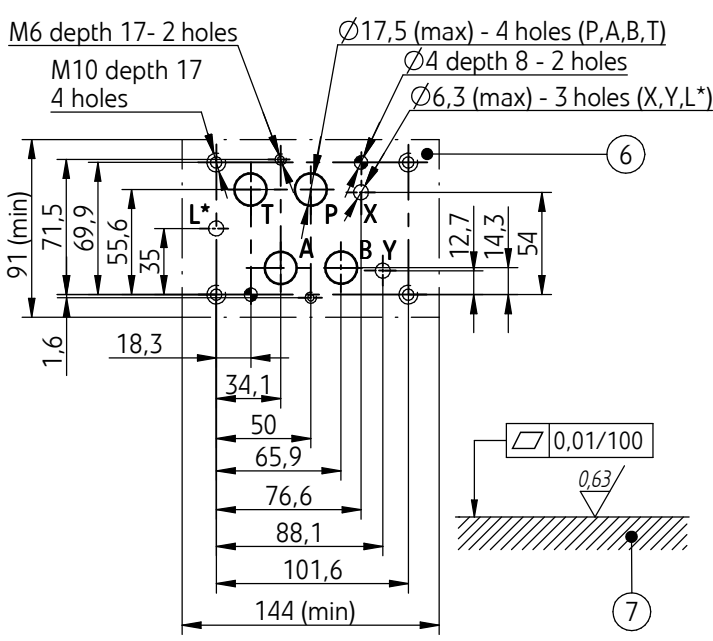
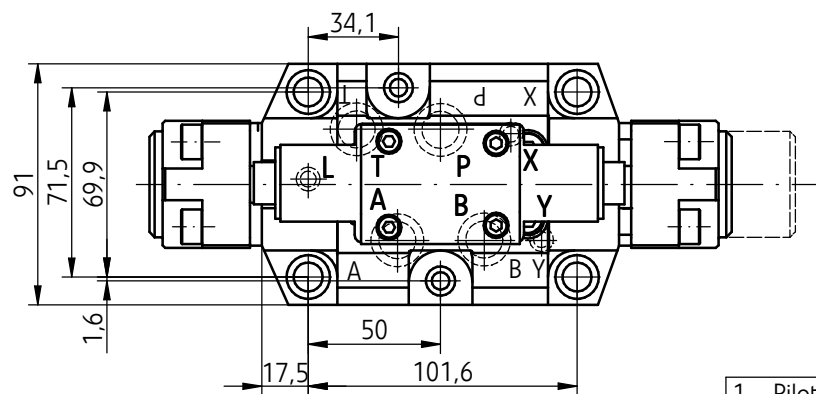
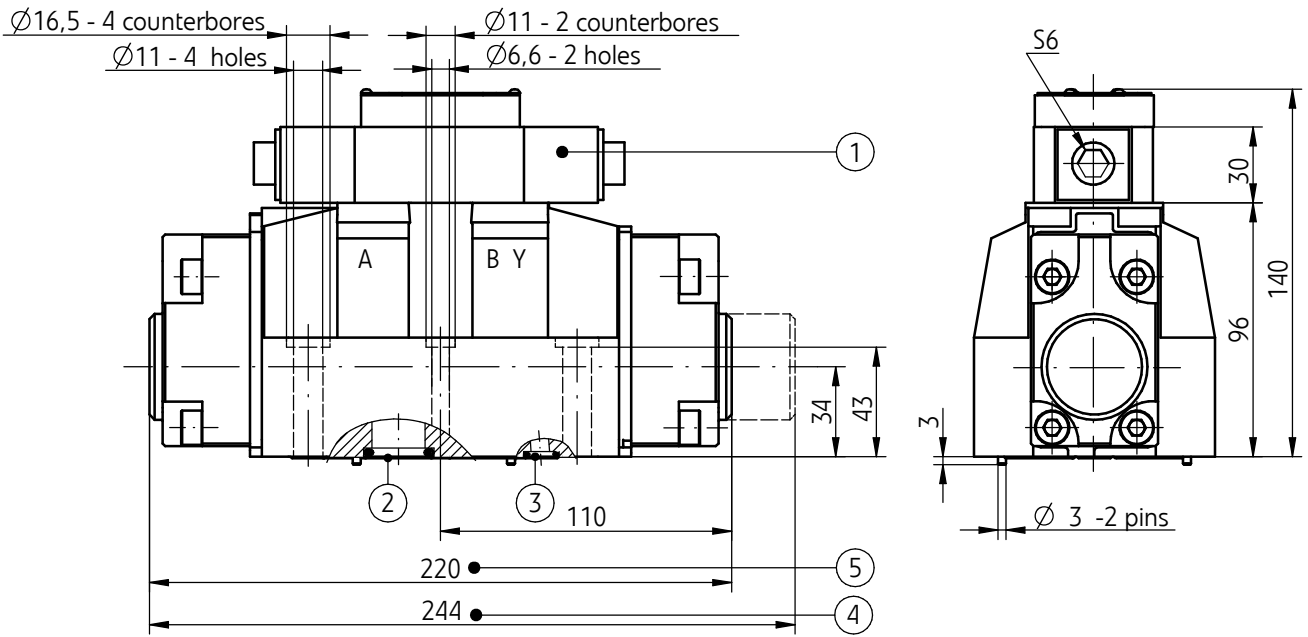
standard 3-position versions...4WH16...7X/S...



- 1 - Pilot choke adjustment (optional accessories)
 - 2 - **Square cross-section** sealing ring 22,5 x 2,1
4 pcs/kit (P, T, A, B)
 - 3 - **Square cross-section** sealing ring 10 x 2
3 pcs/kit (X, Y, L)
 - 4 - Overall dimension of **3-position directional spool valve spring centered** (spool diagrams: E, F, G, H, J, L, M, P, Q, R, T, U, V, W - according to page 6)
 - 5 - Overall dimension of **3-position directional spool hydraulically centered** spool diagrams: E, F, G, H, J, L, M, P, Q, R, T, U, V, W - according to page 6)
 - 6 - Porting pattern - configuration of surface holes in subplate in accordance with the following standards:
 - CETOP RP 121H - identified by CETOP 4.2-4-07-320 (nominal size CETOP 07)
 - ISO 4401 - identified by ISO 4401-07-06-0-94 mounting bolts in accordance with PN -EN ISO 4762
- M10 x 60 - 10.9** - 4 pcs/kit
tightening torque **Md = 62 Nm**
- M6 x 60 - 10.9** - 2 pcs/kit
tightening torque **Md = 12,5 Nm**
- NOTE:**
(*) - only for 3-position versions with θ (neutral) position of the spool hydraulically centered
- 7 - Subplate surface required

OVERALL AND CONNECTION DIMENSIONS

standard 2-position versions ...4WH16...7X/S...



- 1 - Pilot choke adjustment (optional accessories)
 - 2 - **Square cross-section** sealing ring 22,5 x 2,1
4 pcs/kit (P, T, A, B)
 - 3 - **Square cross-section** sealing ring 10 x 2
3 pcs/kit (X, Y, L)
 - 4 - Overall dimension of **2-position directional spool valve spring centered** (spool diagrams: C, D, K, Z, according to page 6)
 - 5 - Overall dimension of **2-position directional spool hydraulically centered** spool diagrams C, D, K, Z, according to page 6)
 - 6 - Porting pattern - configuration of surface holes in subplate in accordance with the following standards:
 - CETOP RP 121H - identified by CETOP 4.2-4-07-320 (nominal size CETOP 07)
 - ISO 4401 - identified by ISO 4401-07-06-0-94 mounting bolts in accordance with PN -EN ISO 4762
- M10 x 60 - 10.9** - 4 pcs/kit
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- M6 x 60 - 10.9** - 2 pcs/kit
tightening torque **Md = 12,5 Nm**
- NOTE:**
(*) - only for 3-position versions with θ (neutral) position of the spool hydraulically centered
- 7 - Subplate surface required

OVERALL DIMENSIONS OF DIRECTIONAL VALVE WITH OPTIONAL ACCESSORIES

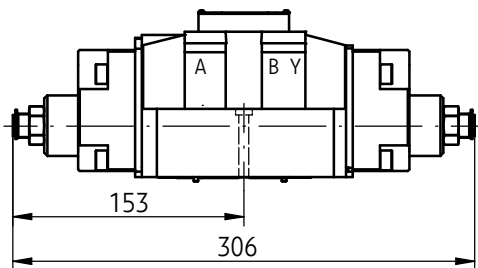
Versions with stroke limiter

3-position versions with the spool spring centered

stroke limiter may be mounted:

- at the **A** side - version ...4WH16...72/...11...
- at the **B** side - version ...4WH16...72/...12...
- at the **A** and **B** side - version ...4WH16...72/...10...

...4WH16...72/...10...

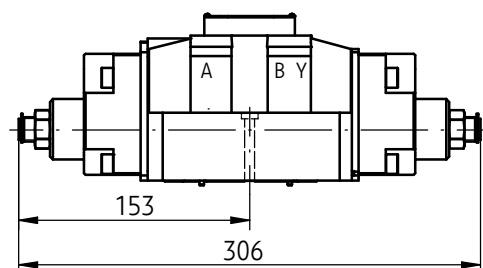


2-position versions with hydraulically positioned spool

stroke limiter may be mounted:

- at the **A** side - version ...4WH16H...72/...11...
- at the **B** side - version ...4WH16H...72/...12...
- at the **A** i **B** side - version ...4WH16H...72/...10...

...4WH16H...72/...10...

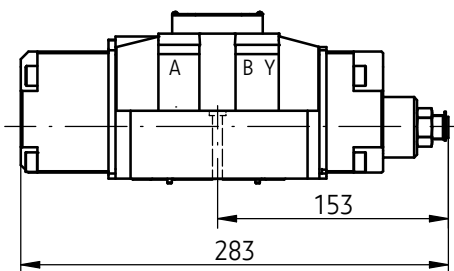


3-position versions with hydraulically centered spool

stroke limiter may be mounted:

- at the **B** side - version ...4WH16H...72/...12...

...4WH16H...72/...12...

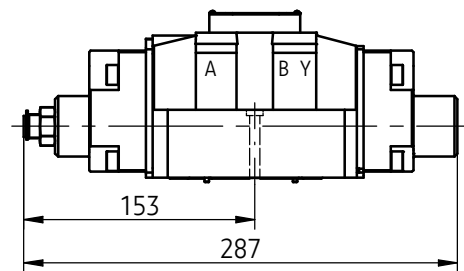


2-position versions with spring positioned spool

stroke limiter may be mounted:

- at the **A** side - version ...4WH16...72/...11...

...4WH16...72/...11...



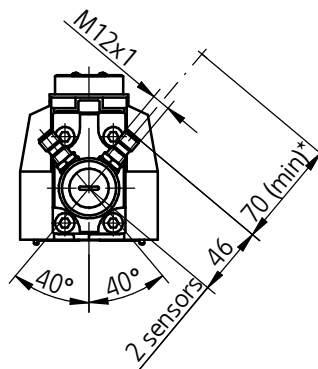
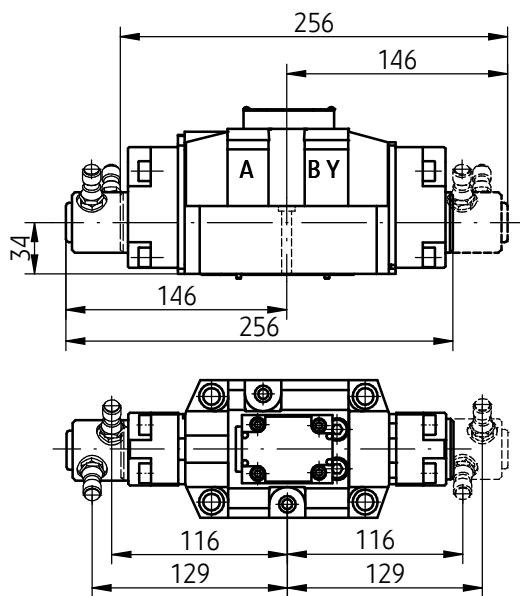
OVERALL DIMENSIONS OF THE VALVE WITH OPTIONAL ACCESSORIES

Versions with end position monitor

3-position versions with spring centered spool

end position monitor may be mounted:

- at the **A** side
versions: ...4WH16...72/...18...(contact breaker);...22...(contact maker)
- at the **B** side
versions: ...4WH16...72/...19...(contact breaker);...23...(contact maker)



- | | |
|------------------------|------------------------|
| ...4WH16...72/...18... | ...4WH16...72/...19... |
| ...4WH16...72/...22... | ...4WH16...72/...23... |

NOTE:

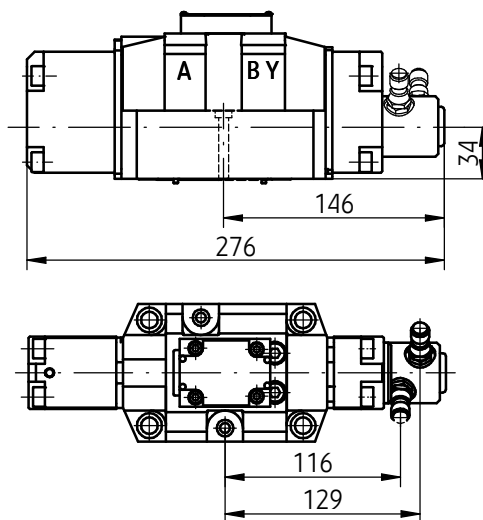
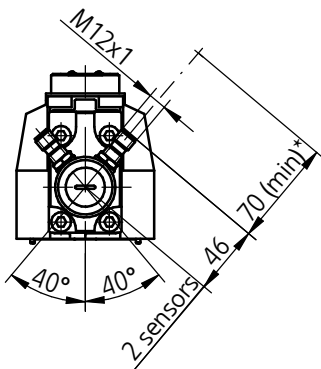
(*) - Distance for mounting plug-in connector and cable of sensor (plug-in connectors according to page 3 - 2 pcs not shown on drawing, delivered with the valve)

3-position versions with hydraulically centered spool

end position monitor may be mounted:

- at the **B** side - versions: ...4WH16H...72/...19... (contact breaker)
...4WH16H...72/...23... (contact maker)

- | |
|-------------------------|
| ...4WH16H...72/...19... |
| ...4WH16H...72/...23... |



NOTE:

(*) - Distance for mounting plug-in connector and cable of sensor (plug-in connectors according to page 3 - 2 pcs not shown on drawing, delivered with the valve)

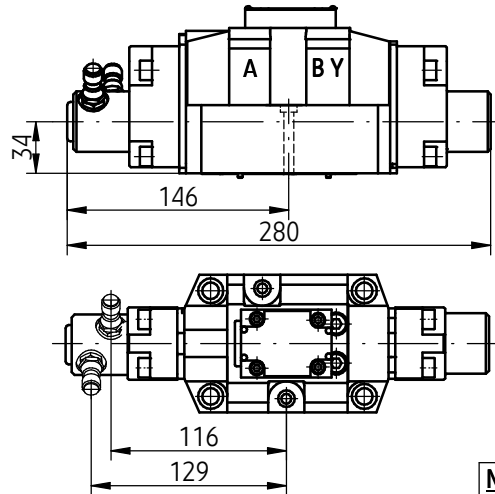
OVERALL DIMENSIONS OF THE VALVE WITH OPTIONAL ACCESSORIES

Versions with end position monitor

2-position versions with spring positioned spool

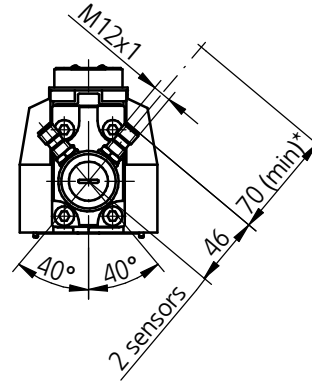
end position monitor may be mounted:

- at the **A** side
versions: ...4WH16...72/...18... (contact breaker); ...22... (contact maker)



...4WH16...72/...18...

...4WH16...72/...22...



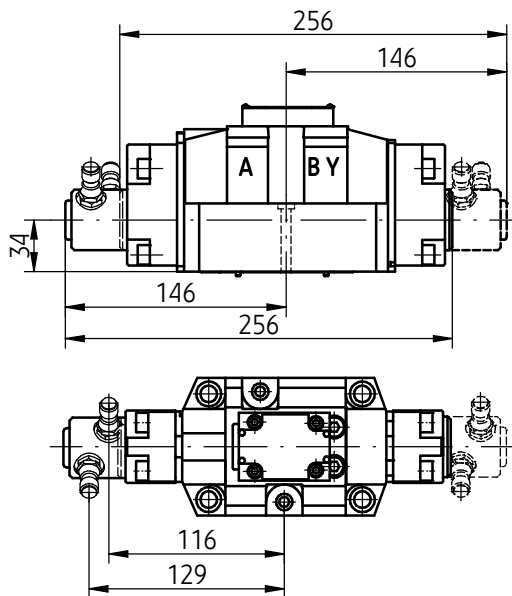
NOTE:

(*) - Distance for mounting plug-in connector and cable of sensor (plug-in connectors according to page 3 - 2 pcs not shown on drawing, delivered with the valve)

2-position versions with hydraulically positioned spool

end position monitor may be mounted:

- at the **A** side
versions: ...4WH16H.../...18... (contact breaker) ;...22... (contact maker)
- at the **B** side
versions: ...4WH16H.../...19... (contact breaker) ;...23... (contact maker)

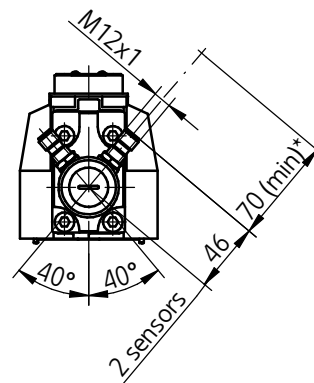


...4WH16H...72/...18...

...4WH16H...72/...19...

...4WH16H...72/...22...

...4WH16H...72/...23...



NOTE:

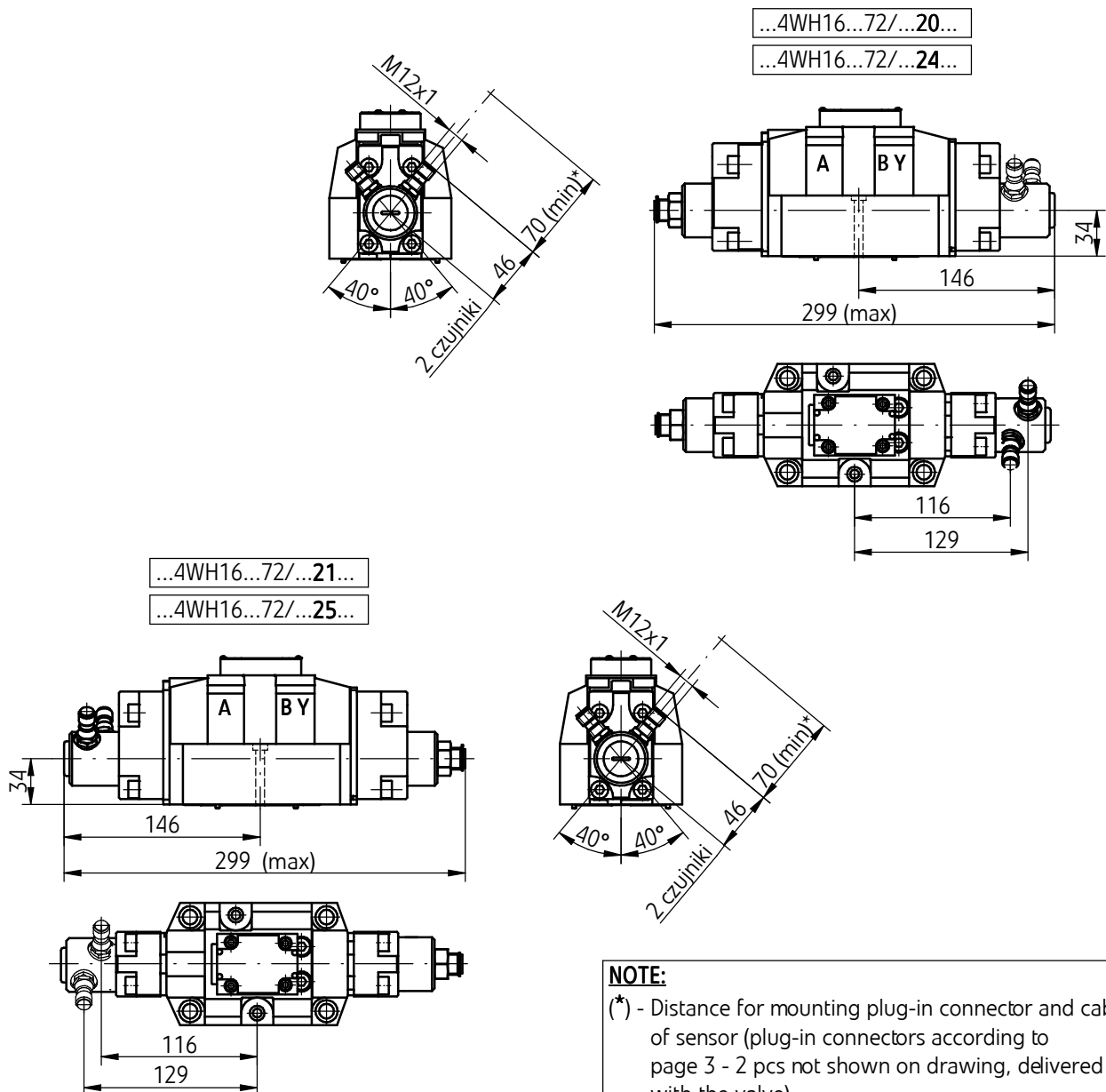
(*) - Distance for mounting plug-in connector and cable of sensor (plug-in connectors according to page 3 - 2 pcs not shown on drawing, delivered with the valve)

OVERALL DIMENSIONS OF THE VALVE WITH OPTIONAL ACCESSORIES

Versions with stroke limiter and end position monitor

3-position versions with spring centered spool
stroke limiter and end position monitor may be mounted:

- stroke limiter at the **A** side and end position monitor **contact breaker** at the **B** side - version ...4WH16...72/...20...
- stroke limiter at the **A** side and end position monitor **contact maker** at the **B** side - version ...4WH16...72/...24...
- stroke limiter at the **B** side and end position monitor **contact breaker** at the **A** side - version ...4WH16...72/...21...
- stroke limiter at the **B** side and end position monitor **contact maker** at the **A** side - version ...4WH16...72/...25...



NOTE:

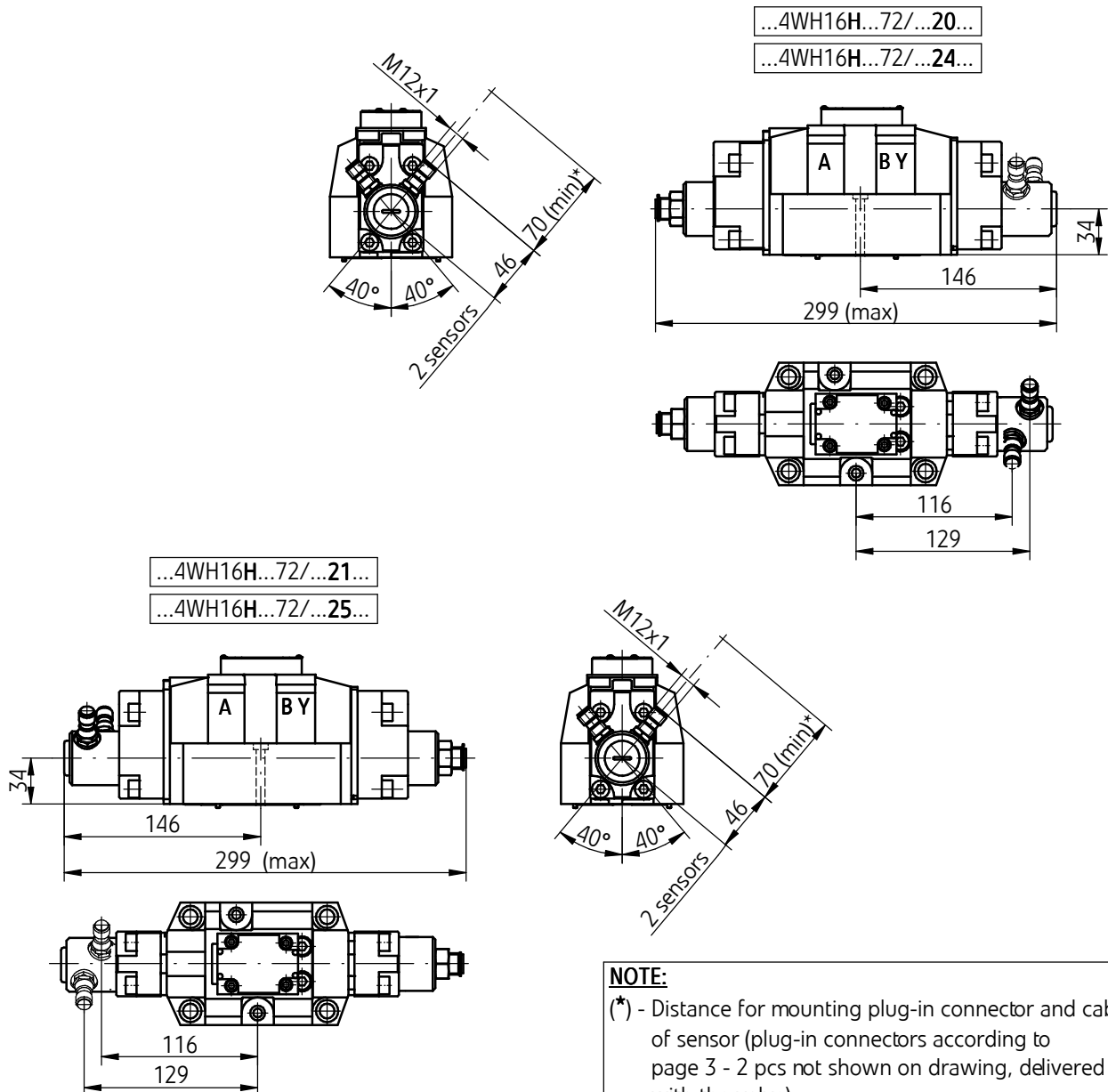
(*) - Distance for mounting plug-in connector and cable of sensor (plug-in connectors according to page 3 - 2 pcs not shown on drawing, delivered with the valve)

OVERALL DIMENSIONS OF THE VALVE WITH OPTIONAL ACCESSORIES

Versions with stroke limiter and end position monitor

2-position versions with hydraulically positioned spool
stroke limiter and end position monitor may be mounted:

- stroke limiter at the **A** side and end position monitor **contact breaker** at the **B** side - version ...4WH16H...72/...20...
- stroke limiter at the **A** side and end position monitor **contact maker** at the **B** side - version ...4WH16H...72/...24...
- stroke limiter at the **B** side and end position monitor **contact breaker** at the **A** side - version ...4WH16H...72/...21...
- stroke limiter at the **B** side and end position monitor **contact maker** at the **A** side - version ...4WH16H...72/...25...



NOTE:

(*) - Distance for mounting plug-in connector and cable of sensor (plug-in connectors according to page 3 - 2 pcs not shown on drawing, delivered with the valve)

PERFORMANCE CURVES

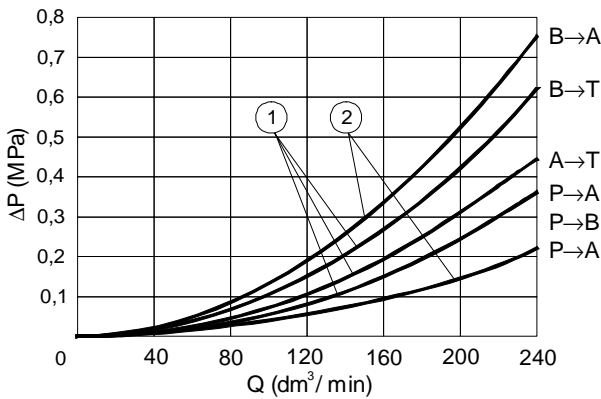
measured at viscosity $\nu = 41 \text{ mm}^2/\text{s}$ and temperature $t = 50^\circ\text{C}$

Flow resistance curves

characteristic curves $\Delta p(Q)$ for directional valves type ...WH16... with spools **E** and **R**

1 - spools: **E, R**

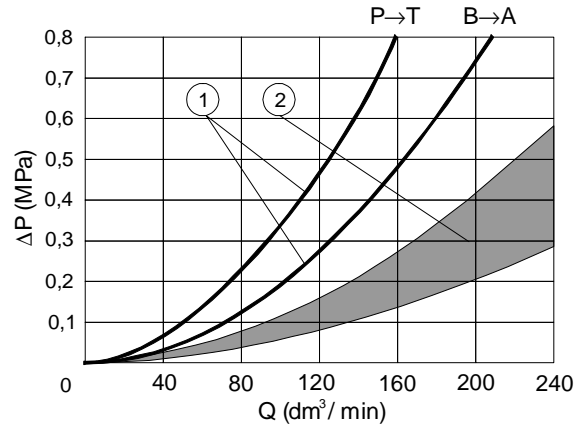
2 - spool **R** - flow direction **P** → **A** and **B** → **A**



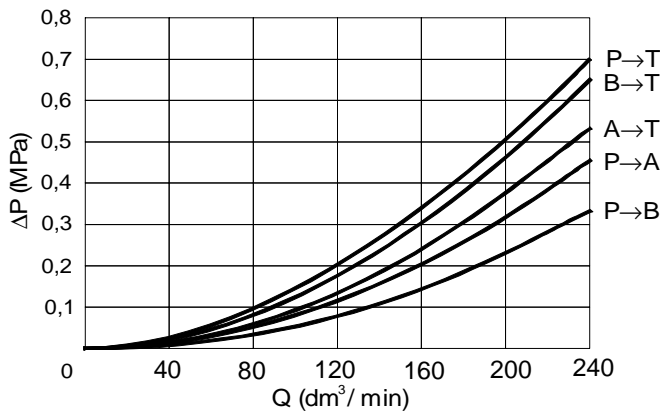
characteristic curves $\Delta p(Q)$ for directional valves type ...WH16... with spools: **F, H, J, L, M, Q, S, U, V, W, C, D, K, Z**

1 - spool **S**

2 - spools: **F, H, J, L, M, Q, U, V, W, C, D, K, Z**



flow curves $\Delta p(Q)$ for directional valves type ...WH16... with spools **G** and **T**



Operating limits

spool type (diagrams see page 6)	pressure p [MPa]				
	7	14	21	28	35
	flow rate Q [dm ³ /min]				
E, J, L, M, Q, R, U, V, W, C, D, K, Z	240	240	205	180	170
F	200	145	115	100	90
G, H, S, T	220	160	130	110	100

NOTES:

Above operating limits are related to standard application of 4-way directional spool valve i.e. using two flow directions: **P** to **A** and at the same time **B** to **T**. In case 4-way directional spool valve with only one flow direction - **P** to **A** (**B** plugged) or **A** to **T** (**B** plugged) is applied then actual operating limit rates are significantly lower.

HOW TO ORDER

H	4	WH	16			/	+		*
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Version

normal pressure
up to 28 MPa = no designation
high pressure
up to 35 MPa = **H**

Number of service ports

4-way = **4**

Nominal size (NS)

NS16 = **16**

Centering/spool positioning

spring centering = no designation
hydraulic off-set = H

Spool type

spool diagrams - according to **page 6**

Series number

(70 - 79) - installation and connection dimensions unchanged = 7X
series 72 = **72**

Switching time adjustment

without switching time adjustment = no designation
switching time adjustment as meter-in control = S
switching time adjustment as meter-out control = S2

Accessories (available options acc. to pages 3 to 5 and 9 to 13)

without accessories = no designation
stroke limiter at the **A** and **B** side = 10
stroke limiter at the **A** side = 11
stroke limiter at the **B** side = 12
end position monitor contact breaker at the **A** side = 18
end position monitor contact breaker at the **B** side = 19
stroke limiter at the **A** side and end position monitor contact breaker at the **B** side = 20
stroke limiter at the **B** and end position monitor contact breaker at the **A** side = 21
end position monitor contact maker at the **A** side = 22
end position monitor contact maker at the **B** side = 23
stroke limiter at the **A** side and end position monitor contact maker at the **B** side = 24
stroke limiter at the **B** side and end position monitor contact maker at the **A** side = 25

Sealing

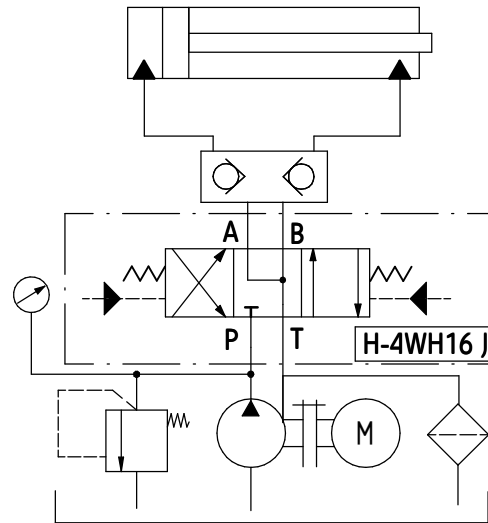
NBR (for fluids on mineral oil base) = no designation
FPM (for fluids on phosphate ester base) = V

Further requirements in clear text (to be agreed with the manufacturer)

NOTES:

The directional spool valve should be ordered according to the above coding.
The symbols in bold indicate the preferred versions, available in short delivery time.
Coding example: H- 4 WH16 E 72/S2

EXAMPLE OF APPLICATION IN HYDRAULIC SYSTEM



SUBPLATES AND FIXING SCREWS

Subplates must be ordered according to Data Sheet WK 450 788. Subplate types:

G174/01 - threaded connections	P, T, A, B - G 1
	X, Y, L - G1/4
G174/02 - threaded connections	P, T, A, B - M33 x 2
	X, Y, L - M14 x 1,5
G172/01 - threaded connections	P, T, A, B - G3/4
	X, Y, L - G1/4
G172/02 - threaded connections	P, T, A, B - M27 x 2
	X, Y, L - M14 x 1,5

NOTE:

Subplate symbol in bold are preferred versions in short delivery time.

Fixing screws for mounting directional spool valve in accordance with PN - EN ISO 4762:

M10 x 60 - 10,9 - pcs 4/kit

M6 x 60 - 10,9 - pcs 2/kit

must be ordered separately.

Tightening torques for screws:

M10 x 60 - Md = 62 Nm; M6 x 60 - Md = 12,5 Nm

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