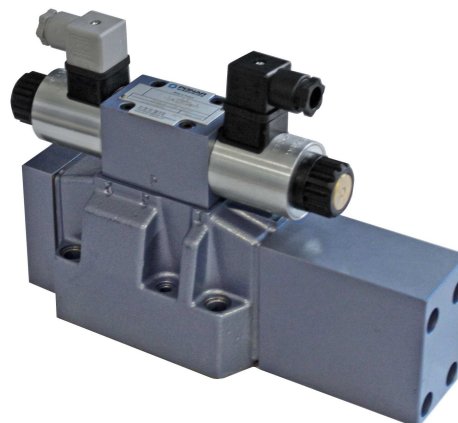


DATA SHEET - OPERATION MANUAL

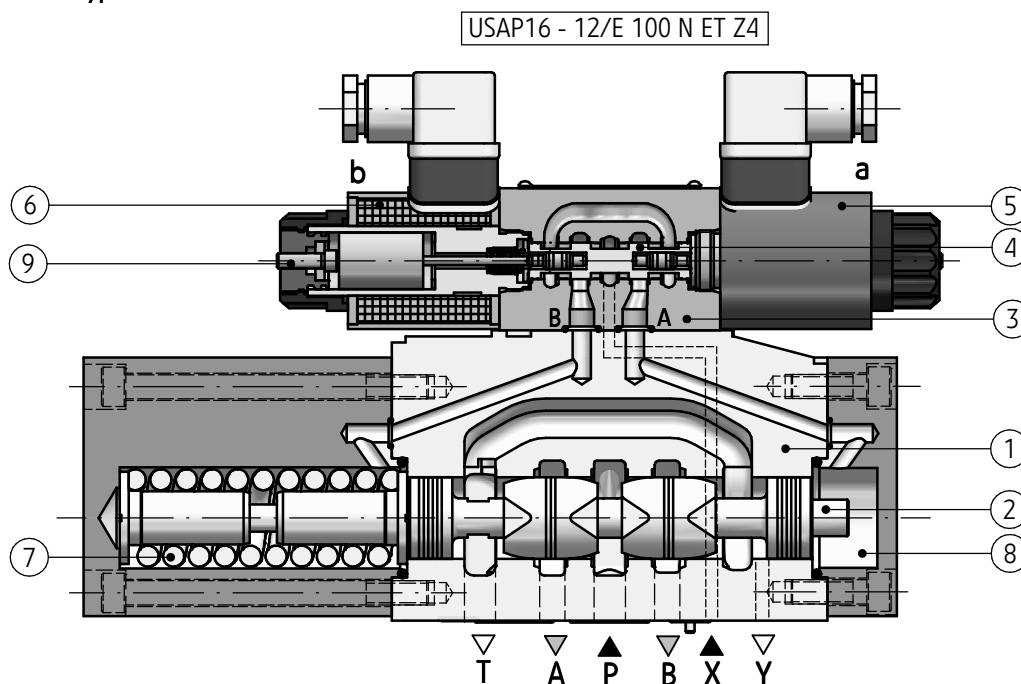
APPLICATION

4-way proportional directional control valve type **USAP16**... operated by pilot valve type **3WZCDE6**..., with proportional solenoids, is intended for the control of direction and value of flow rate in the hydraulic system. 3-way pressure reducing valve, electrically operated, proportional type **3WZCDE6**... is used for reducing of the pressure, continuously, as a function of a current controlling the coil of solenoid. The valve enables the control of pressure in **A** and **B** ports, independently from the supply stream value (port **P**), port **T** is connected with the tank.



DESCRIPTION OF OPERATION

proportional directional control valve,
pilot operated type USAP16...

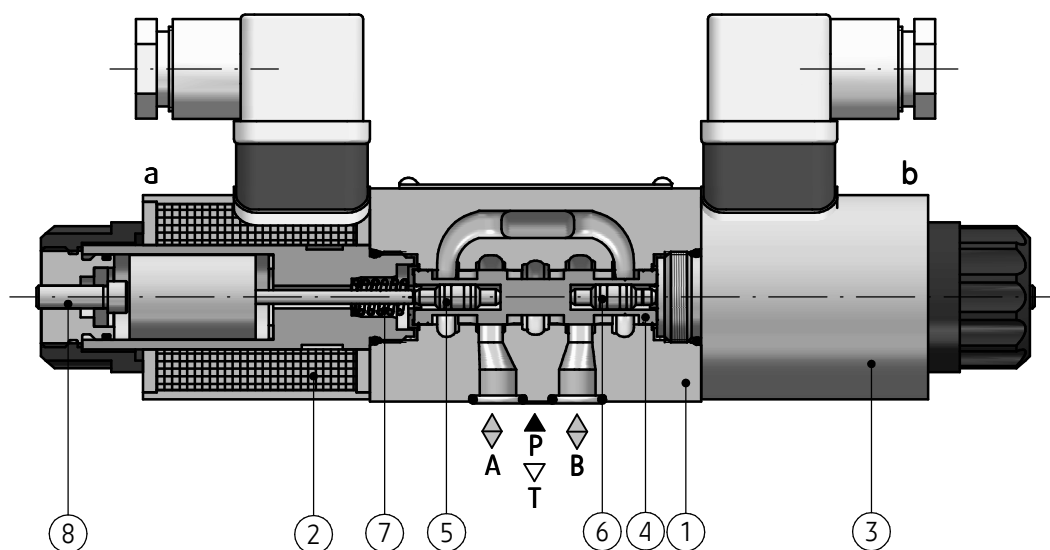


Main elements of proportional directional control valve type **USAP16**... are: main valve (1) with the main spool (2) and centring spring (7), pilot valve (3) with pilot spool (4) and proportional solenoids (5) and (6). When the solenoids (5) and (6) are not overload yet, the centring spring (7) ensures the middle position of main spool (2). By means of pilot valve (3) the main spool (2) is operated. The main spool (2) proportionally moves until the overload of solenoids (5) and (6). For example the overload of the solenoid (6) on the **b** side causes the pilot spool (4) moves right, the control oil flows by the pilot valve (3) to the pressure chamber (8) and tilts up the main spool (2)

proportionally to the electric input signal. The connection from **P** to **A** and from **B** to **T** takes place through tapered cross sections with progressive flow characteristic. Feeding the control oil to the pilot valve (3) takes place internally by connection **P** or externally by connection **X**. The disconnection of solenoid (6), causes the move of the pilot spool (4) and the main spool (2) returns to the middle position. The buttons of manual override (9) allow the move of the pilot spool (4) in case solenoids (5) and (6) power failure. The list of dedicated electronic controllers for the operation of proportional solenoids (5) and (6) can be found in the table on page no.3.

DESCRIPTION OF OPERATION

pilot valve type 3WZCDE6...



Proportional pressure reducing valve type 3WZCDE6... is the 3-way direct operated valve. The main elements of the valve in the **3-position** version are: housing (1), proportional solenoids (2) and (3), spool (4) with measuring pistons (5) and (6), and centring springs (7). A valve in a not activated position (zero power of the solenoid coil) the spool (4) is kept in central position by centring springs (7). Ports **A** and **B** are connected with the tank through **T** port, **P** port is shut off. In this position the pressure reduced in port **A** and **B** has a zero value. After the pilot current is turned on, for example solenoid (2), the move of measuring piston (5) follows, including the spool towards the solenoid (3). As a result the flows between ports **P** to **B** and **A** to **T** open. Simultaneously, pressure created in port **B**, by the surface of measuring

piston (6) acts on the spool (4) in the solenoid (2) power opposite direction. If the pressure created in port **B** exceeds the value of the current piloting the solenoid (2) the spool moves (4) and the flow from port **B** to **T** opens till the balanced is reached again, equivalent to set value of the current piloting the solenoid (2). As a result, for each value of solenoid coil current (3), the balance state is created by other power value, which causes that the value of reduced pressure in port **B** is proportional to the value of pilot current. In case of power failure the move of the spool (4) can be performed manually by means of the buttons (8). In **2-position** versions (with 1 solenoid on **a** or **b** side) the valve works in a similar way, whereas the pressure is reduced only in one of **A** or **B** ports.

TECHNICAL DATA

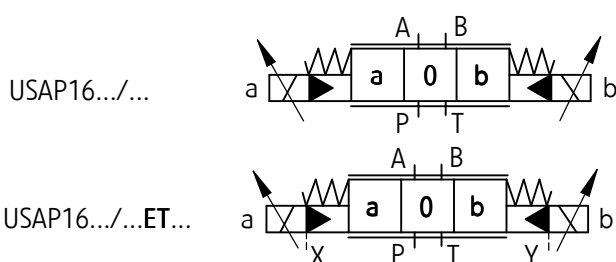
Hydraulic fluid	mineral oil		
Required fluid cleanliness class	ISO 4406 class 20/18/15		
Nominal fluid viscosity	37 mm ² /s at temperature 55 °C		
Viscosity range	2,8 up to 380 mm ² /s		
Fluid temperature range (in a tank)	recommended	40 °C up to 55 °C	
	max	-20 °C up to +70 °C	
Ambient temperature range	- 20 °C up to +50 °C		
Maximum operating pressure	ports P, A, B	versions: USAP16...; USAP16...T... (with external pilot oil supply) versions: USAP16...ED...; USAP16...ETD... (with internal pilot oil supply and pressure reducing valve)	35 MPa
		versions: USAP16...E...; USAP16...ET... (with internal pilot oil supply, without pressure reducing valve)	21 MPa
	port T	versions: USAP16...T...; USAP16...ET... (with internal pilot oil drain)	1 MPa
		versions: USAP16...; USAP16...E... (with external pilot oil drain)	25 MPa
Pilot pressure in X port	min	3 MPa	
	max	21 MPa	
Max flow rate	460 dm ³ /min		
Fluid volume per 1 switch by step control signal 0 → 100%	4,6 cm ³		
Hysteresis (for PWM 150Hz)	< 6% Q _{max}		
Work repeatability	< ± 3% Q _{max}		
Work position	optional		
Duty cycle	100 %		
Degree of protection	IP 65		
Weight	versions with 1 solenoid - 11,1 kg		
	versions with 2 solenoids - 11,7 kg		
Max current of solenoid coil	1,5 A		0,8 A
Resistance of cold solenoid coil (20°C)	5,4 Ω		19,5 Ω
Electronic regulator	30RE20 according to data sheet WK 495 773 30RE20D according to data sheet WK 420 830		—
	30RC20D according to data sheet WK 430 340 (when powered by a stabilized voltage 24V DC set the maximum current value I _{max}) MAP2 according to data sheet on PONAR WADOWICE website electronic joystick (when powered by a stabilized voltage 24V DC set the maximum current value I _{max})		

INSTALLATION AND OPERATION REQUIREMENTS

1. Only fully functional and operational valve, properly connected to electrical installation must be used.
Connecting or disconnecting the valve to an electrical installation must only be carried out by qualified personnel.
2. Solenoid plug shall precisely adhere to socket and shall be secured with thread bolt screwed in securely in a place. It is forbidden to operate the valve if the tightness and suitable clamp of cable in the plug gland are not ensured.
3. During the period of operation must be kept fluid viscosity acc. to requirements defined in this Data Sheet - Operation Manual
4. In order to ensure failure free and safe operation the following must be checked:
 - condition of the electrical connection
 - proper working of the valve
 - cleanliness of the hydraulic fluid
5. Due to heating of solenoid coils to high temp., the valve shall be placed in such way to eliminate the risk of accidental contact with solenoid during operation or to apply suitable covers acc. to European standards: PN - EN ISO 13732 - 1 and PN - EN 4413
6. In order to ensure tightness of the directional valve block, one should take care of dimension of sealing rings, tightening torques and valve operation parameters given in this Data Sheet - Operation Manual
7. Before exploitation of the valve the hydraulic system shall be vented.
8. The value of current I_{max} must not be exceeded during exploitation – it can cause solenoid failure.
9. A person that operates the valve must be thoroughly familiar with this Data Sheet - Operation Manual.

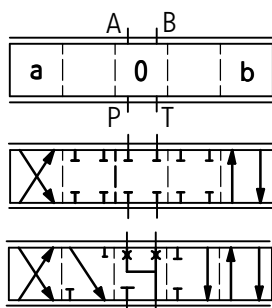
DIAGRAMS

diagrams of 3-position directional valves

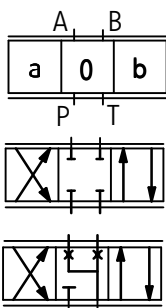


diagrams of spools

working and indirect positions



working positions



E, E1, E2

W, W1, W2

NOTES:

For spools **E1** i **W1** the flows are:

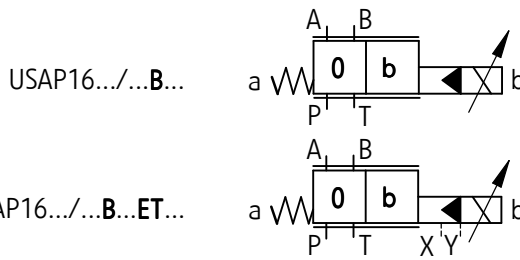
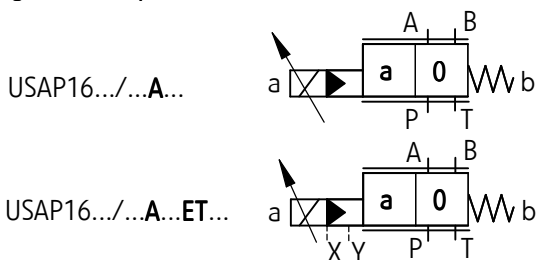
P → **A**: Q max **B** → **T**: 0,5 Q max
P → **B**: 0,5 Q max **A** → **T**: Q max

For spools **E2** i **W2** the flows are:

P → **A**: 0,5 Q max **B** → **T**: Q max
P → **B**: Q max **A** → **T**: 0,5 Q max

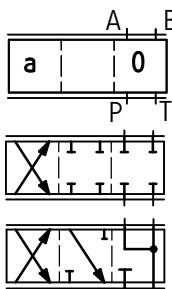
DIAGRAMS

diagrams of 2-position directional valves

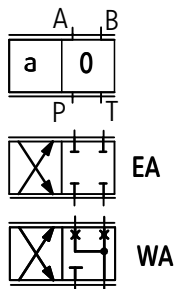


diagrams of spools

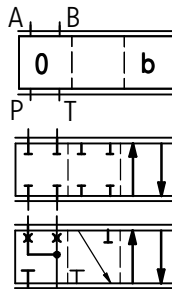
working and indirect positions



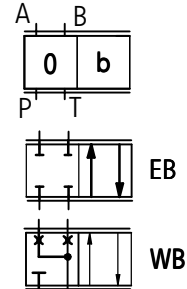
working positions



working and indirect positions



working positions

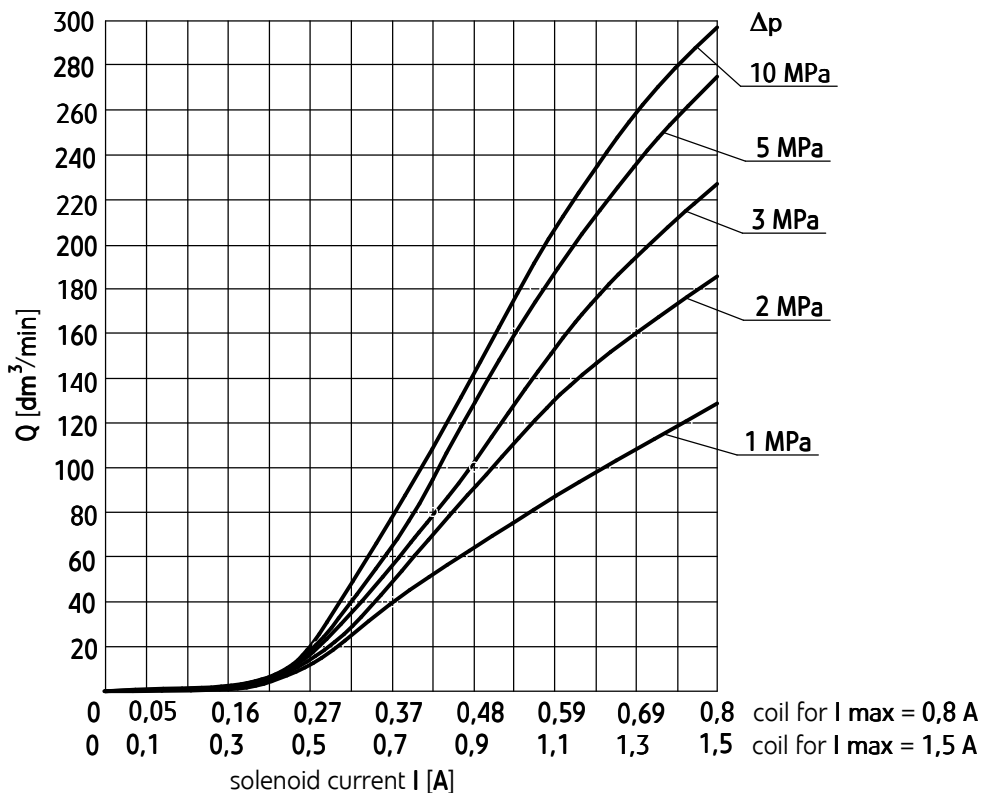


PERFORMANCE CURVES

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

Flow rate curves

characteristic curves $Q(I)$ - flow rate Q depending on solenoid current I by constant Δp for directional valve type USAP16... in versions with spools E, W; nominal flow rate $Q_n = 100 \text{ dm}^3/\text{min}$ by $\Delta p = 1 \text{ MPa}$; flow direction: $P \rightarrow A/B \rightarrow T$; $P \rightarrow B/A \rightarrow T$

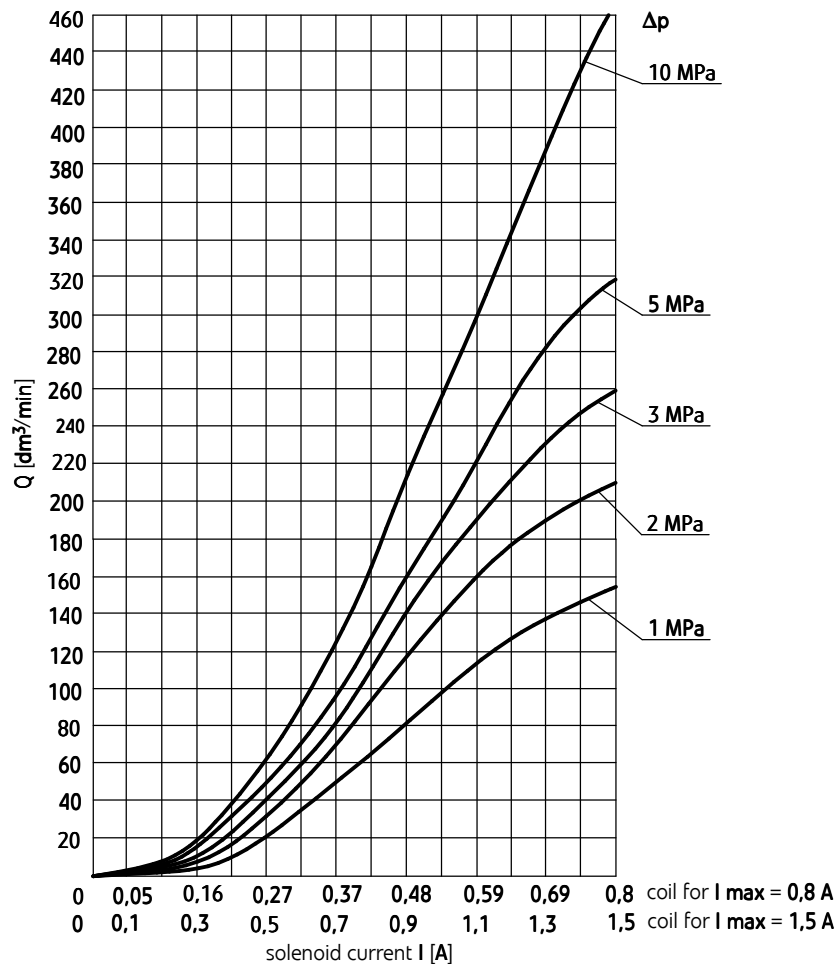


PERFORMANCE CURVES

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

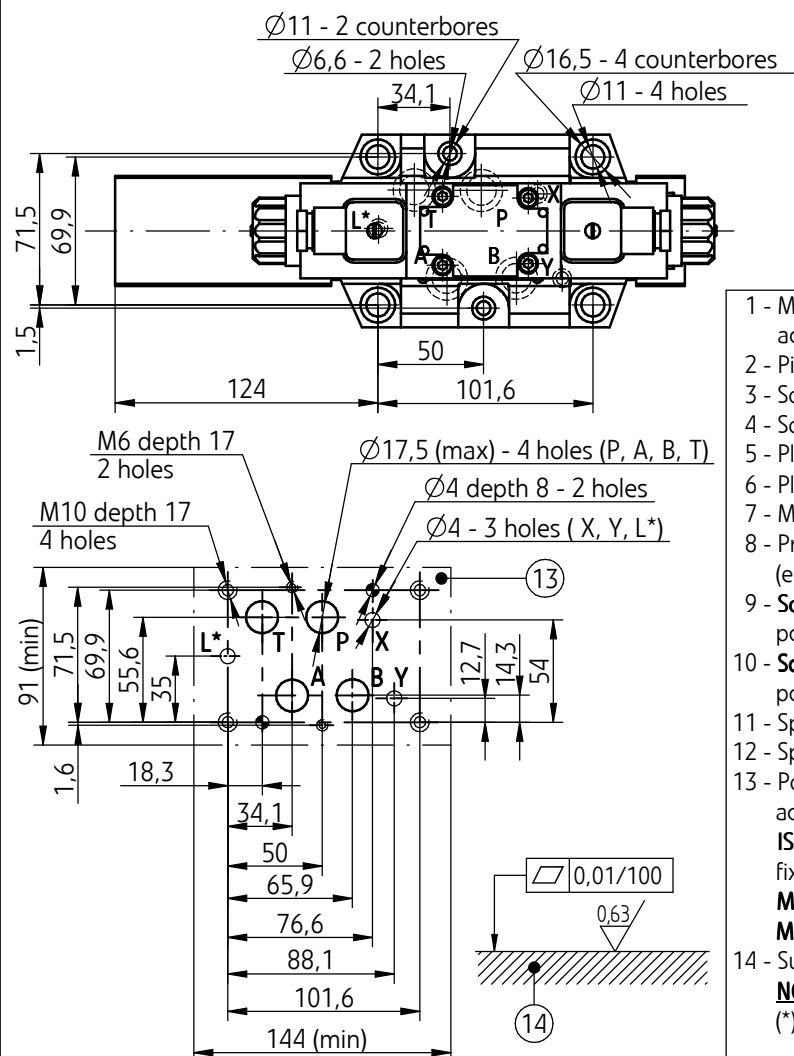
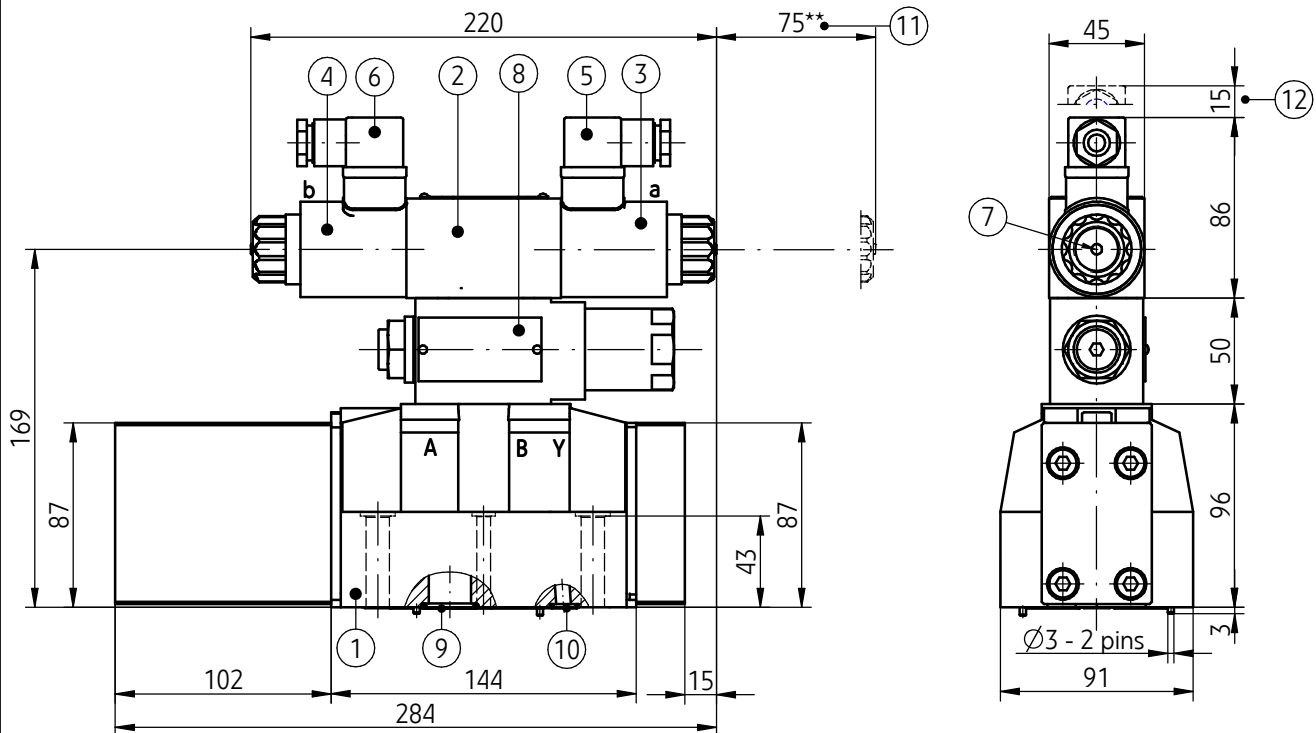
Flow rate curves

characteristic curves $Q(I)$ - flow rate Q depending on solenoid current I by constant Δp for directional valve type **USAP16...** in versions with spools **E, W**;
nominal flow rate $Q_n = 150 \text{ dm}^3/\text{min}$ by $\Delta p = 1 \text{ MPa}$;
flow direction: $P \rightarrow A/B \rightarrow T$; $P \rightarrow B/A \rightarrow T$



OVERALL AND CONNECTION DIMENSIONS

3-position versions with pressure reducing valve USAP16...NEZ4D...; ...NETZ4D...



- 1 - Main valve (spool diagrams: E, E1, E2, W, W1, W2 according to page 3)
- 2 - Pilot valve
- 3 - Solenoid on side **a**
- 4 - Solenoid on side **b**
- 5 - Plug-in connector on side **a** - type ISO 4400 (DIN43650 - A)
- 6 - Plug-in connector on side **b** - type ISO 4400 (DIN43650 - A)
- 7 - Manual override
- 8 - Pressure reducing valve - constant setting **3 MPa** (equipment option)
- 9 - **Square cross-section** sealing ring kw 22,3 x 2,4 pcs 4/set (P, T, A, B)
- 10 - **Square cross-section** sealing ring kw 10 x 2 pcs 3/set (X, Y, L*)
- 11 - Space for disassembly of coil
- 12 - Space for disassembly of plug-in connector
- 13 - Porting pattern - configuration of connection holes in accordance with the standard ISO 4401 - designation ISO 4401-07-06-0-94 (CETOP 07) fixing screws in acc. with the standard PN - EN ISO 4762 M10 x 60 - 10.9 - pcs 4; tightening torque **Md = 62 Nm** M6 x 60 - 10.9 - pcs 2; tightening torque **Md = 12,5 Nm**
- 14 - Subplate surface required

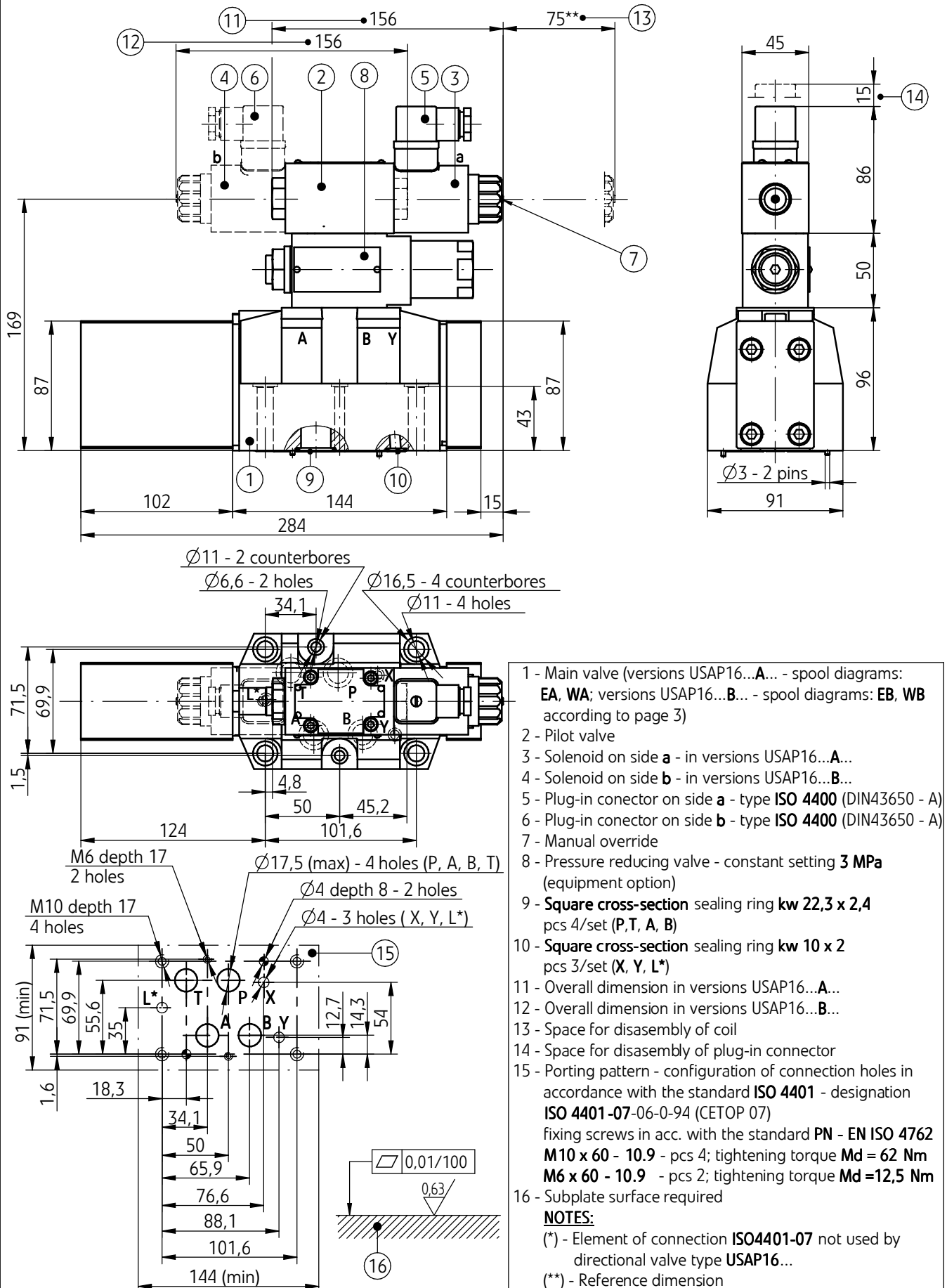
NOTES:

(*) - Element of connection ISO4401-07 not used by directional valve type USAP16...

(**) - Reference dimension

OVERALL AND CONNECTION DIMENSIONS

2-position versions with pressure reducing valve USAP16...A...NEZ4D...; ...A...NETZ4D...; ...B...NEZ4D...; ...B...NETZ4D...



PILOT OIL SUPPLY AND DRAIN

Pilot oil supply (X) - external
pilot oil drain (Y) - external
version USAP16.../...

In version USAP16.../... the hole screw plugs (3) and (5) and plugs (4) and (6) must be mounted in the position mentioned on the drawing.

Pilot oil supply (X) - internal
pilot oil drain (Y) - external
version USAP16.../...E...

In version USAP16.../...E... the hole screw plug (3) is not used, the hole screw plug (5) and plugs (4) and (6) are mounted, port X in the subplate must be plugged.

Pilot oil supply (X) - internal
pilot oil drain (Y) - internal
version USAP16.../...ET...

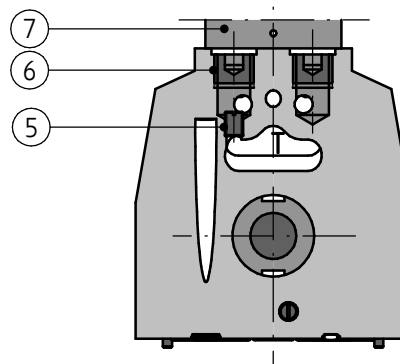
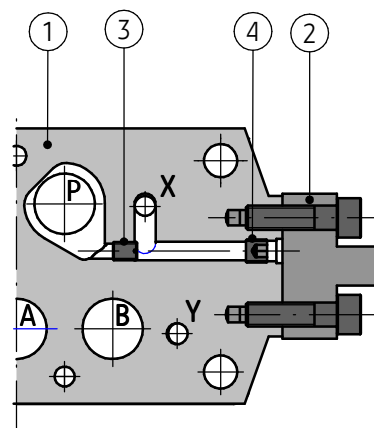
In version USAP16.../...ET...the hole screw plugs (3) and (5) are not used, plugs (4) and (6) are mounted and ports X and Y in the subplate must be plugged.

Pilot oil supply (X) - external
pilot oil drain (Y) - internal
version USAP16.../...T...

In version USAP16.../...T... the hole screw plug (3) and plugs (4) and (6) are mounted, the hole screw plug (5) is not used; port Y in the subplate must be plugged.

NOTES:

The access to the screw (3) in line X is available after disassembly of the side cover (2) of the main valve (1).
 The access to the screw (5) in line Y is available after disassembly of the pilot valve (7).



- 1 - Housing of main valve
- 2 - Side cover
- 3 - Hole screw plug **M6 - 8,8** (S3)
- 4 - Plug
- 5 - Hole screw plug **M6 - 8,8** (S3)
- 6 - Plug
- 7 - Pilot valve housing

HOW TO ORDER

USAP	16	+	/	+		N		Z4			★
-------------	-----------	----------	----------	----------	--	----------	--	-----------	--	--	----------

Nominal size (NS)

NS16 = **16**

Series number

(12-19) - connection and installation

dimensions unchanged = 1X

series 12 = **12**

Type of the spool

spool diagrams according to **pages 4, 5**

Nominal flow P → T by $\Delta p = 1 \text{ MPa}$

100 dm³/min = **100**

150 dm³/min = **150**

Types of solenoid coils

coil for max current I max = 1,5 A = **12**

coil for max current I max = 0,8 A = 24

Manual override

solenoids with manual override = **N**

Pilot oil supply and pilot oil drain

external pilot oil supply, external pilot oil drain = no designation

internal pilot oil supply, external pilot oil drain = E

internal pilot oil supply, internal pilot oil drain = **ET**

external pilot oil supply, internal pilot oil drain = T

Electrical connection

plug-in-connector type ISO 4400 (DIN 43650 - A) = **Z4**

Pilot pressure reducing valve

(constant setting 3MPa, only for version with internal pilot oil supply ...E...; ...ET...)

without pressure reducing valve = **no designation**

with pressure reducing valve = D

Sealing

NBR (for fluids on mineral oil base) = **no designation**

FKM (for fluids on phosphate ester base) = V

Further requirements in dear text

(to be agreed with the manufacturer)

NOTES:

The proportional directional valve should be ordered according to the above coding.

The symbols in bold are preferred versions available in short delivery time.

Coding example: USAP16 - 12/E100NETZ4

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:

The subplate symbol in bold is the preferred version
available in short delivery time.

Fixing screws for the assembly of the directional valve
in accordance with **PN - EN ISO 4762**:

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

M6 x 60 -10.9 - pcs 2/set

must be ordered separately.

Tightening torques:

M10 x 60 - Md = 62 Nm

M 6 x 60 - Md = 12,5 Nm

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