



## 4WRLE

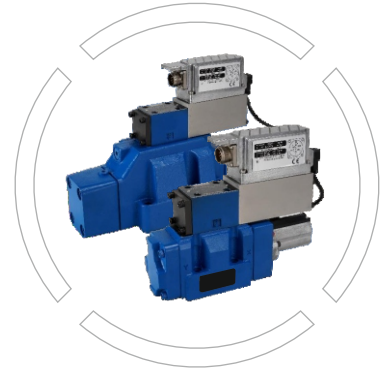
High-response directional control valves, pilot operated, with electrical position feedback and integrated electronics(OBE)

Size 10 ... 27

Component series 4X

Maximum operating pressure 350bar

Nominal flow 60...600 L/min ( $\Delta p = 10$  bar)



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## Features

- High-response 2-stage proportional directional valve, pilot valve and main valve with electrical position feedback, integrated digital controller
- Pilot valve: using spool/sleeve structure with servo valve performance, closed-loop position control
- Control spool of the main stage in the spring centered central position and/or in the offset position
- Flexible – suitable for position, speed and pressure control
- Precise – high response sensitivity and little hysteresis
- For subplate mounting: porting pattern to ISO4401(NS 10...27)
- Electrical connection: 6P+PE



## Ordering Code

<b>4WRL</b>	<b>E</b>	<b>16</b>	<b>E</b>	<b>200</b>	<b>L</b>	<b>J</b>	<b>-</b>	<b>4X</b>	<b>/</b>	<b>M</b>	<b>XY</b>	<b>/</b>	<b>24</b>	<b>A1</b>	<b>*</b>
01	02	03	04	05	06	07		08		09	10		11	12	13

01	<b>4WRL</b>	4 main ports directional control valve, pilot-operated
02	<b>E</b>	With integrated digital electronics
03	<b>10</b>	NS 10
	<b>16</b>	NS 16
	<b>25</b>	NS 25
	<b>27</b>	NS 27

### Symbols

04	<b>E</b>	E, E1-, W6-, W8-, V, V1-, Q3-; Hydraulic symbol table for details see page 2
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### Rated flow ( $\Delta p = 5$ bar/control edge)

05	<b>60</b>	60 l/min (only symbol E, E1-, W6-, W8-, V, V1-)	NS 10
	<b>100</b>	100 l/min	
05	<b>200</b>	200 l/min (only symbol W6-, W8-)	NS 16
	<b>250</b>	250 l/min (only symbol E, E1-, V, V1-, Q3-)	
	<b>350</b>	350 l/min (only symbol W6-, W8-)	
05	<b>400</b>	400 l/min (only symbol E, E1-, V, V1-, Q3-)	NS 25
	<b>430</b>	350 l/min (only symbol W6-, W8-)	
05	<b>600</b>	400 l/min (only symbol E, E1-, V, V1-, Q3-)	NS 27

06	<b>L</b>	Linear
	<b>P</b>	Linear with fine control range (available for NG10, other sizes on request)
	<b>M</b>	Progressive with linear fine control (only symbol Q3-)

07	<b>J</b>	Overlap jump (opening point 5% with covered valve; only symbols E, E1-, W6-, W8-)
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08	<b>4X</b>	Component series 40 ... 49 (40 ... 49: unchanged installation and mounting dimensions)
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### Seal material

09	<b>M</b>	NBR seals
	<b>V</b>	FKM seals

### Pilot oil supply and drain

10	<b>XY</b>	External pilot oil supply, external pilot oil return
	<b>PY</b>	Internal pilot oil supply, external pilot oil return
	<b>PT</b>	Internal pilot oil supply; internal pilot oil return
	<b>XT</b>	External pilot oil supply, internal pilot oil return

11	<b>24</b>	Supply voltage 24 V
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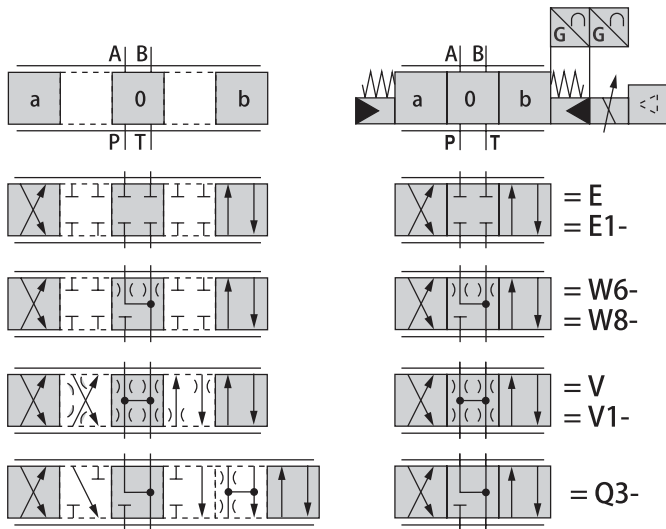
### Interfaces of the control electronics

12	<b>A1</b>	Command value input $\pm 10$ V
	<b>F1</b>	Command value input 4 ... (12) ... 20 mA

13	<b>*</b>	Further details in the plain text
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## Symbols

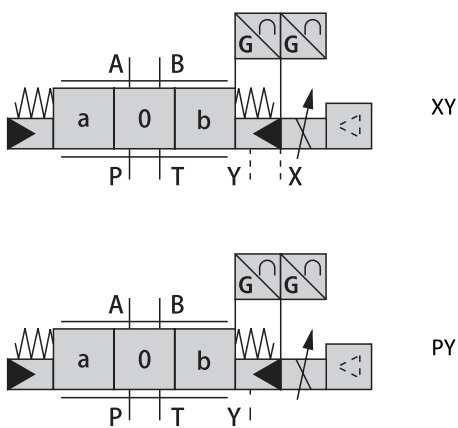


With symbols: E1-, V1-, W8-

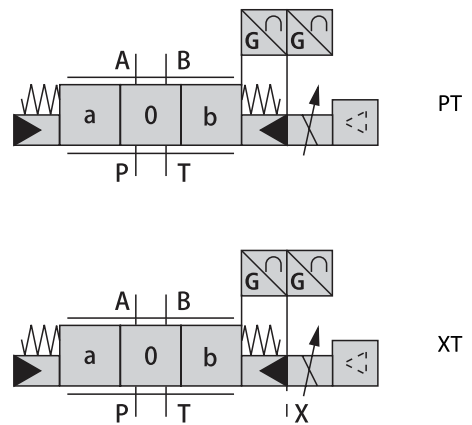
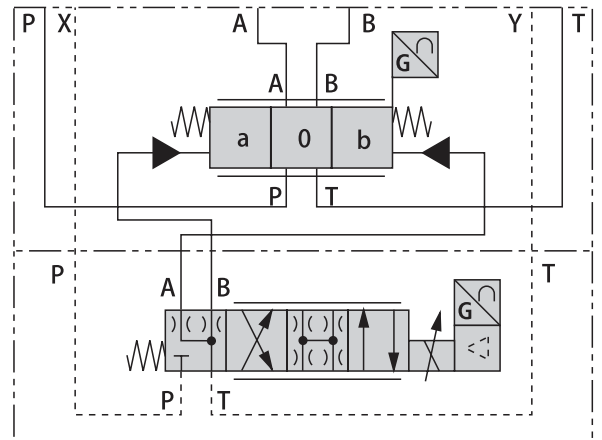
$P \rightarrow A: q_{V \text{ nom}}$        $B \rightarrow T: q_{V \text{ nom}} / 2$

$P \rightarrow B: q_{V \text{ nom}} / 2$        $A \rightarrow T: q_{V \text{ nom}}$

Simple



## Detailed (type "XY")





## Function Section

The valve type 4WRL(E) is a pilot-operated directional control valve with electrical position feedback and integrated electronics (OBE).

### Set-up

- Pilot control valve (1) with control spool and sleeve, return spring, control solenoid and inductive position transducer
- Main valve (2) with centering spring and position feedback
- Integrated control electronics (OBE) (3)

### Function

When the integrated control electronics (OBE) is switched off or inactive, the control spool of the pilot control valve is spring-operated in the "fail-safe" position. The control spool of the main valve is in its spring-centered central position.

The integrated control electronics (OBE) compares the specified command value to the position actual value of the main valve control spool. In case of control deviations, the control solenoid will be activated. Due to the changed magnetic force, the pilot control spool is adjusted against the spring.

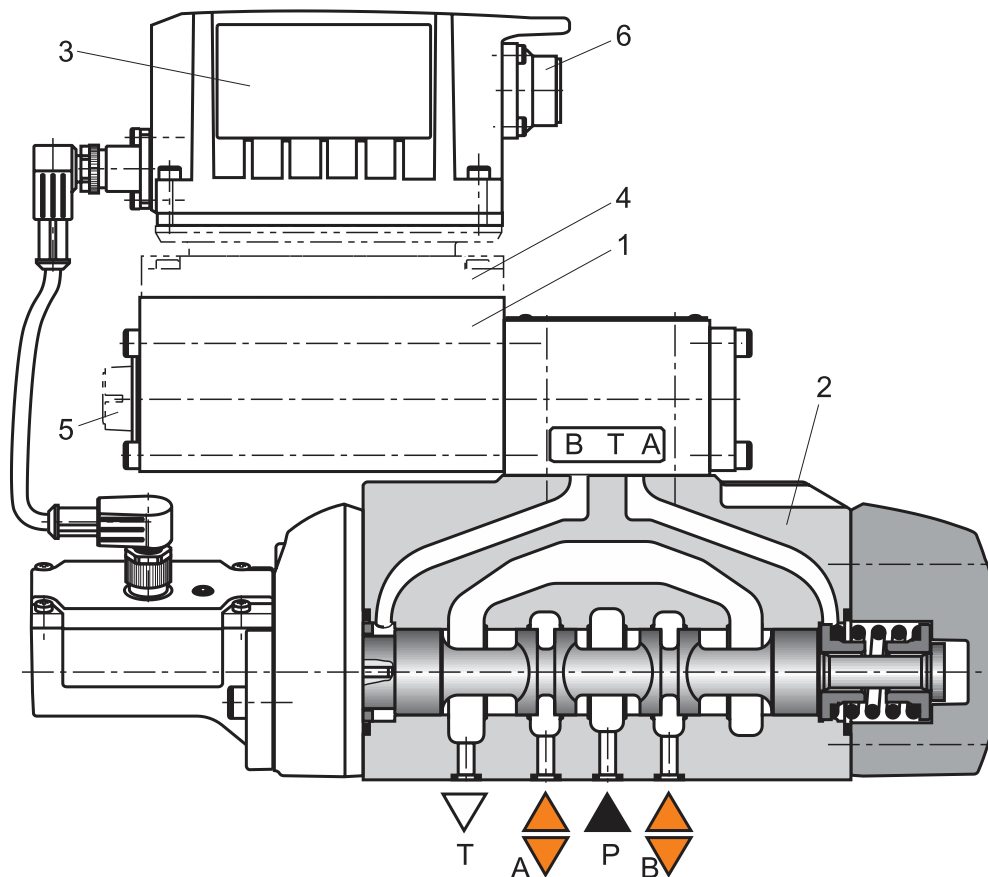
The flow which is activated via the control cross-sections leads to an adjustment of the main control spool. The stroke/control cross-section of the main control spool is regulated proportionally to the command value.

The pilot oil supply in the pilot control valve is either internal via port P or external via port X. The feedback can be internal via port T or external via port Y to the tank.

In case of the following errors, the control solenoids are de-energized by the integrated electronics (OBE), the pilot control spool is set to "fail-safe" position and unloads the pilot oil chambers of the main valve. Operated by the spring, the main valve control spool will move to the central position.

- Falling below the minimum supply voltage
- Only at interface "F1": falling below the minimum current command value of 2 mA (includes cable break of the command value line (current loop)).

4WRL...-4X/...

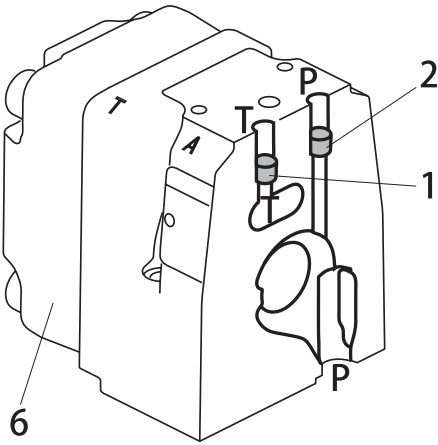




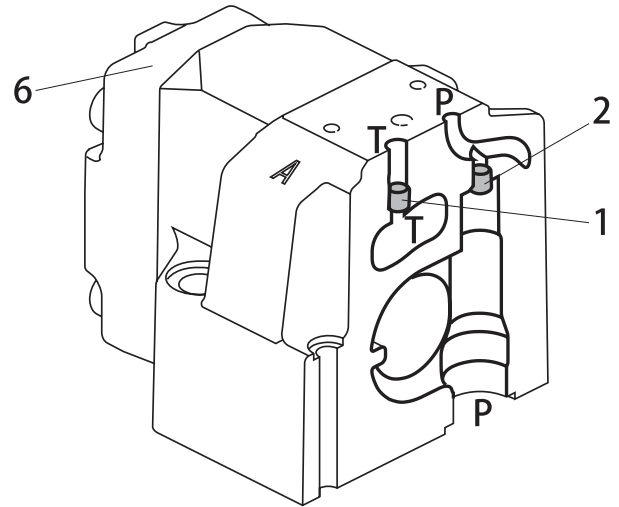


## Pilot Oil supply and drain

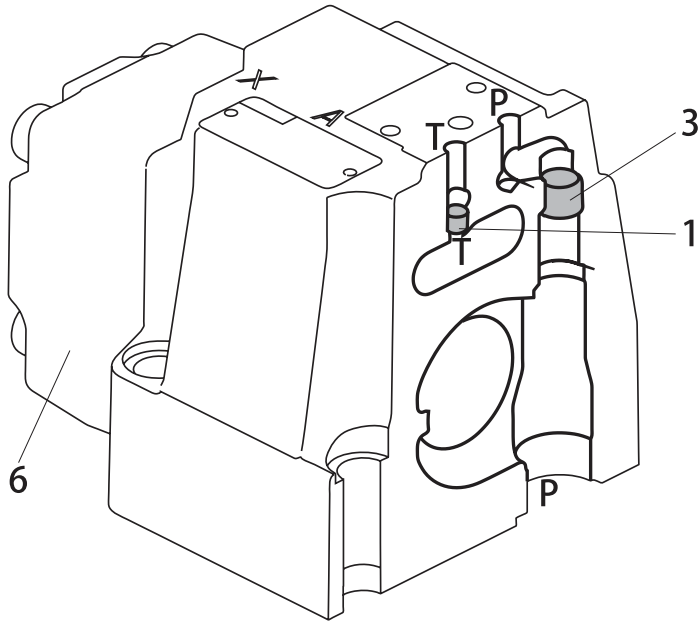
NS 10



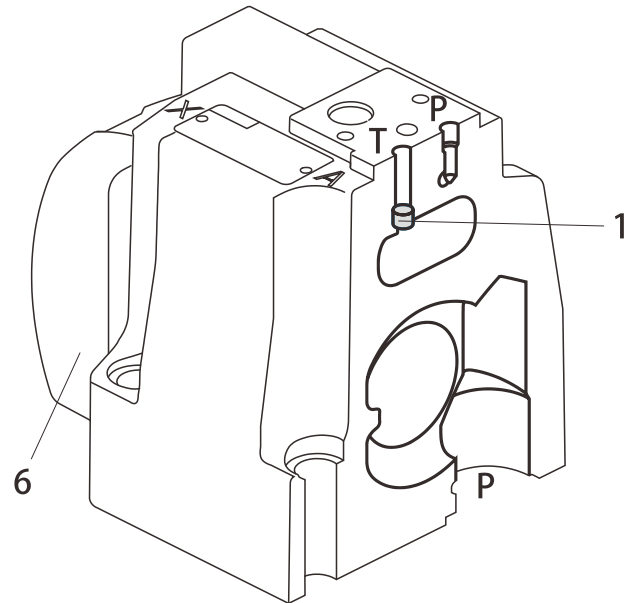
NS 16



NS 25



NS 27



Pilot oil supply  
external: 2, 3 closed  
internal: 2, 3 open

Pilot oil return  
external: 1 closed  
internal: 1 open

1. Plug screw M6 , wrench size 3 – pilot oil return
2. Plug screw M6 , wrench size 3 – pilot oil supply
3. Plug screw M12 x 1.5 , wrench size 6 – pilot oil supply
6. Housing cover main stage (position transducer side)

### Pilot oil supply and drain

#### Version "XY"

External pilot oil supply; external pilot oil return  
The pilot oil is supplied from a separate control circuit (external).  
The pilot oil return is not directed into channel T of the main valve, but is separately directed to the tank via port Y (external).

#### Version "PY"

Internal pilot oil supply; external pilot oil return  
The pilot oil is supplied from channel P of the main valve (internal).  
The pilot oil return is not directed into channel T of the main valve, but is separately directed to the tank via port Y (external).  
In the subplate, port X is to be closed.

#### Version "PT"

Internal pilot oil supply; internal pilot oil return  
The pilot oil is supplied from channel P of the main valve (internal).  
The pilot oil is directly returned to channel T of the main valve (internal).  
In the subplate, ports X and Y are to be closed.

#### Version "XT"

External pilot oil supply; internal pilot oil return  
The pilot oil is supplied from a separate control circuit (external).  
The pilot oil is directly returned to channel T of the main valve (internal).  
In the subplate, port Y is to be closed.



## Technical data (For applications outside these parameters, please consult us!)

### General

Nominal size		10	16	25	25			
Installation position		Any						
Ambient temperature range	°C	-20 ... +60						
Weight	Kg	9	12	19	19			
<b>Hydraulic (measured at p = 100 bar, with HLP46 at 40 °C ± 5 °C)</b>								
Maximum operating pressure	Ports A, B, P	350			270			
	-External pilot oil supply	bar						
	-Pilot oil supply internal	bar			270			
	Port X	bar			270			
	Ports T, Y	bar			210			
Minimum pilot pressure (pilot control valve)	bar	10						
Rated flow ( $\Delta p = 5$ bar/control edge) <sup>1)</sup>	L/min	60	200	350	430			
		100	250	400	600			
Maximum flow	L/min	300	800	1250	4700			
Pilot oil flow <sup>2)</sup>	Symbols E, W	L/min	2.4	3.5	7.5			
	Symbols V, Q3	L/min	4.5	11.5	22			
Maximum leakage flow inlet pressure 100bar	Symbols E,E1-main valve+pilot valve	L/min	0.14	0.28	0.42			
	Symbols W6 - ,W8 -main valve+pilot valve	L/min	0.2	0.41	0.6			
Maximum zero flow inlet pressure 100bar	Symbols V,V1-main valve+pilot valve	L/min	1.85	2.6	3.2	3.7		
	Symbols Q3-main valve+pilot valve	L/min	0.55	1.9	2.2	2.6		
Flow unloading central position $\Delta p = 5$ bar/control edge	Symbol W6-	L/min	A→T	B→T	A→T	B→T	A→T	B→T
			2.8	2.8	4	4	6	6
Pilot oil volume (0...100%)	ml	1.3	2.9	6.8	6.8			
		DIN51524...535 other fluids after prior consultation						
Hydraulic fluid		DIN51524...535 other fluids after prior consultation						
Hydraulic fluid temperature range (flown-through)	°C	-20 ... +70						
Viscosity range	mm <sup>2</sup> /s	10 ... 800 (preferably 20 ... 100)						
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class		ISO4406 18/16/13						
Hysteresis	%	< 0.1						
Range of inversion	%	< 0.08						
Response sensitivity	%	< 0.05						
Actuating time for 0 ... 100% at X = 210 bar	ms	25	37	36	36			
Temperature drift (temperature range 20 °C ... 80 °C)	%/10°C	< 0.25						

1) Flow rate at a different  $\Delta p$ :  $q_x = q_{V \text{ nom}} \cdot \sqrt{\frac{\Delta p_x}{5}}$

2) At X = 100 bar, step signal for 0 ... 100%

3) The purity classes stated for the components must be complied with in hydraulic systems. Effective filtration prevents problems and also extends the service life of components.



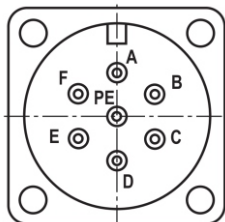
## Electrical connections

### Electrical, integrated electronics (OBE)

Voltage type		DC	
		VDC	24
Supply voltage	Terminal A	VDC	19...36
	Terminal B	VDC	0
Maximum admissible residual ripple		Vpp	2.5
Maximum power consumption		VA	40
Fuse protection, external		A <sub>T</sub>	2.5
Command value	Version "A1" ( $U_{D-E}$ )	V	±10
	Version "F1" ( $I_{D-E}$ )	mA	4...20
Test signal,version "A1"			LVDT
	Terminal F	V	0...±10
	Terminal C	Reference 0V	
Test signal,version "F1"			LVDT signal 4 ... 20 mA on external load 200 ... 500 Ω maximum
	Terminal F ( $I_{F-C}$ )	mA	4...20
	Terminal C ( $I_{F-C}$ )	Current loop $I_{F-C}$ feedback	
Relative duty cycle		%	100
Max. solenoid temperature		°C	120
Protection class according to EN 60529		IP65	

### Connector pin assignment

Terminal	Version "A1"	Version "F1"
A	Supply voltage 24 VDC	
B	GND	
C	Reference potential actual value - pin F	
D	Command value ±10V $R_e > 100k\Omega$	Command value 4...20mA $R_e = 200\Omega$
E	Reference potential command value - pin D	
F	Actual value ±10V $R_i = 1k\Omega$	Actual value 4..20mA Max.load 500Ω
PE	Functional ground (directly connected to the valve housing)	

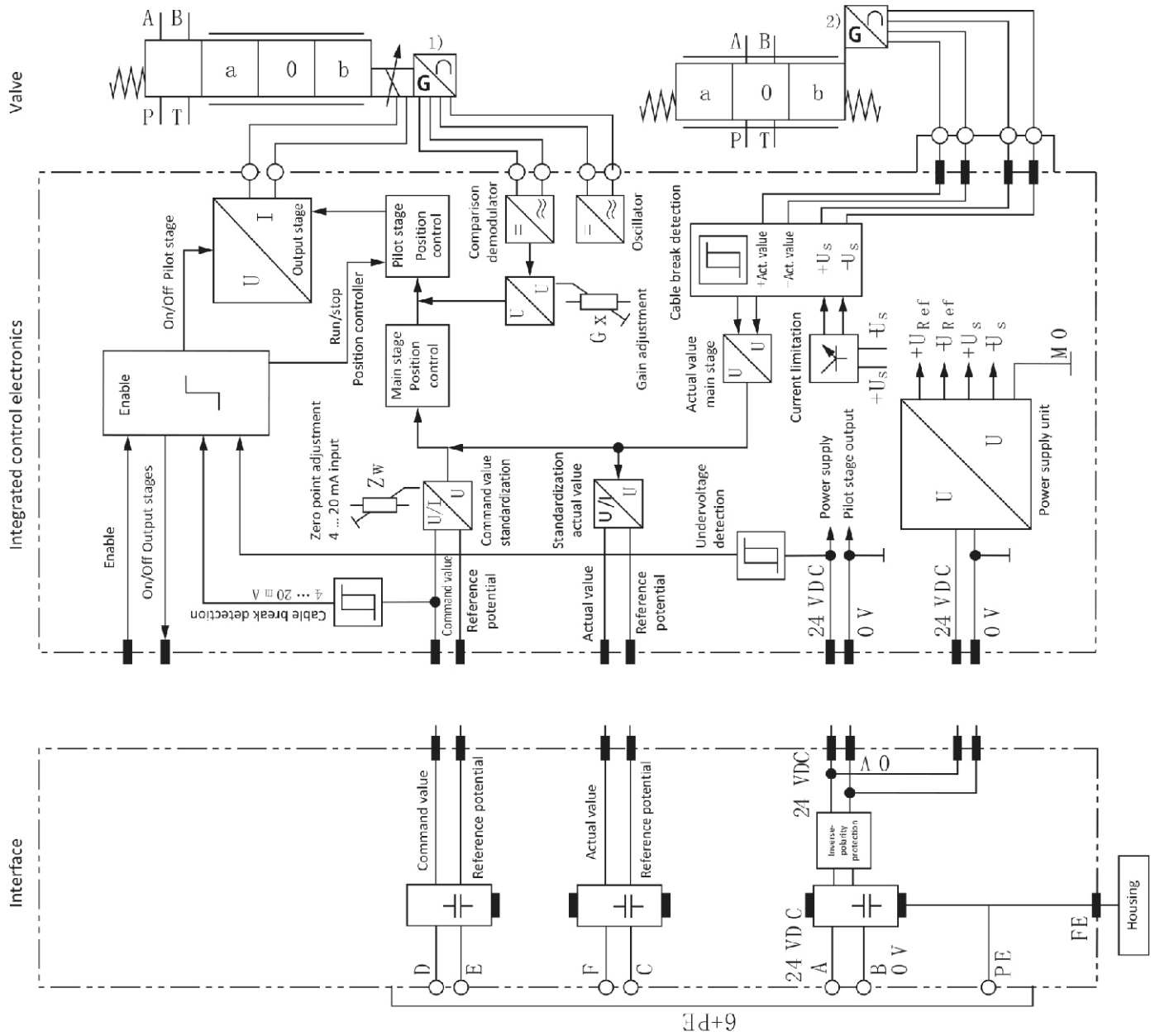


**Command value:** - Positive command value (0 ... 10 V or 12 ... 20 mA on D and reference potential on E cause flow from P → A and B → T.  
- Negative command value (0 ... -10 V or 12 ... 4 mA) at D and reference potential at E cause flow from P → B and A → T.

**Connection cable :** - Up to 20 m cable length type LiYCY 7 x 0.75 mm<sup>2</sup>  
(recommendation) - Up to 40 m cable length type LiYCY 7 x 1.0 mm<sup>2</sup>



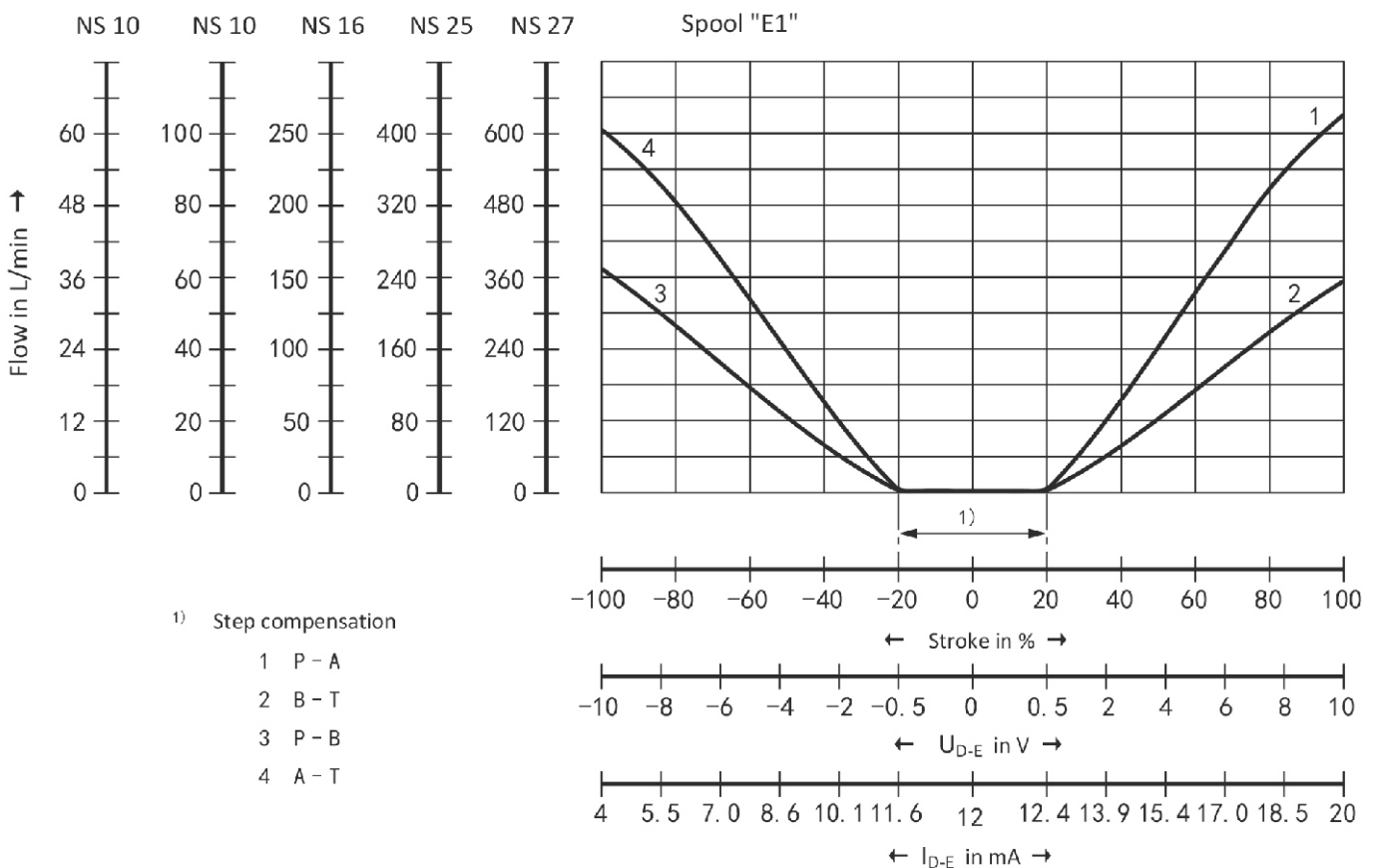
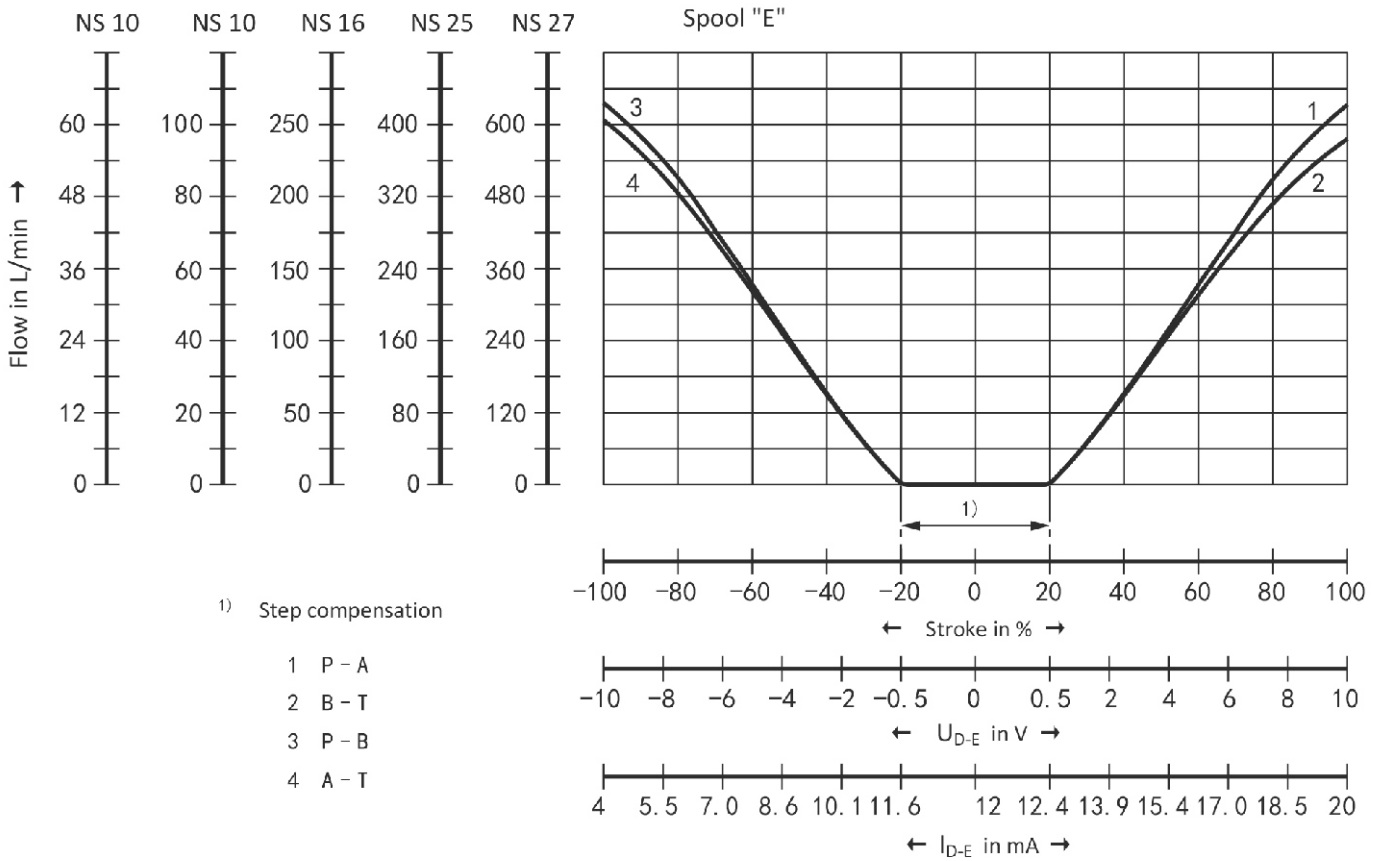
Block diagram/controller function block





## Characteristic curves (HLP46 at 40°C ± 5°C)

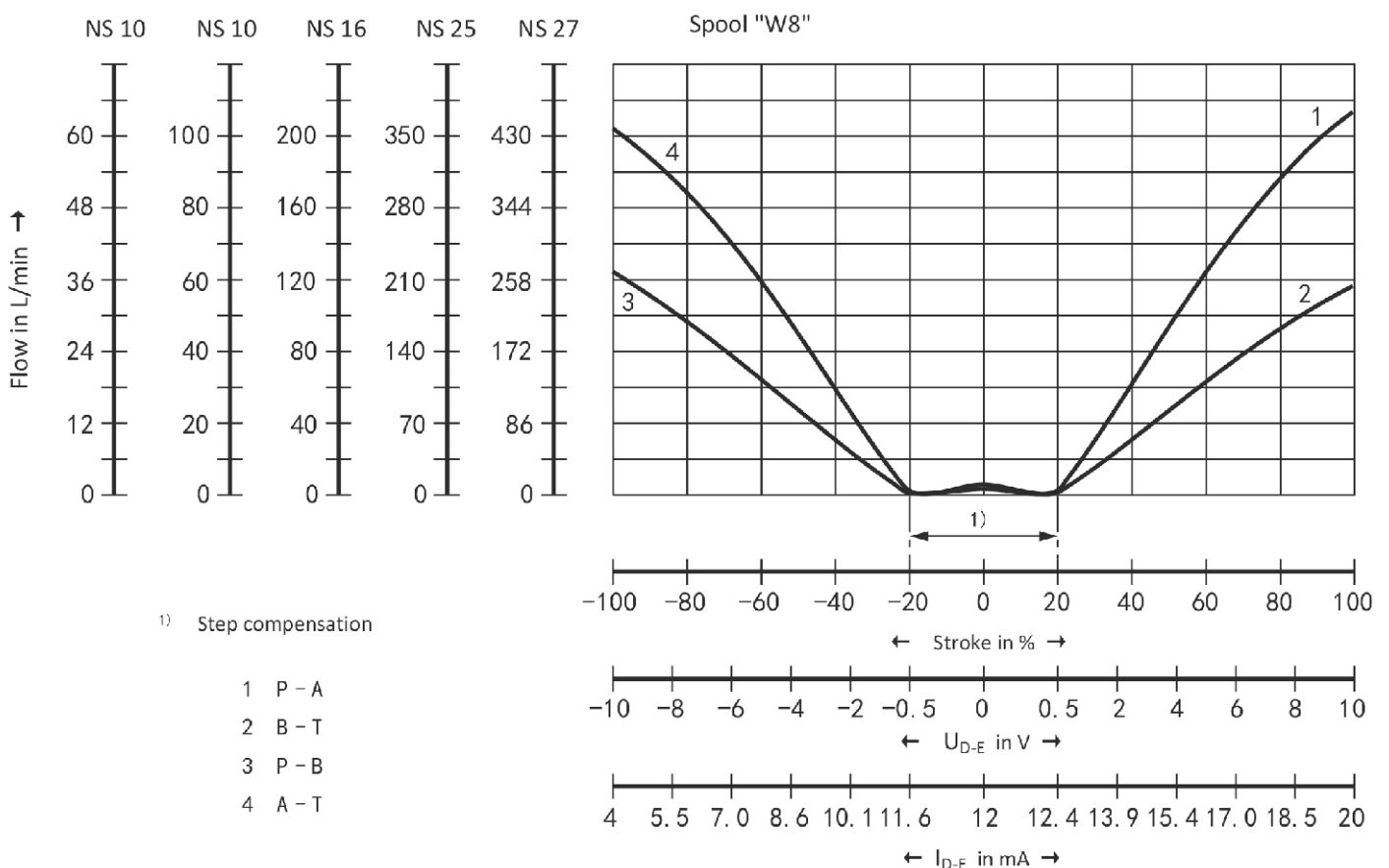
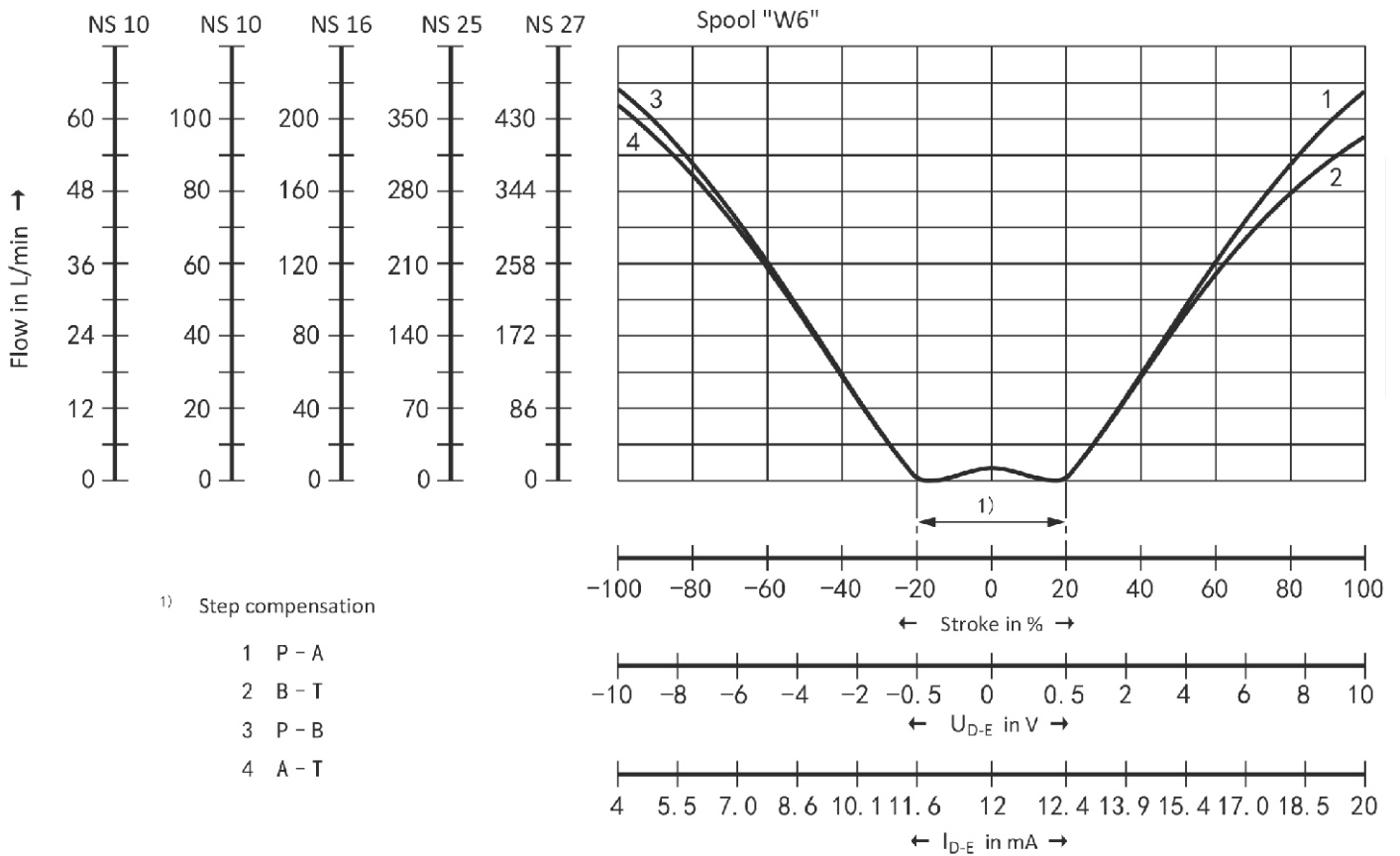
Characteristic curves: Flow characteristic "L" ( $\Delta p = 5 \text{ bar/control edge}$ )





## Characteristic curves (HLP46 at 40°C ± 5°C)

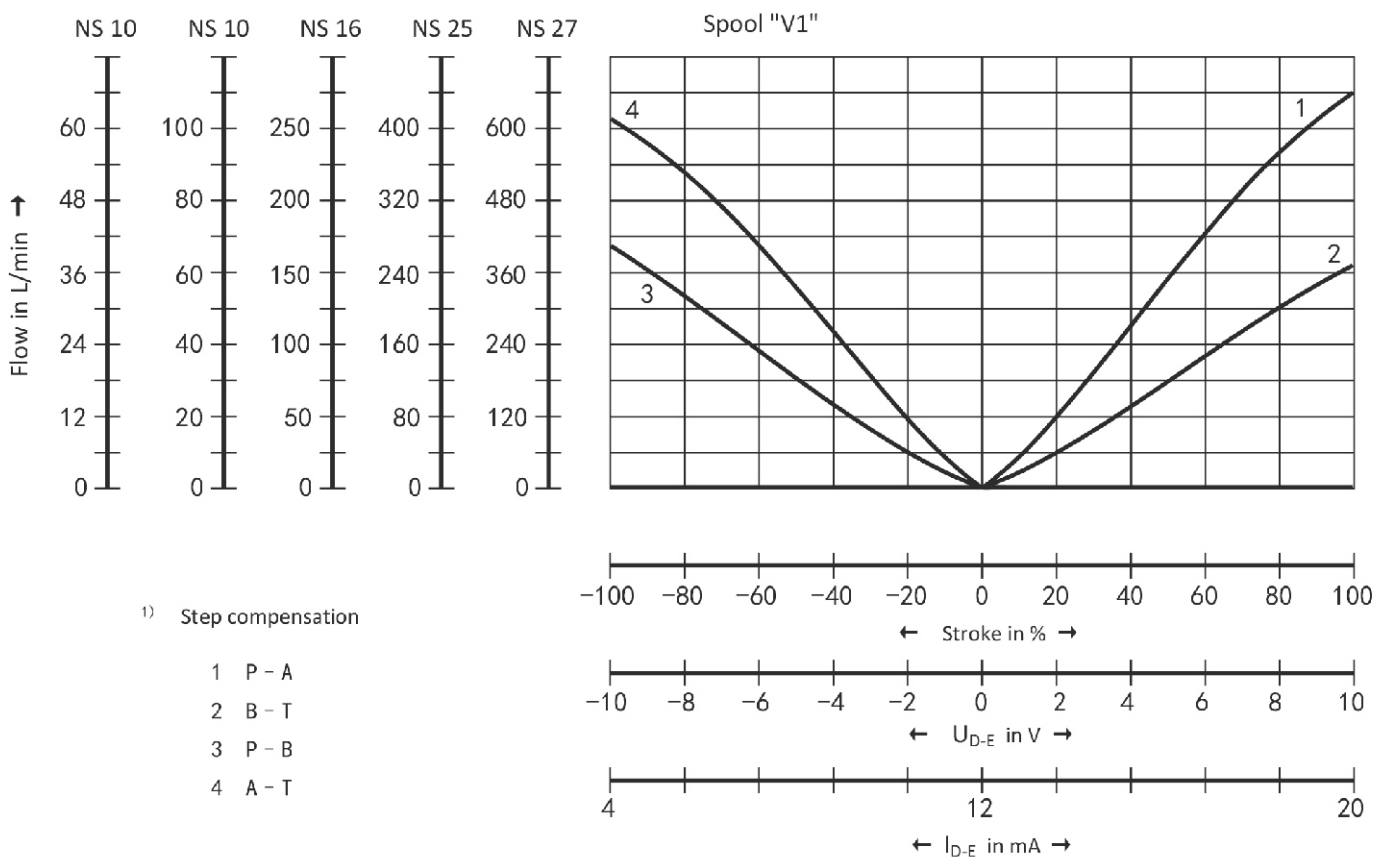
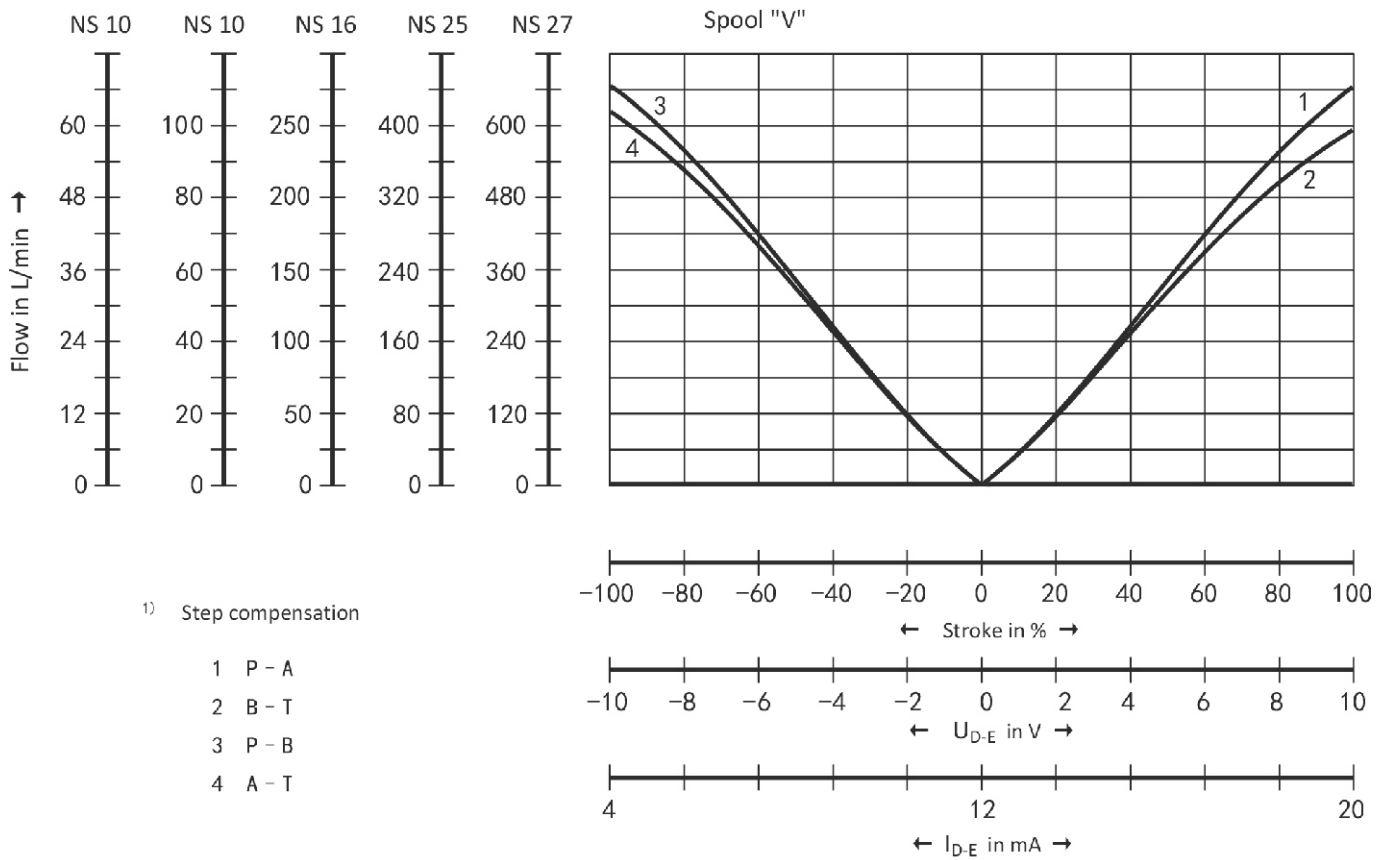
Characteristic curves: Flow characteristic "L" ( $\Delta p = 5 \text{ bar/control edge}$ )





## Characteristic curves (HLP46 at 40°C ± 5°C)

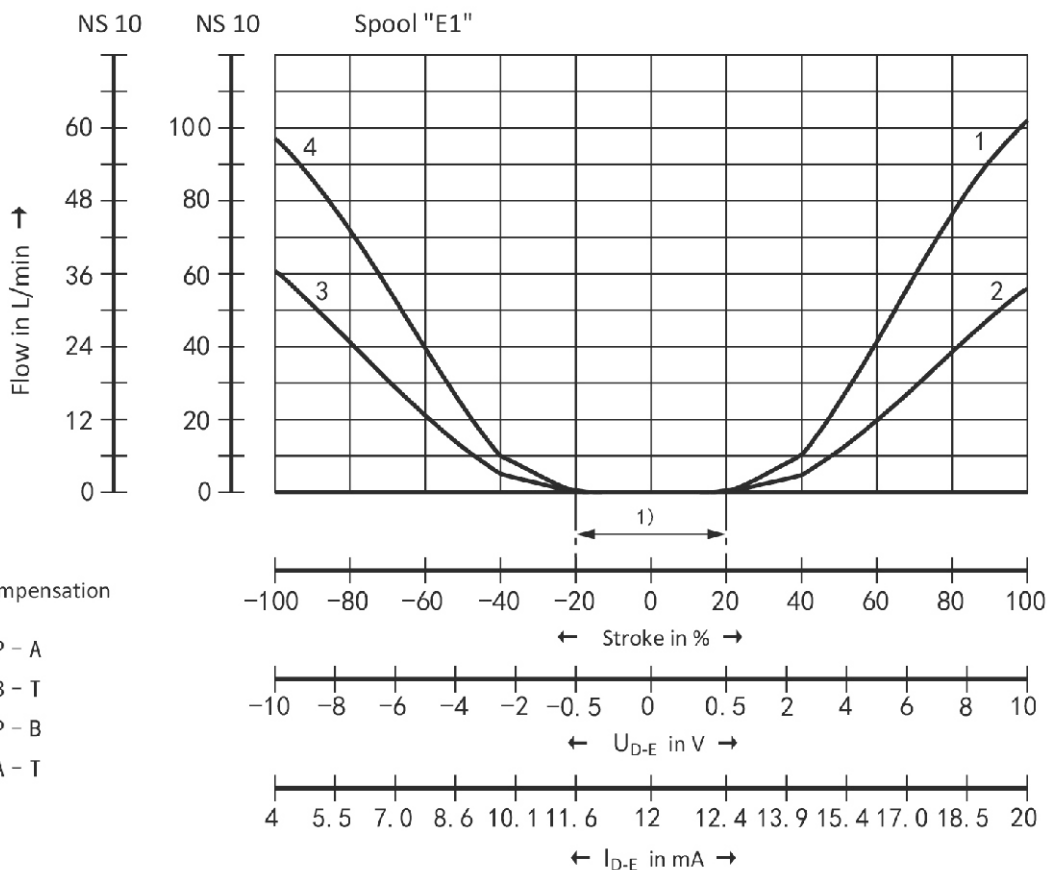
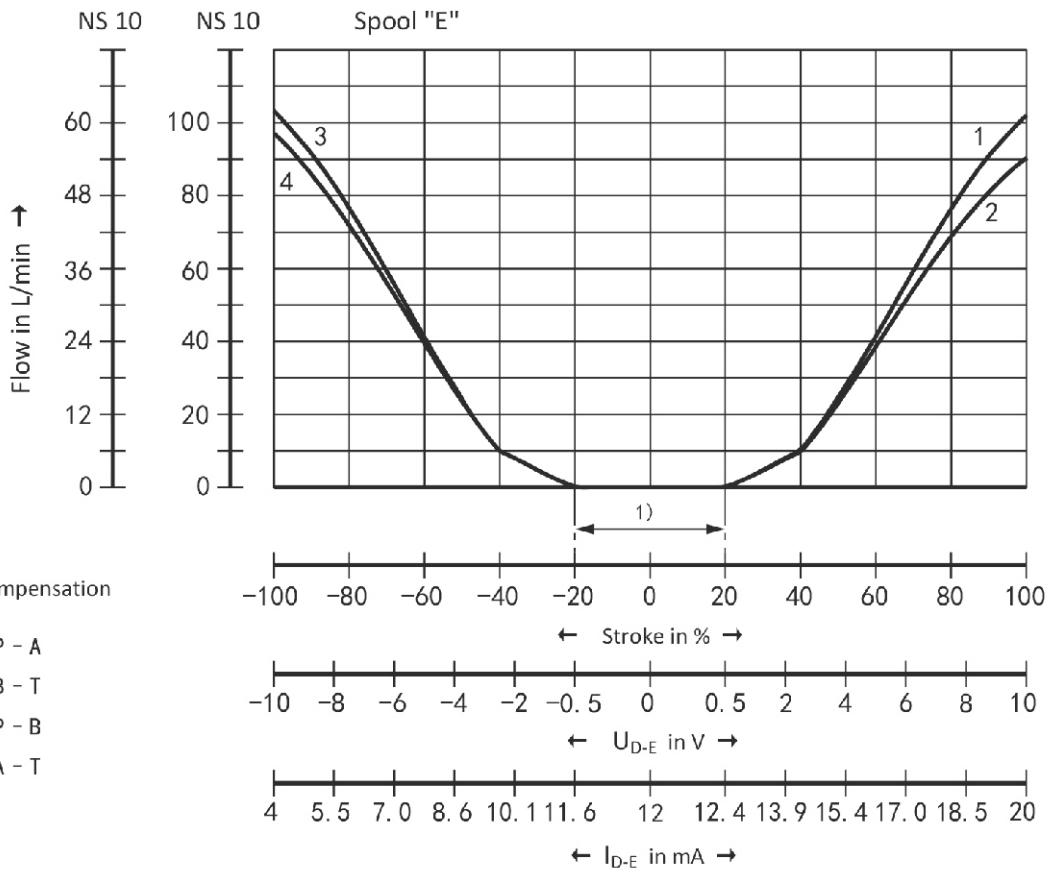
Characteristic curves: Flow characteristic "L" ( $\Delta p = 5 \text{ bar/control edge}$ )





## Characteristic curves (HLP46 at 40°C ± 5°C)

Characteristic curves: Flow characteristic "P" ( $\Delta p = 5 \text{ bar/control edge}$ )

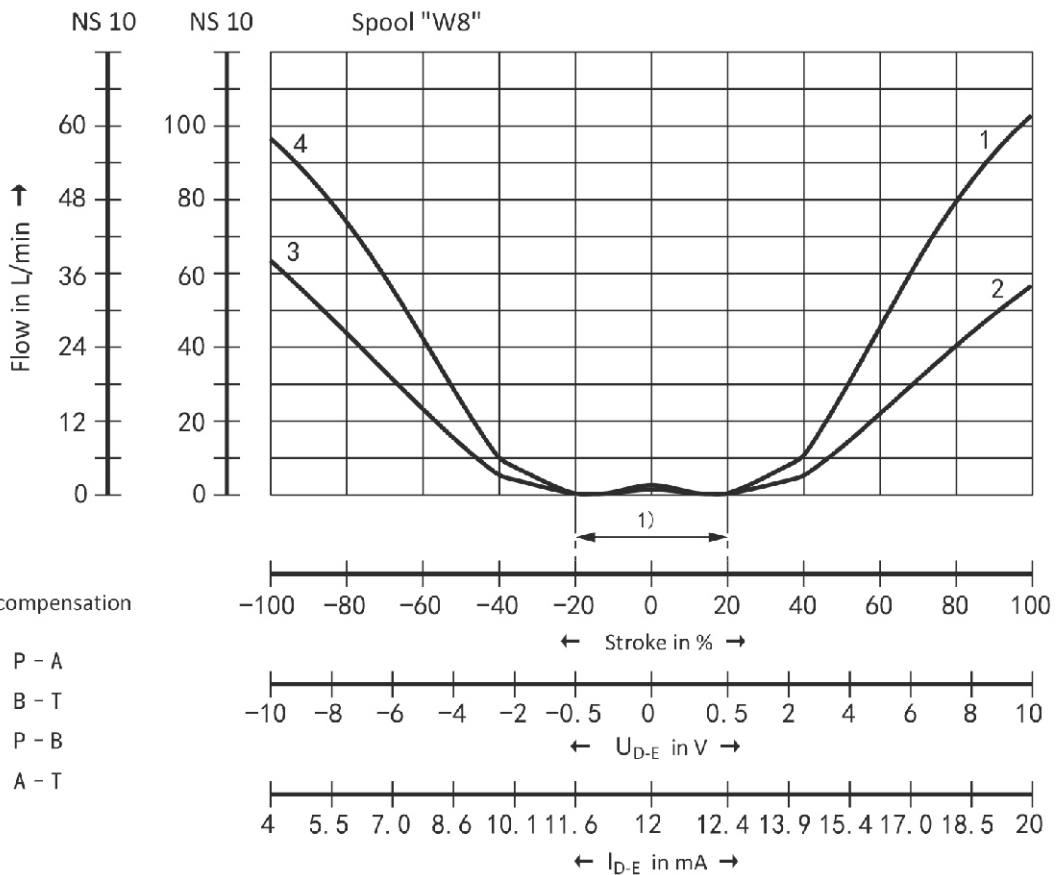
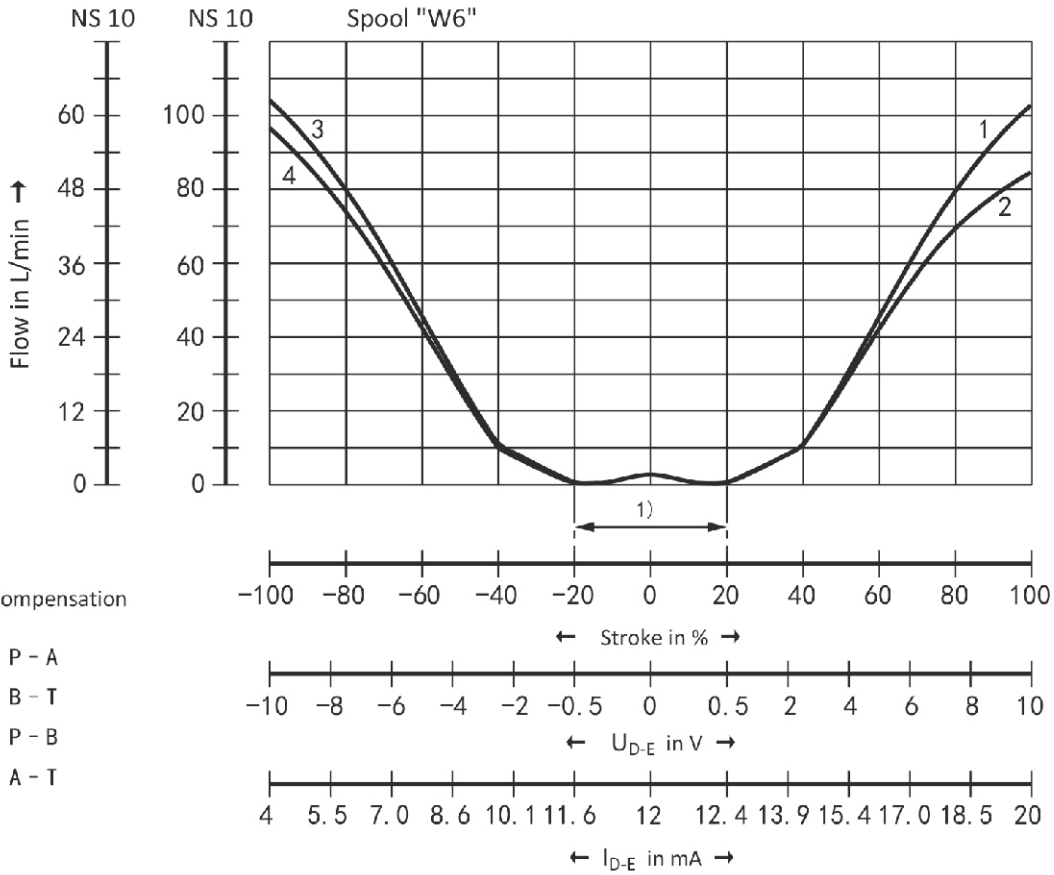






## Characteristic curves (HLP46 at 40°C ± 5°C)

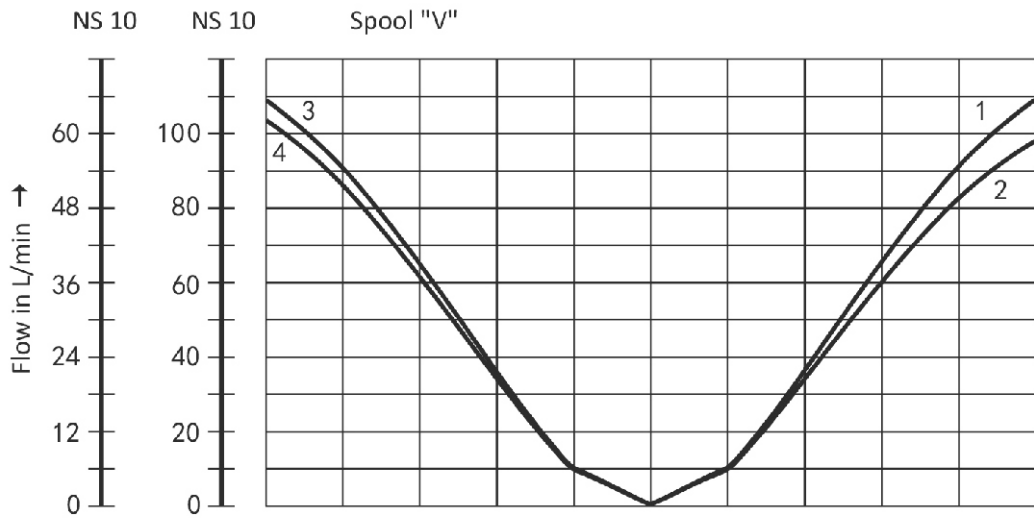
Characteristic curves: Flow characteristic "P" ( $\Delta p = 5 \text{ bar/control edge}$ )





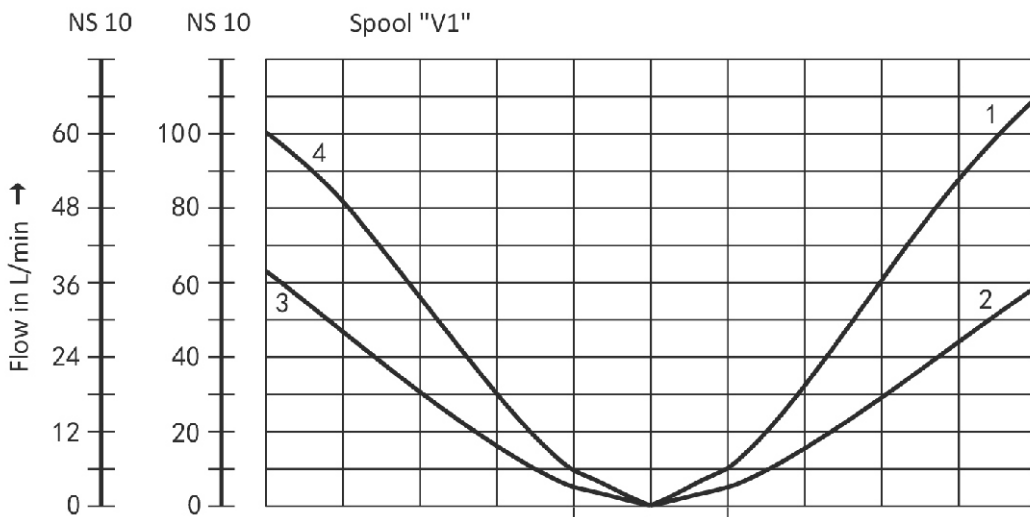
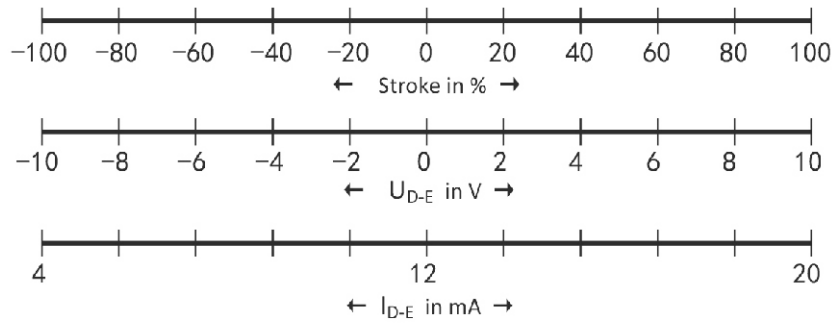
### Characteristic curves (HLP46 at 40°C ± 5°C)

Characteristic curves: Flow characteristic "P" ( $\Delta p = 5 \text{ bar/control edge}$ )



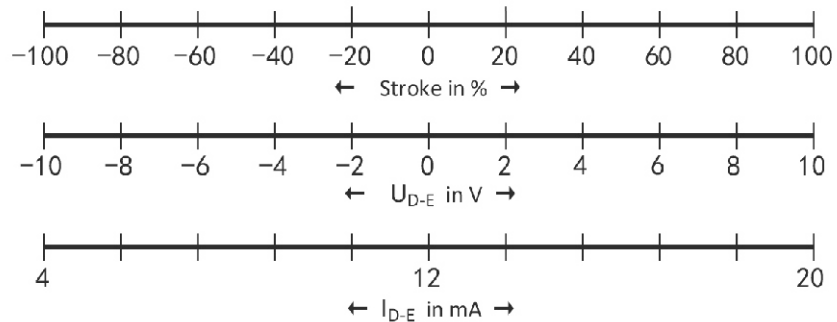
1) Step compensation

- 1 P - A
- 2 B - T
- 3 P - B
- 4 A - T



1) Step compensation

- 1 P - A
- 2 B - T
- 3 P - B
- 4 A - T

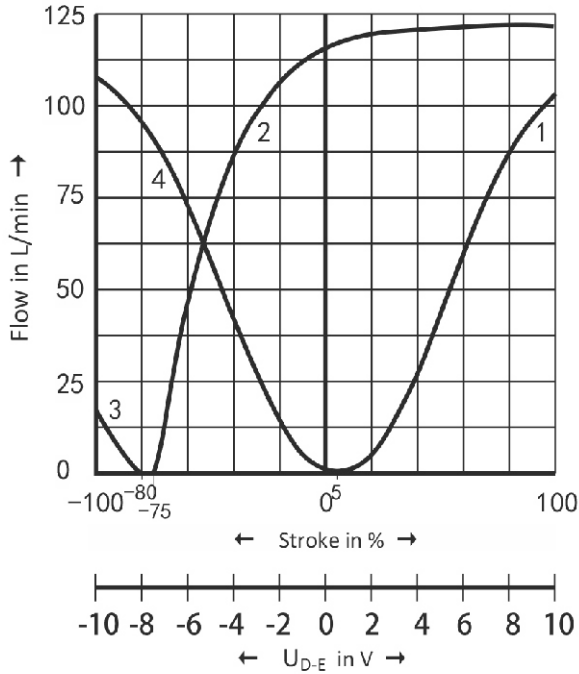




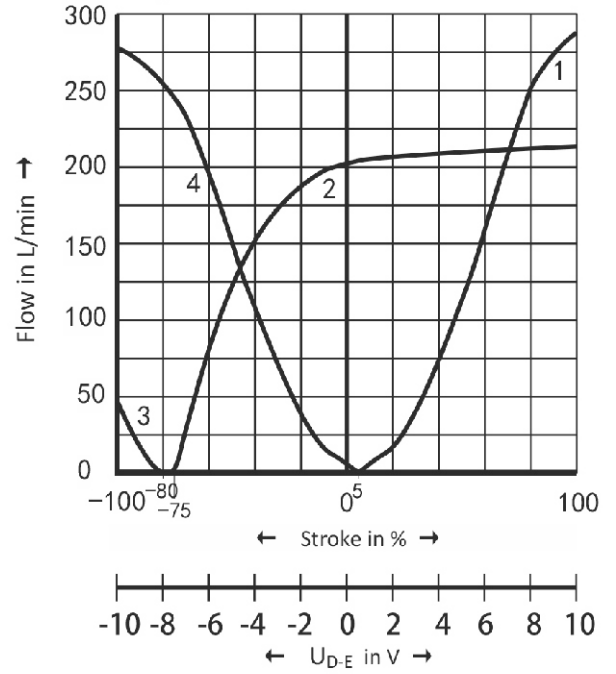
## Characteristic curves (HLP46 at 40°C ± 5°C)

Characteristic curves: Flow characteristic "M" ( $\Delta p = 5 \text{ bar/control edge}$ )

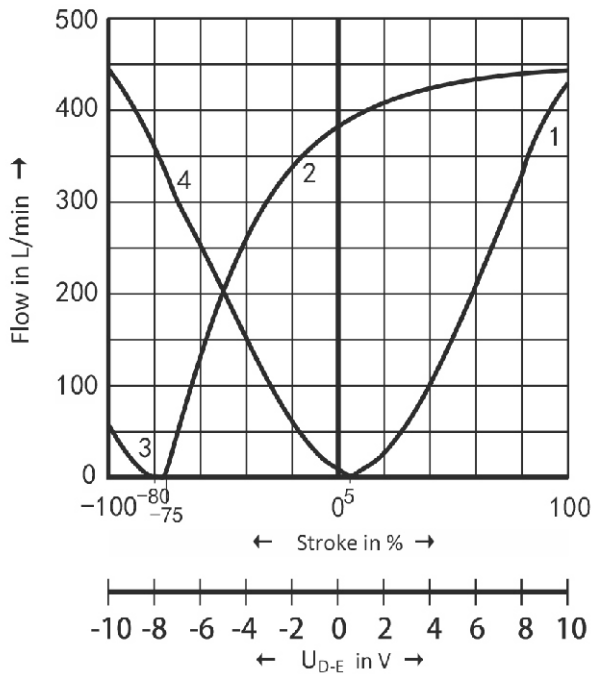
Symbol "Q3", version "100"



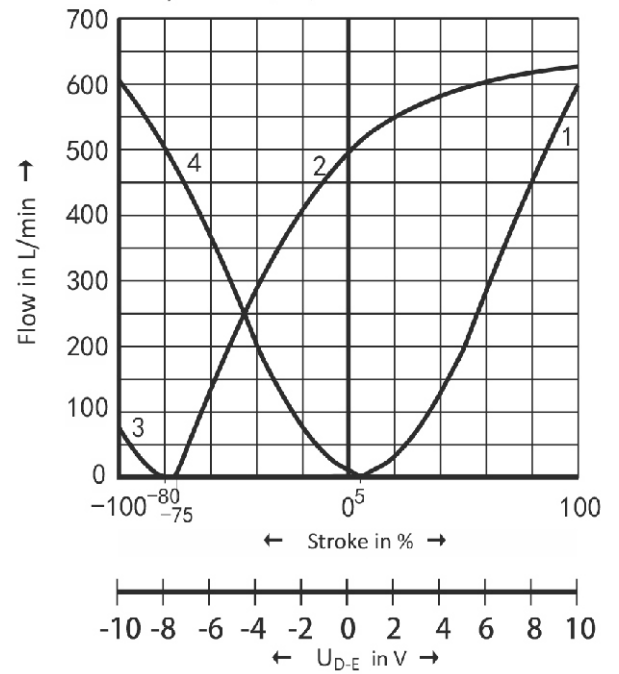
Symbol "Q3", version "250"



Symbol "Q3", version "100"



Symbol "Q3", version "250"

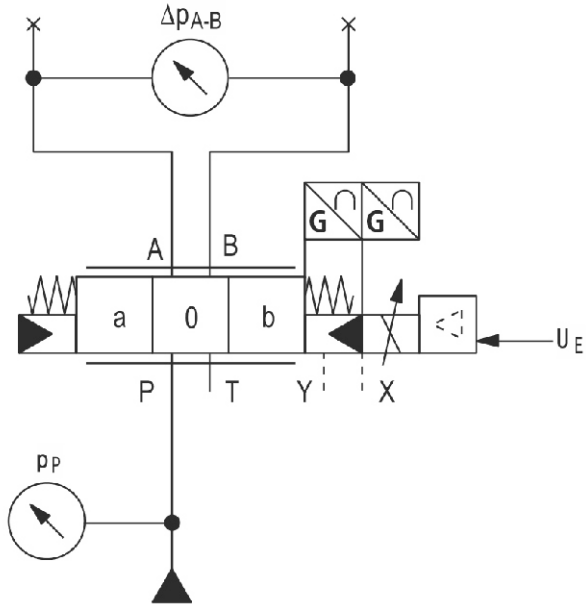


- 1 P→A
- 2 B→T
- 3 P→B
- 4 A→T

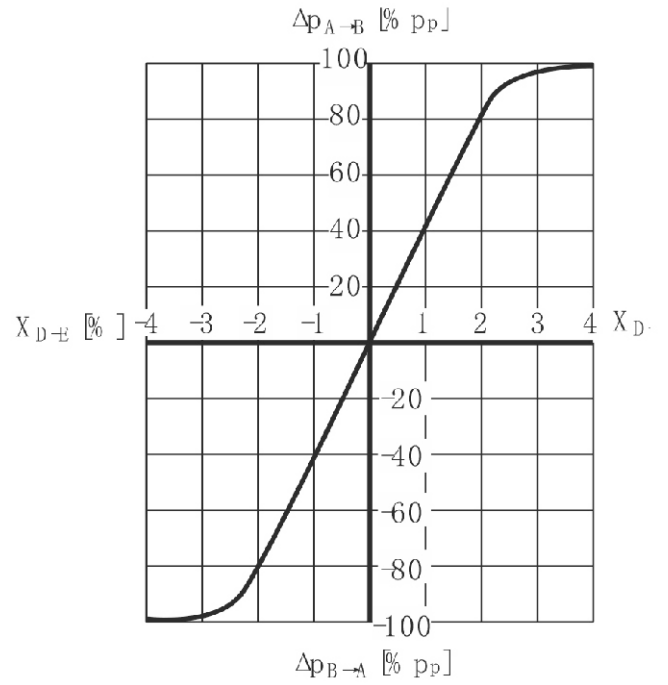


### Characteristic curves (HLP46 at 40°C ± 5°C)

Test block diagram



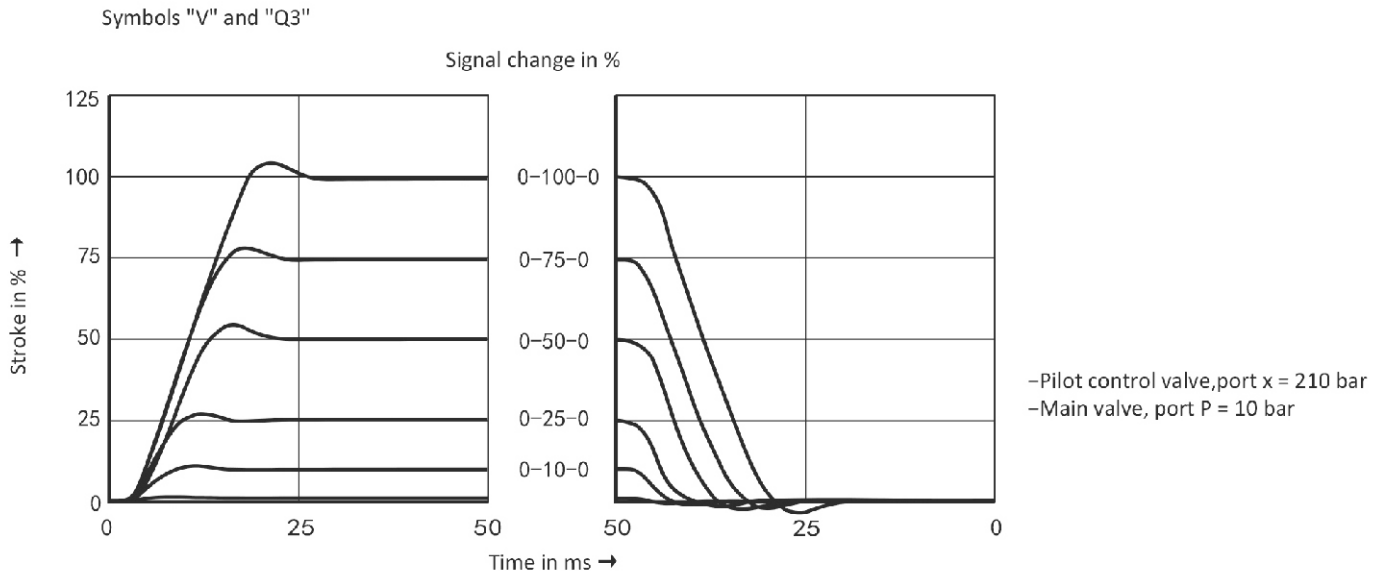
Pressure gain



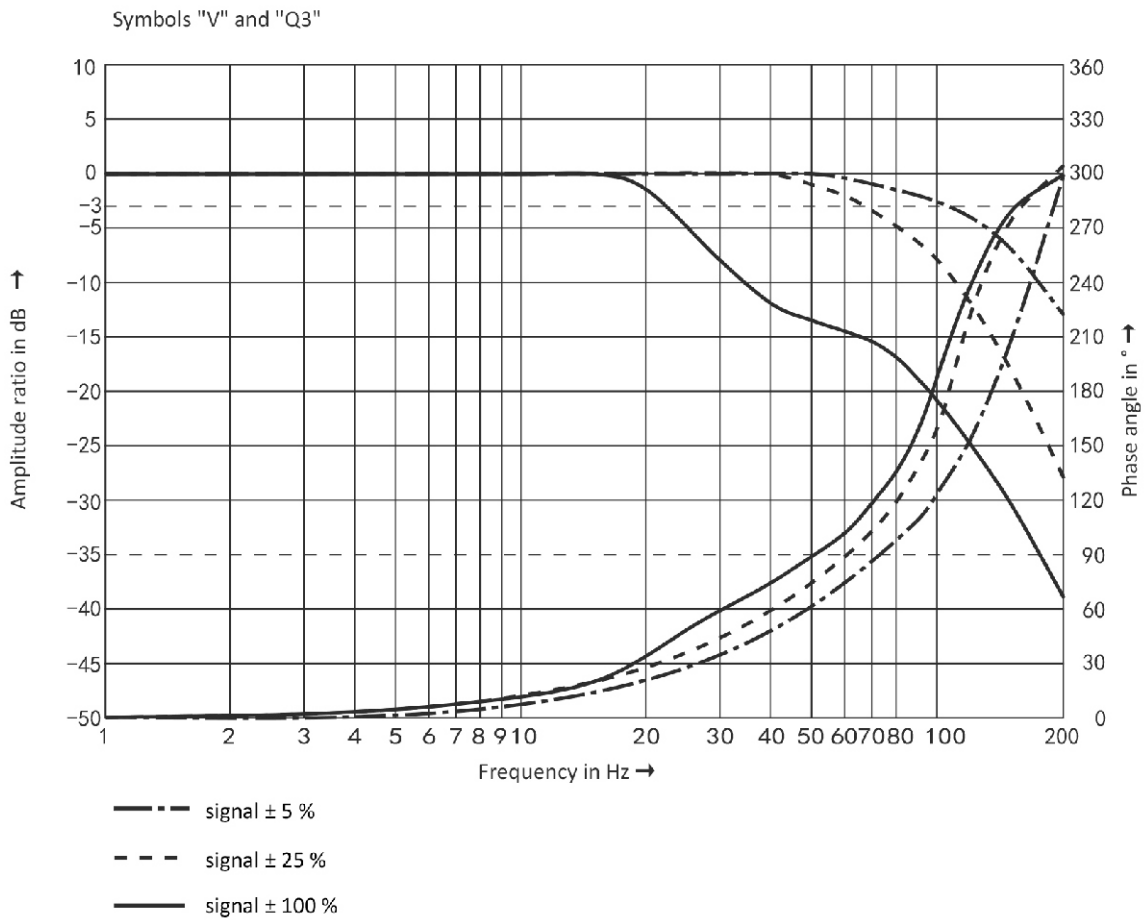


## Characteristic curves NS10 (HLP46 at 40°C ± 5°C)

### Transition function with stepped electric input signals



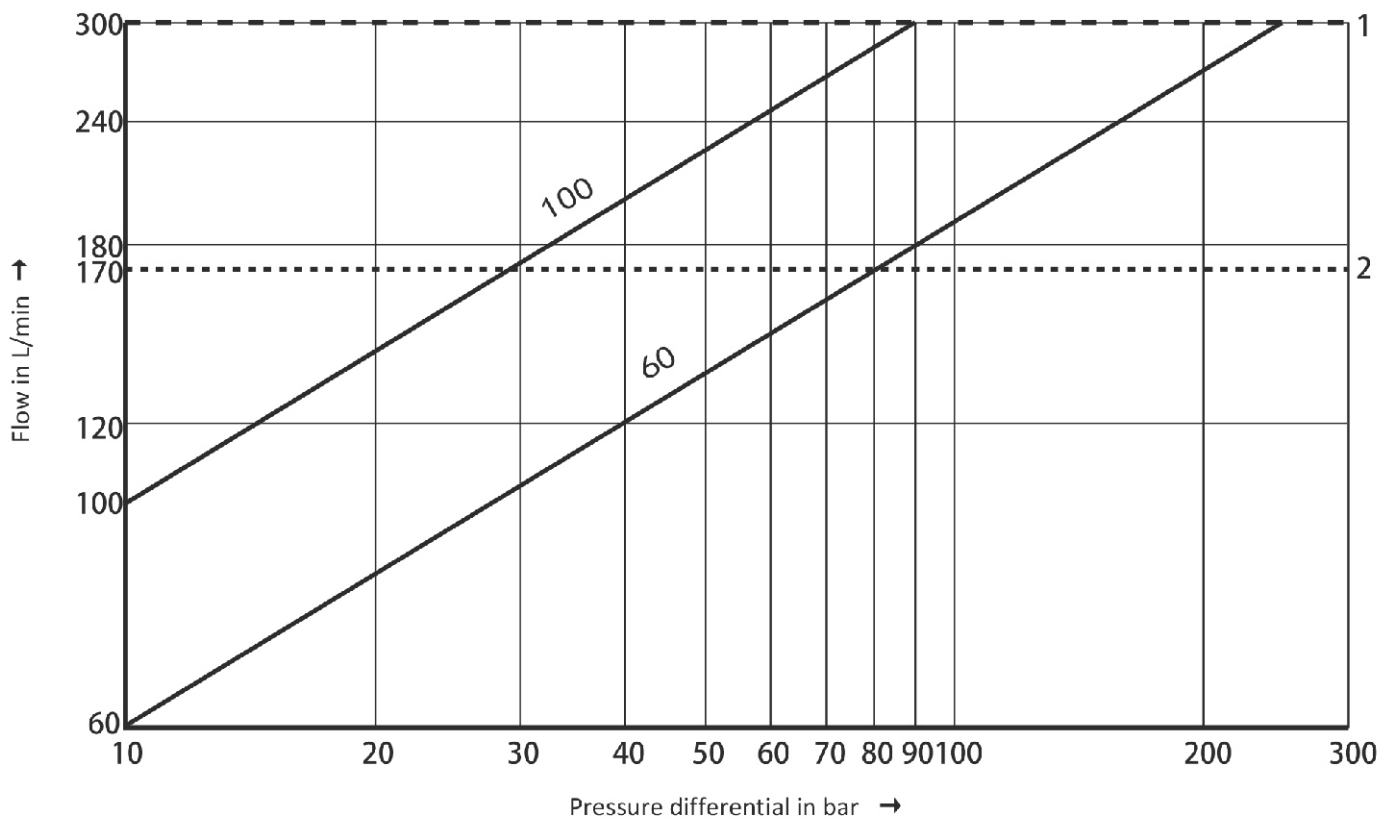
### Frequency response characteristic curves





### Characteristic curves NS10 (HLP46 at 40°C ± 5°C)

Flow/load function with maximum valve opening (with maximum valve opening; tolerance ± 10%)



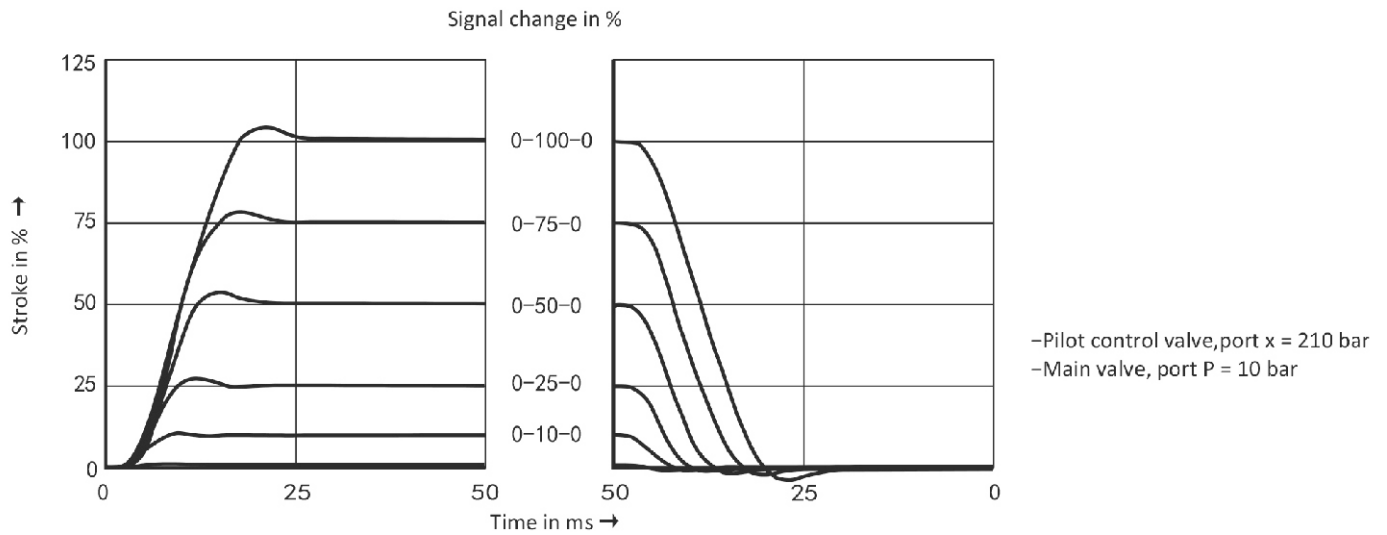
- 1 Maximum admissible flow
- 2 Recommended flow (flow velocity 30 m/s)



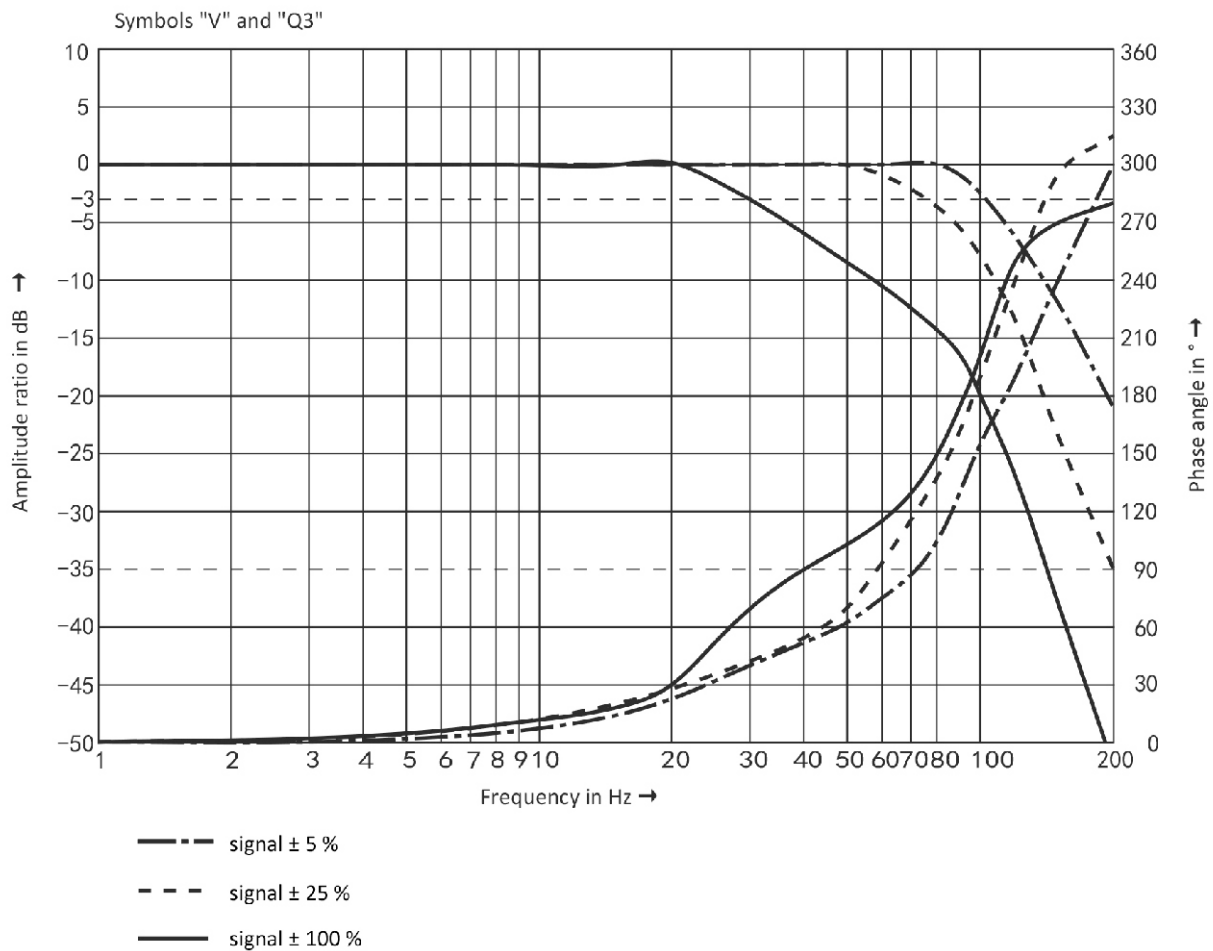
## Characteristic curves NS16 (HLP46 at 40°C ± 5°C)

### Transition function with stepped electric input signals

Symbols "V" and "Q3"



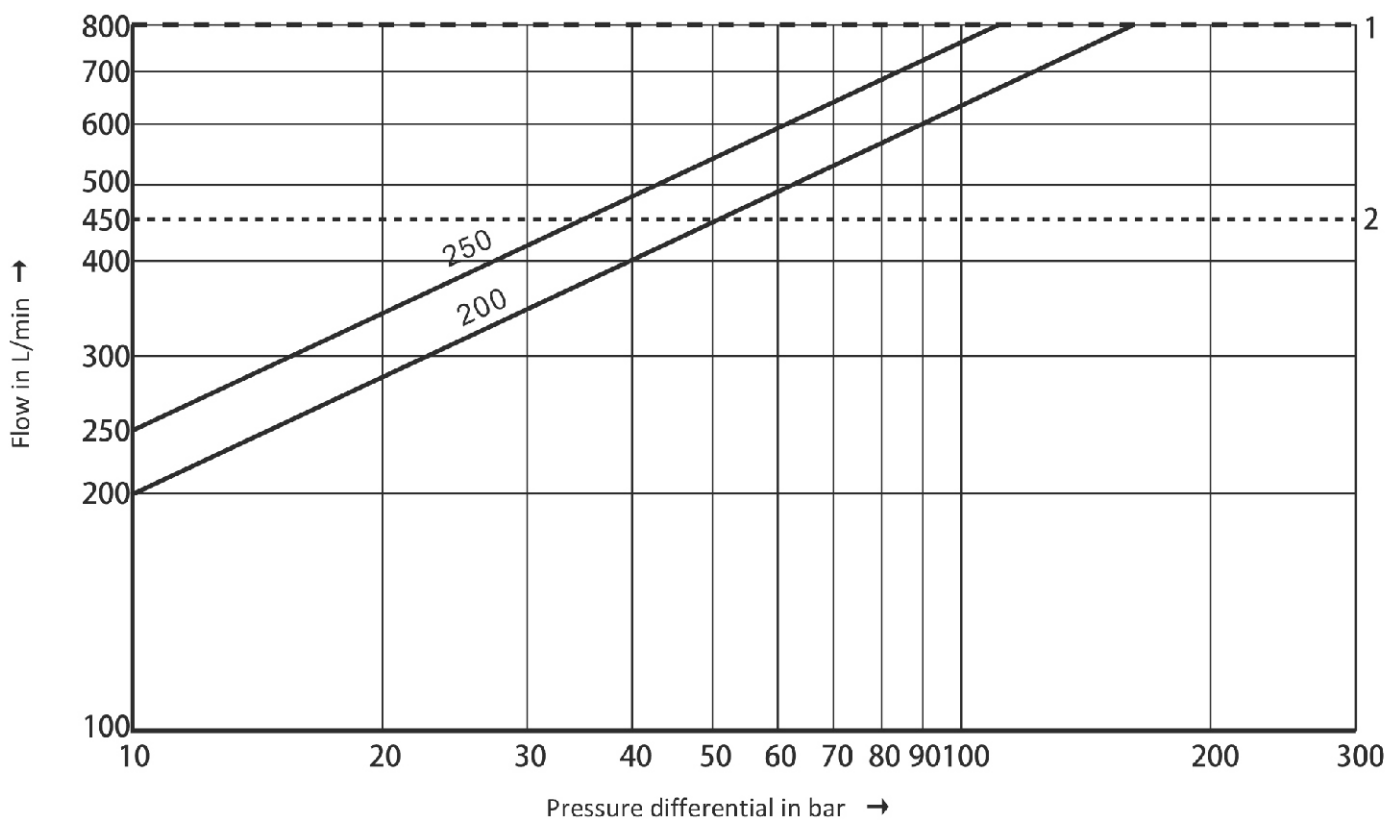
### Frequency response characteristic curves





### Characteristic curves NS16 (HLP46 at 40°C ± 5°C)

Flow/load function with maximum valve opening (with maximum valve opening; tolerance ± 10%)



- 1 Maximum admissible flow
- 2 Recommended flow (flow velocity 30 m/s)

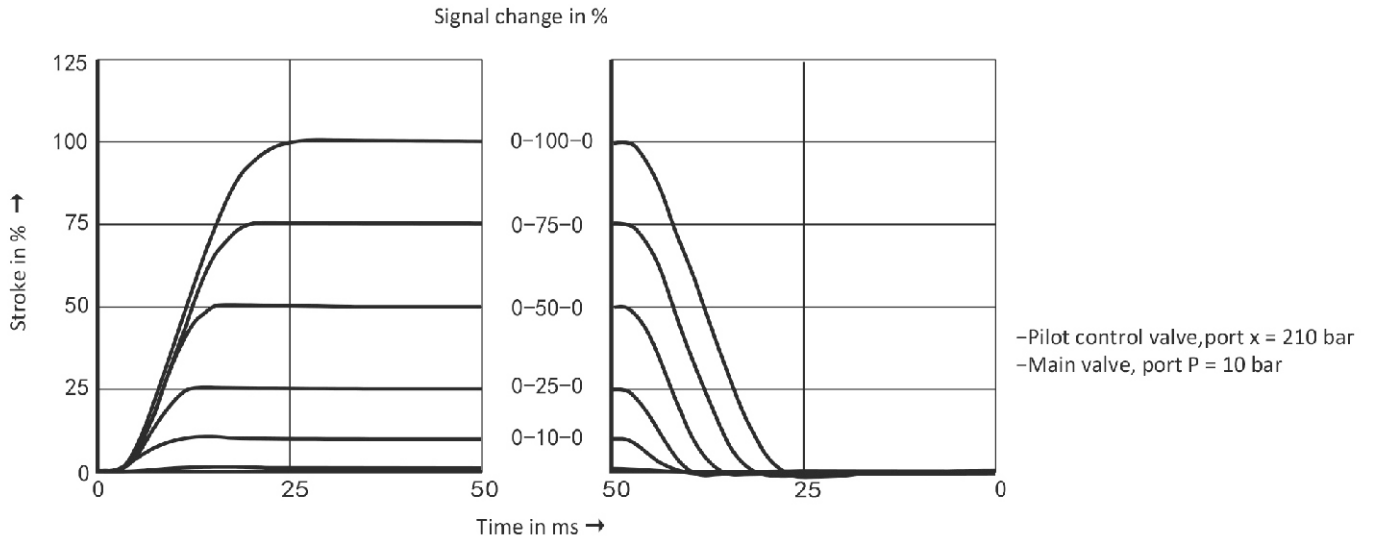




## Characteristic curves NS25 (HLP46 at 40°C ± 5°C)

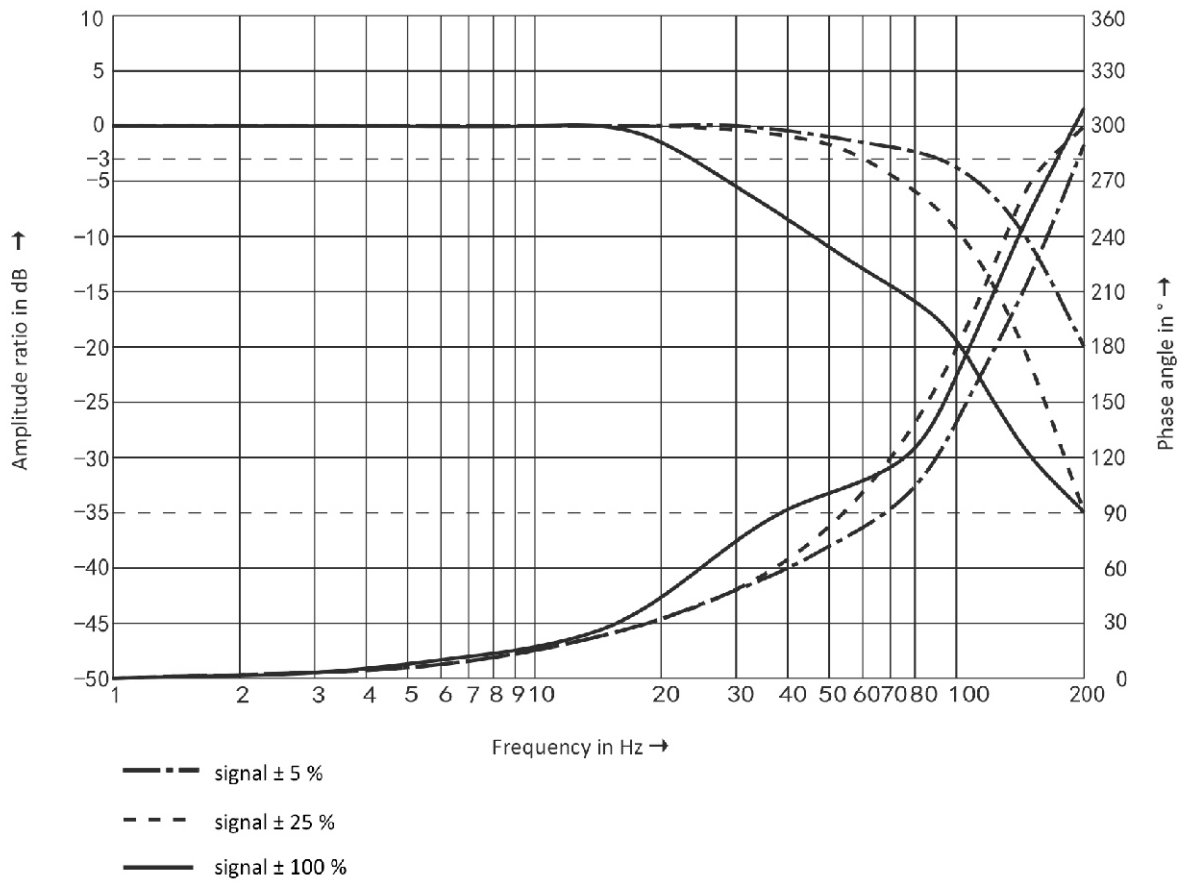
### Transition function with stepped electric input signals

Symbols "V" and "Q3"



### Frequency response characteristic curves

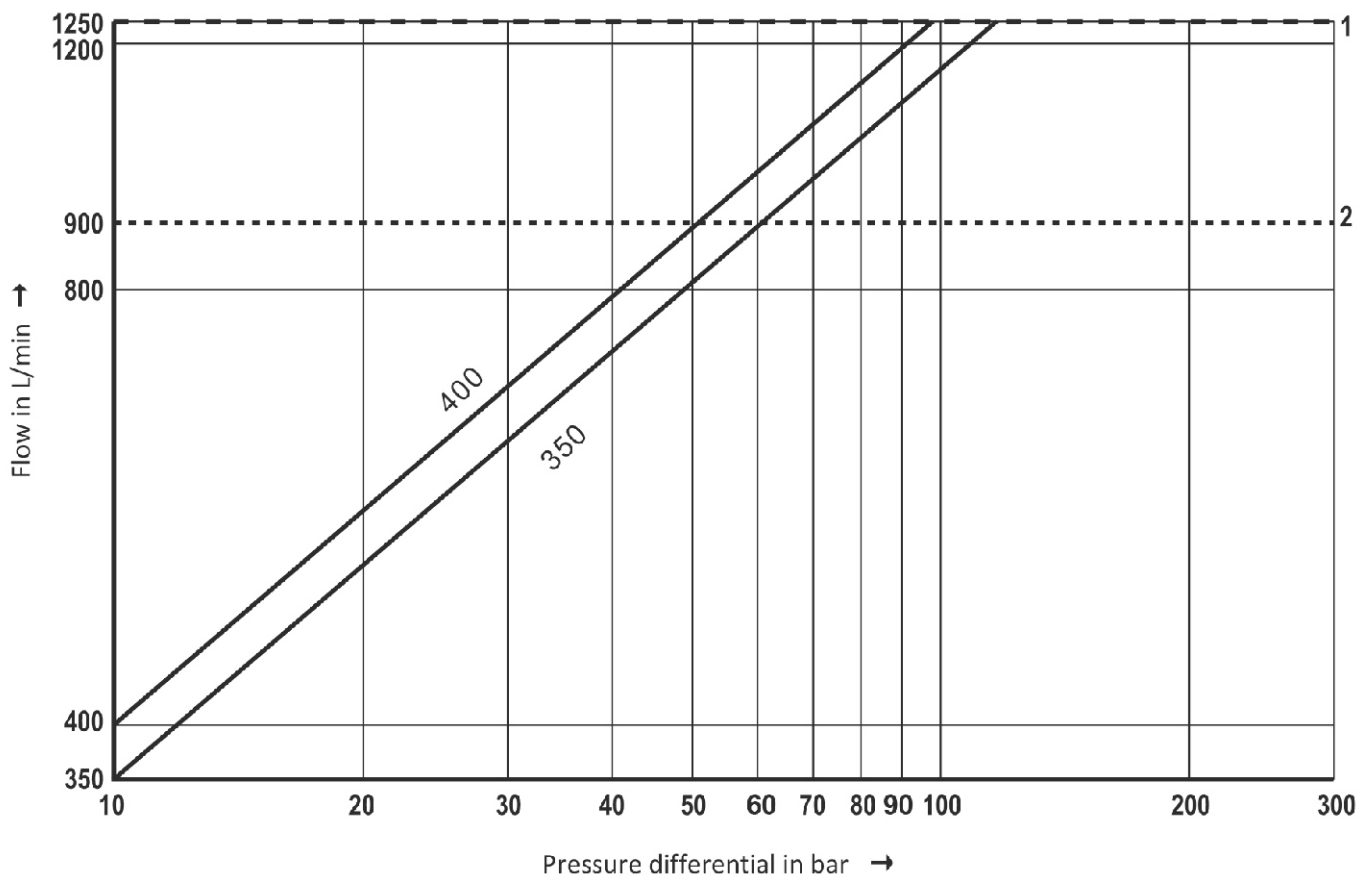
Symbols "V" and "Q3"





### Characteristic curves NS25 (HLP46 at 40°C ± 5°C)

Flow/load function with maximum valve opening (with maximum valve opening; tolerance ± 10%)

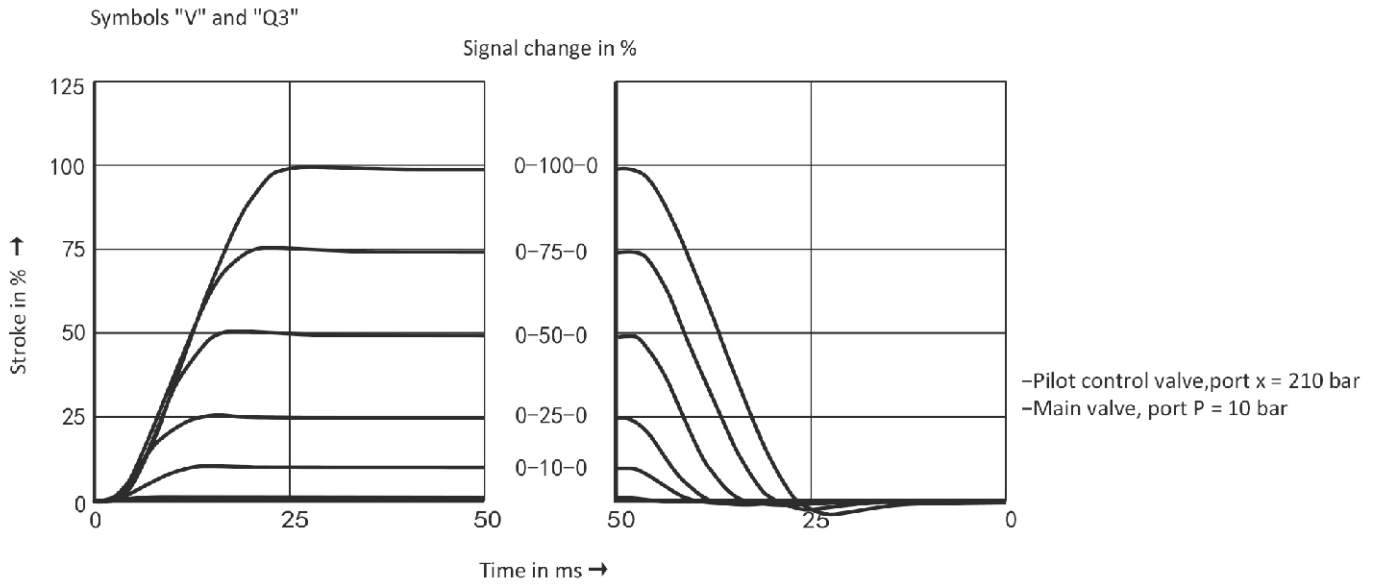


- 1 Maximum admissible flow
- 2 Recommended flow (flow velocity 30 m/s)

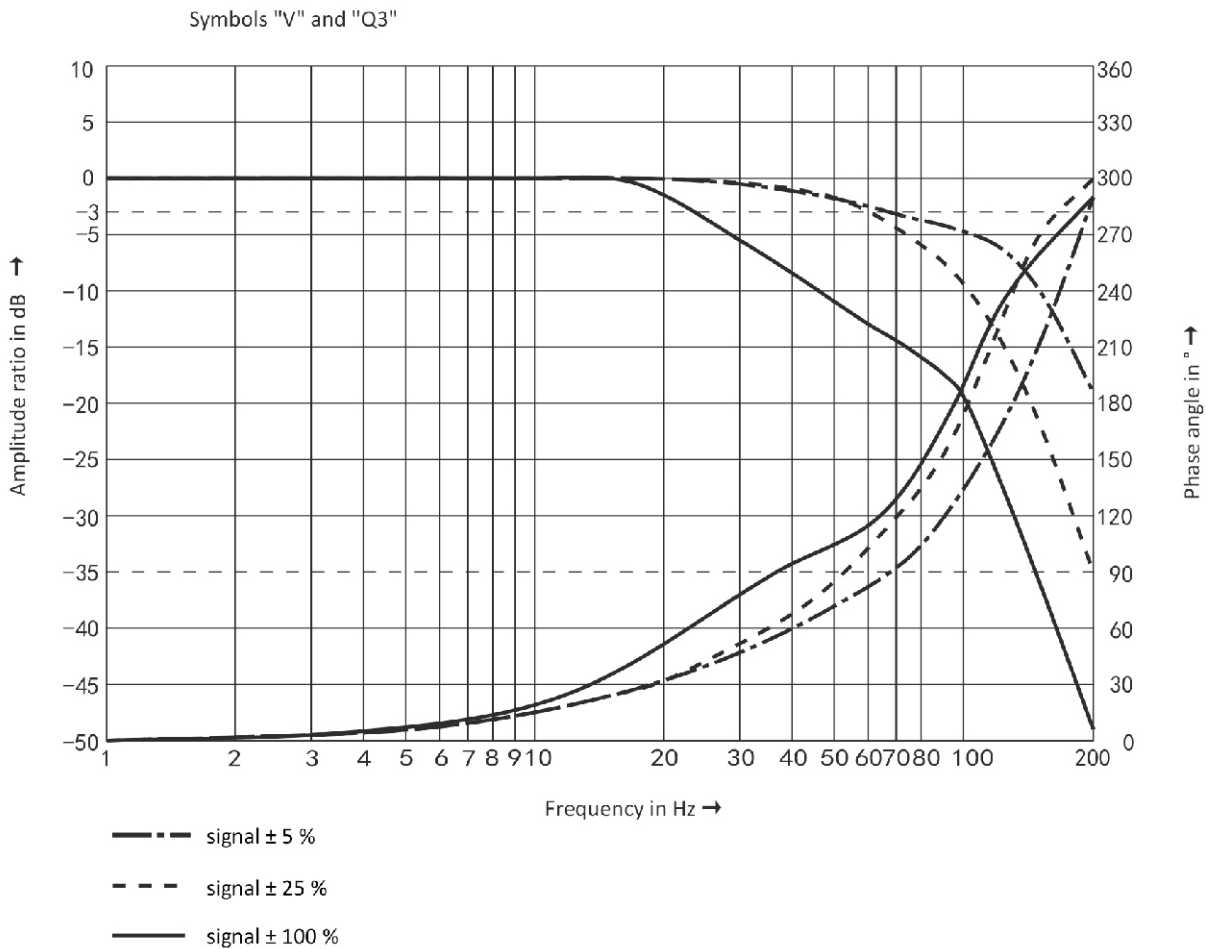


## Characteristic curves NS27 (HLP46 at 40°C ± 5°C)

### Transition function with stepped electric input signals



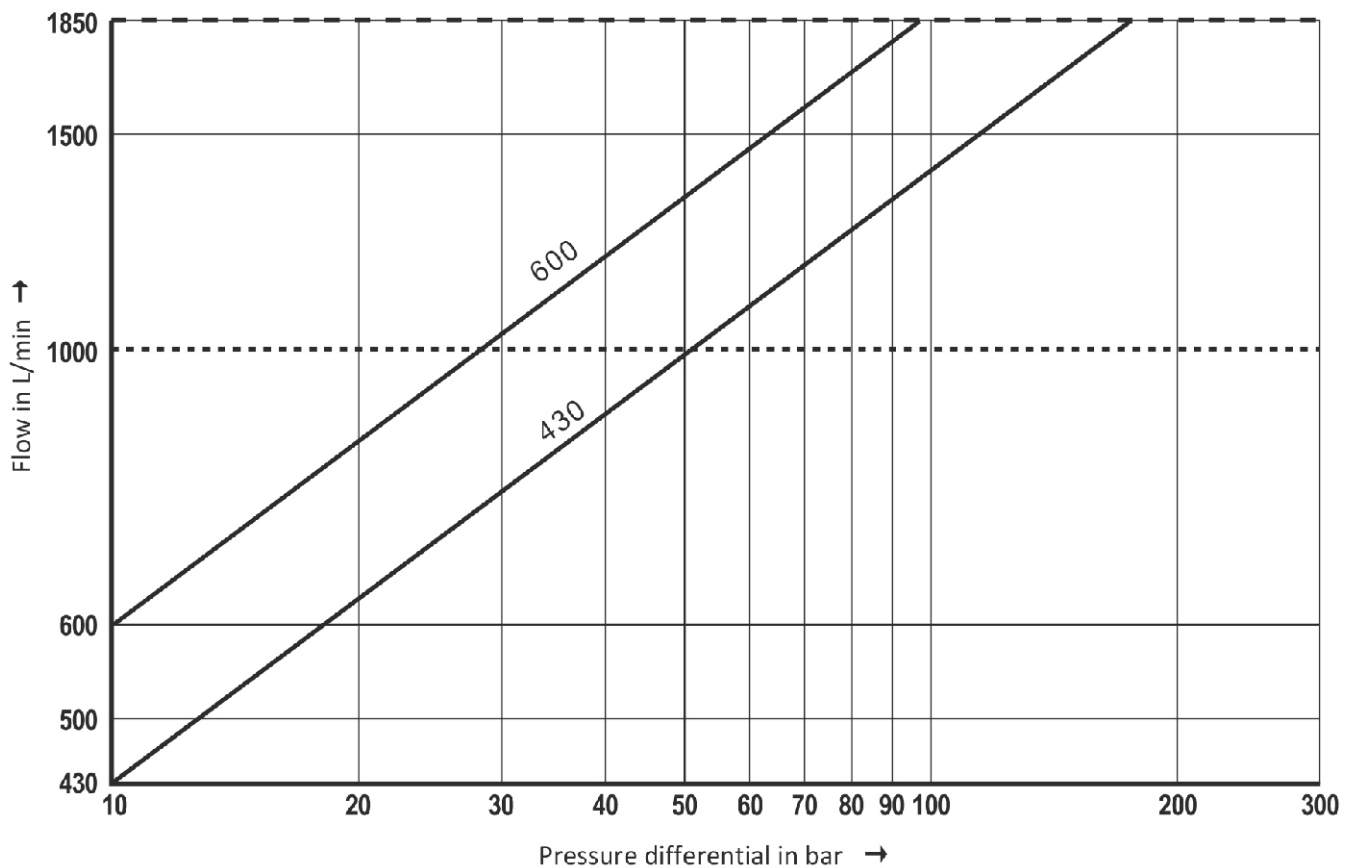
### Frequency response characteristic curves





### Characteristic curves NS27 (HLP46 at 40°C ± 5°C)

Flow/load function with maximum valve opening (with maximum valve opening; tolerance ± 10%)

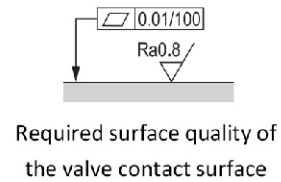
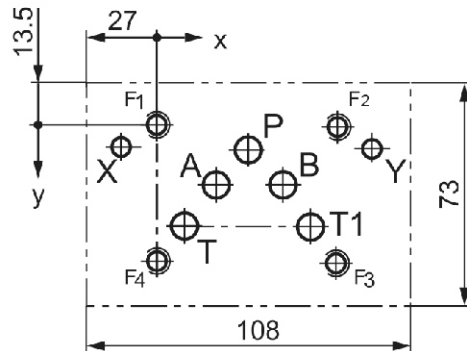
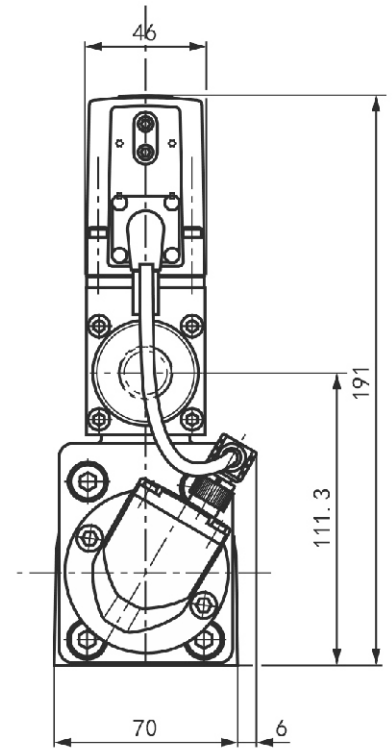
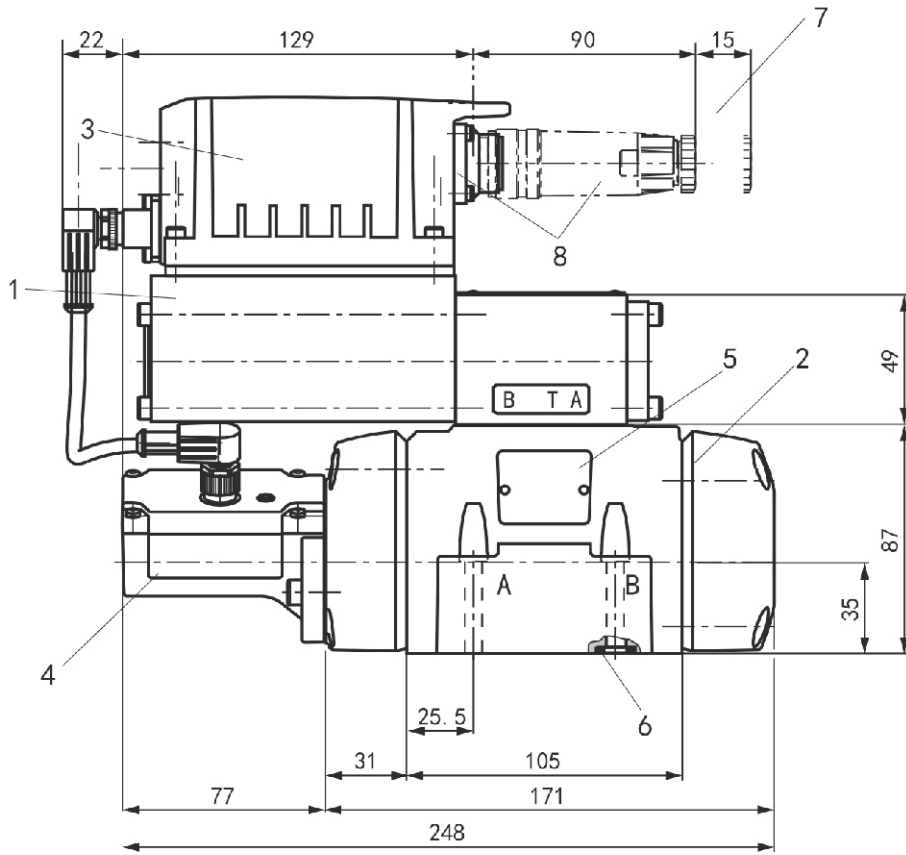


- 1 Maximum admissible flow
- 2 Recommended flow (flow velocity 30 m/s)



**Unit Dimensions NS10**

**(Dimensions in mm)**



Dimensions in mm	p	A	T	T1	B	F1	F2	F3	F4	X	Y
<b>Diameter/thread</b>	Max. ø11.2	Max. ø11.2	Max. ø11.2	Max. ø11.2	Max. ø11.2	M6	M6	M6	M6	Max. ø6.3	Max. ø6.3
<b>x</b>	27	16.7	3.2	50.8	37.3	0	54	54	0	-8	62
<b>y</b>	6.3	21.4	32.5	32.5	21.4	0	0	46	46	11	11

1. Pilot control valve
2. Main valve
3. Integrated electronics (OBE)
4. Inductive position transducer (main valve)
5. Name plate
6. Identical seal rings for ports A, B, P, T,X,Y
7. Space required for connection cable and to remove the mating connector

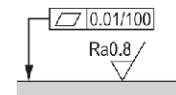
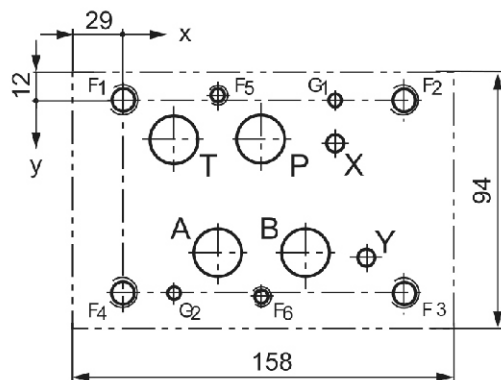
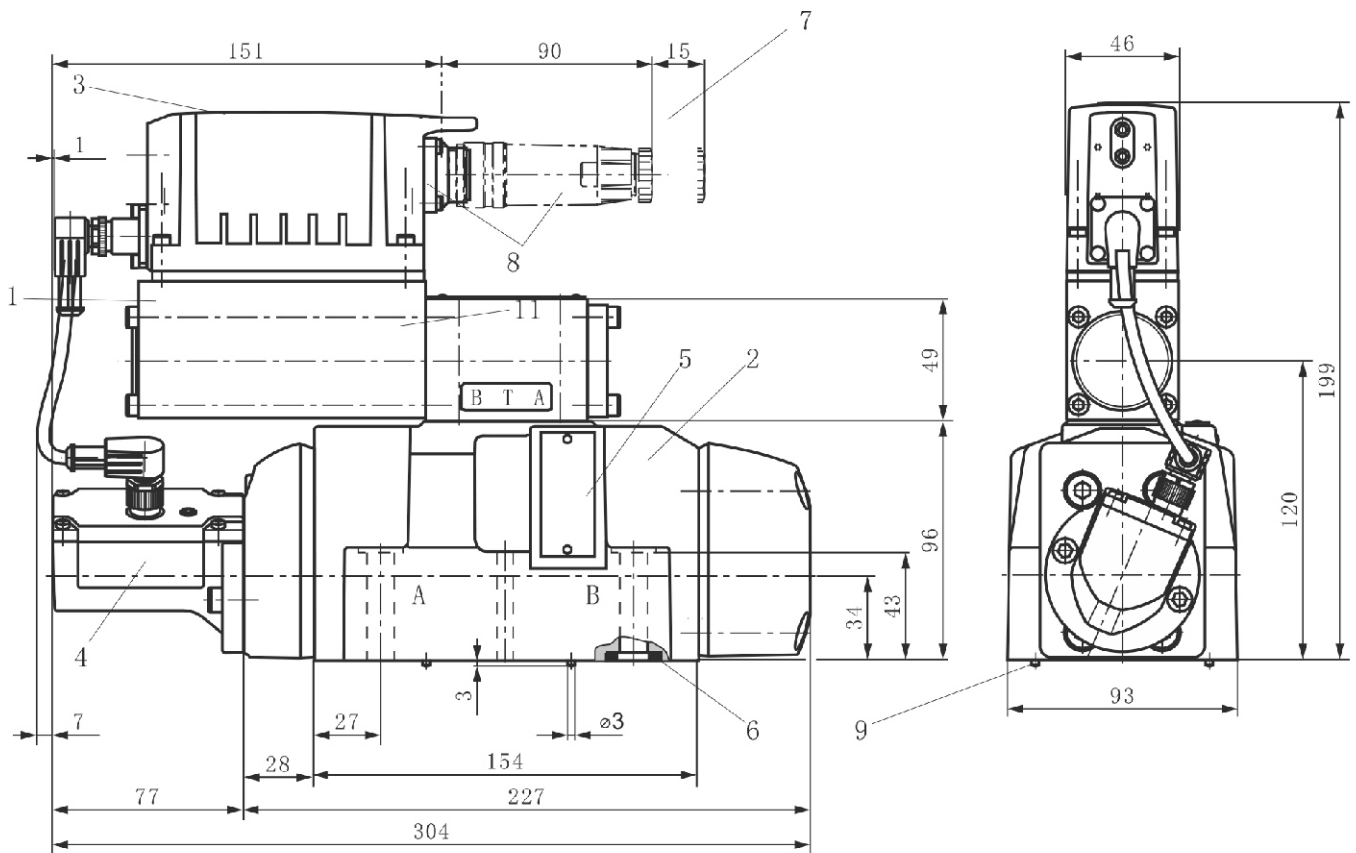
8. Mating connector 6-pole + PE (separate order)
9. Locking pin
10. Machined valve contact surface, porting pattern according to ISO 4401-05-05-0-05

Fixing screws: 4 GB/T 70.1 - M6 x 45 10.9  
Torque: 15.5 Nm ± 10 %



Unit Dimensions NS16

(Dimensions in mm)



Required surface quality of the valve contact surface

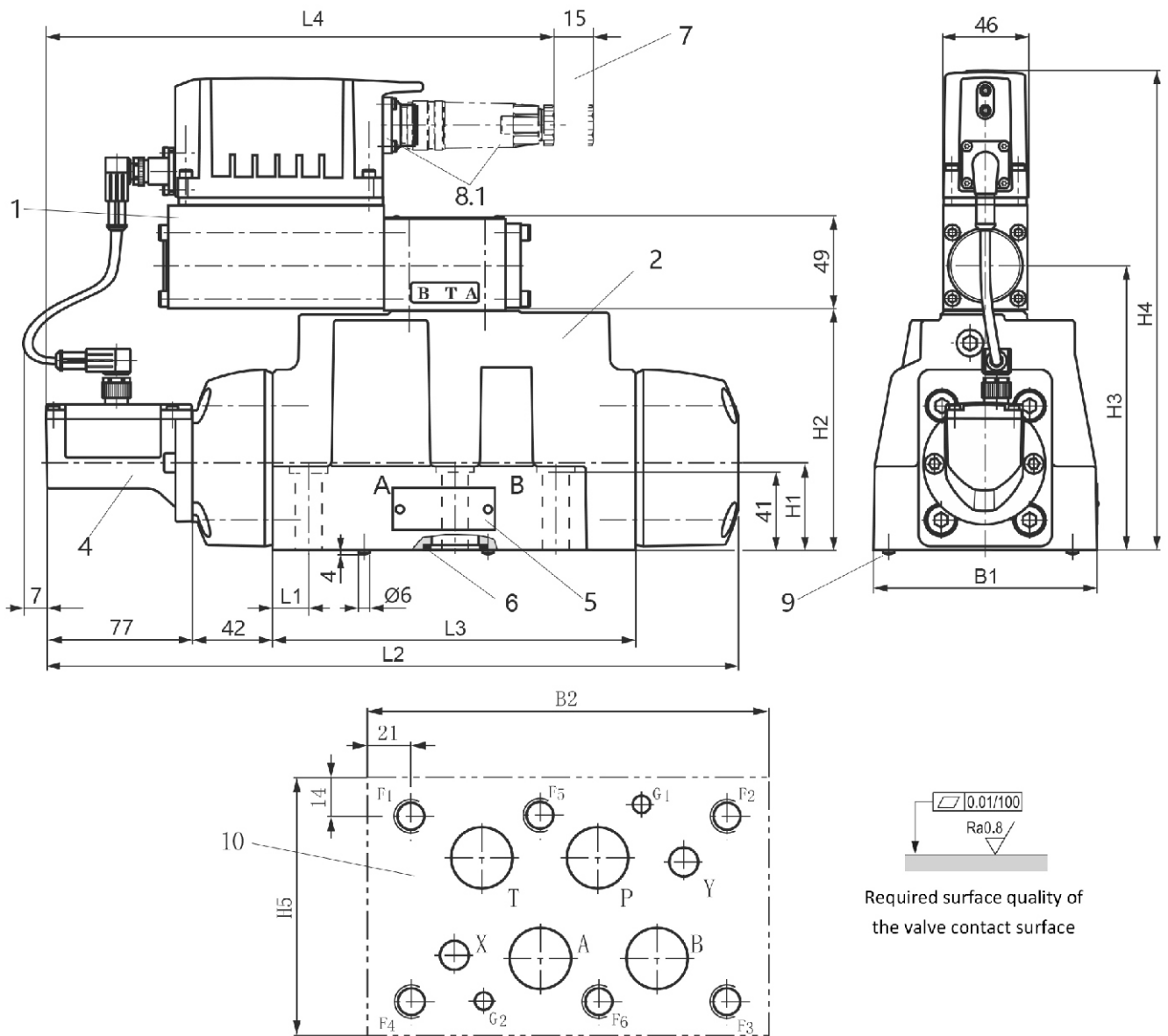
Dimensions in mm	P	A	T	B	X	Y	G1	G2	F1	F2	F3	F4	F5	F6
<b>Diameter/thread</b>	Max. ø17.5	Max. ø17.5	Max. ø17.5	Max. ø17.5	Max. ø6.3	Max. ø6.3	ø4	ø4	M10	M10	M10	M10	M6	M6
<b>x</b>	50	34.1	18.3	65.9	76.6	88.1	76.6	18.3	0	101.6	101.6	0	34.1	50
<b>y</b>	14.3	55.6	14.3	55.6	15.9	57.2	0	69.9	0	0	69.9	69.9	-1.6	71.5

- 1. Pilot control valve
  - 2. Main valve
  - 3. Integrated electronics (OBE)
  - 4. Inductive position transducer (main valve)
  - 5. Name plate
  - 6. Identical seal rings for ports A, B, P, T, X, Y
  - 7. Space required for connection cable and to remove the mating connector
  - 8. Mating connector 6-pole + PE (separate order)
  - 9. Locking pin
  - 10. Machined valve contact surface, porting pattern according to ISO 4401-07-07-0-05  
Deviating from the standard: ports A, B, P, T – ø20 mm
- Fixing screws: 4 GB/T 70.1 - M10 x 60 10.9  
2 GB/T 70.1-M6x60-10.9
- Torque: 75 Nm ± 20 %



Unit Dimensions Ns25 and 27

(Dimensions in mm)



NS	L1	L2	L3	L4	H1	H2	H3	H4	H5	B1	B2
25	19	364	191	274	46	126	150	251	120	118	195
27	20.5	371	198	277	50	140	164	265	124	120	200

Dimensions in mm	P	A	T	B	X	Y	G1	G2	F1	F2	F3	F4	F5	F6
Diameter/thread	Max. ø25	Max. ø25	Max. ø25	Max. ø25	Max. ø11.2	Max. ø11.2	ø7.5	ø7.5	M12	M12	M12	M12	M12	M12
x	77	53.2	29.4	100.8	17.5	112.7	94.5	29.4	0	130.2	130.2	0	53.2	77
y	17.5	74.6	17.5	74.6	73	19	-4.8	92.1	0	0	92.1	92.1	0	92.1

- 1. Pilot control valve
  - 2. Main valve
  - 3. Integrated electronics (OBE)
  - 4. Inductive position transducer (main valve)
  - 5. Name plate
  - 6. Identical seal rings for ports A, B, P, T, X, Y
  - 7. Space required for connection cable and to remove the mating connector
  - 8. Mating connector 6-pole + PE (separate order)
  - 9. Locking pin
  - 10. Machined valve contact surface, porting pattern according to ISO 4401-08-08-0-05  
Deviating from the standard: ports A, B, P, T – Ø32 mm
- Fixing screws: 6 GB/T 70.1 - M12 x 60 10.9  
Torque: 130 Nm ± 20 %

