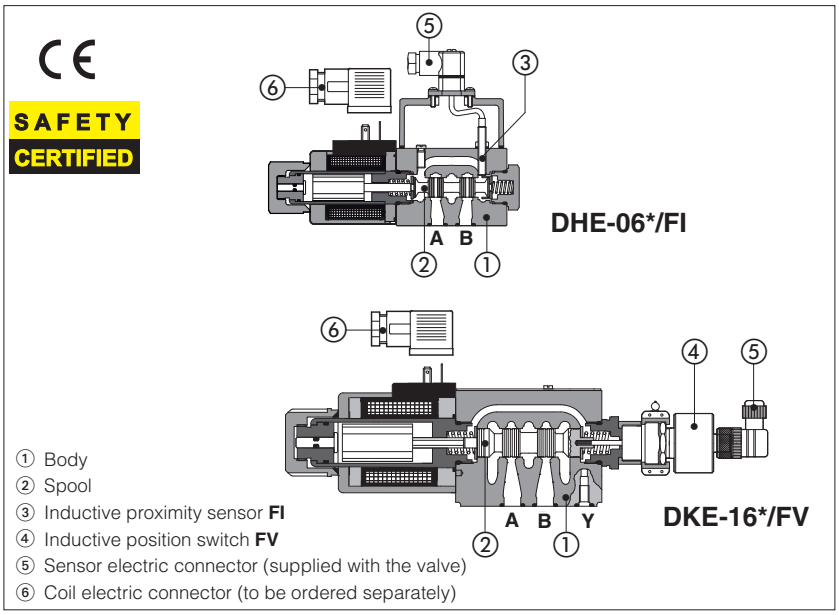
Safety directional valves with spool position monitoring

On-off, direct operated, conforming to Machine Directive 2006/42/EC - certified by



① Body
② Spool
③ Inductive proximity sensor **FI**
④ Inductive position switch **FV**
⑤ Sensor electric connector (supplied with the valve)
⑥ Coil electric connector (to be ordered separately)

Direct operated safety directional valves with spool position monitoring, **CE** marked and certified by **TÜV** in accordance with safety requirements of Machine Directive 2006/42/EC.

DHE, size 06, high performances, for AC and DC supply with cURus certified solenoids

DKE, size 10, for AC and DC supply with cURus certified solenoids

The valves are equipped with **FI** inductive proximity sensor or **FV** inductive position switch for the spool position monitoring, see section 1 and 11 for sensors availability and technical characteristics.

Certification
The **TÜV** certificate can be downloaded from www.atos.com, catalog on line, technical information section.

Mounting surface: **ISO 4401**, size **06** and **10**

Max flow: **DHE 80 l/min**
DKE 150 l/min

Max pressure: **350 bar**

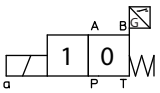
1 RANGE OF VALVE'S MODELS

Valve code	Size	Description	DC solenoids		AC solenoids	
			Sensor type			
			/FI	/FV	/FI	/FV
DHE-06	06	direct operated solenoid valves, on-off, single solenoid	•	•	•	•
DHE-07	06	direct operated solenoid valves, on-off, double solenoid	•	•	•	
DKE-16	10	direct operated solenoid valves, on-off, single solenoid	•	•	•	•
DKE-17	10	direct operated solenoid valves, on-off, double solenoid	•	•	•	

Notes:
FI = inductive proximity sensor, type NO (normally open) or NC (normally closed)
FV = inductive position switch providing both NO and NC contacts to be wired on the electric connector
See section 11 for sensor's characteristics

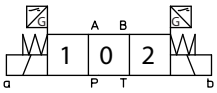
1.1 FI sensor & FV switch configurations

Single solenoid valves size 06 & 10 are provided with n°1 FI sensor or n° 1 FV switch for the spool position monitoring

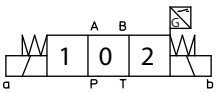


FI or FV

Double solenoid valves size 06 & 10 are provided with n° 2 FI sensors or n° 1 FV switch for the spool position monitoring

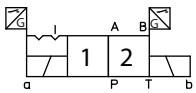


FI

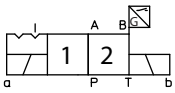


FV

Double solenoid valves size 06 with detent are provided with n°2 FI sensors or n° 1 FV switch for the spool position monitoring

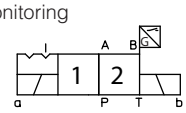


FI



FV

Double solenoid valves size 10 with detent are provided with n° 1 FI sensor or n° 1 FV switch for the spool position monitoring



FI or FV

For model code of DHE safety valves, see section 2
For model code of DKE safety valves, see section 4

2 MODEL CODE OF DHE

DHE	- 0	63	1/2	/ A	/ FV	* - X	24DC	** /	*

Directional control valve size 06
DHE = max flow 80 l/min

Size ISO 4401
0 = size 06

Valve configuration, see section 3
61 = single solenoid, central plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, external plus central position, spring offset
71 = double solenoid, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent

Spool type, see section 3

Options, see section 8

(1) the **FV** inductive position switch provides both NC and NO contacts

Spool position monitor:
FI = inductive proximity switch
FV = inductive position switch (double contact)

Electrical signal - only for **FI** version (1):
/NC = electric contact is closed when the valve is de-energized
/NO = electric contact is open when the valve is de-energized

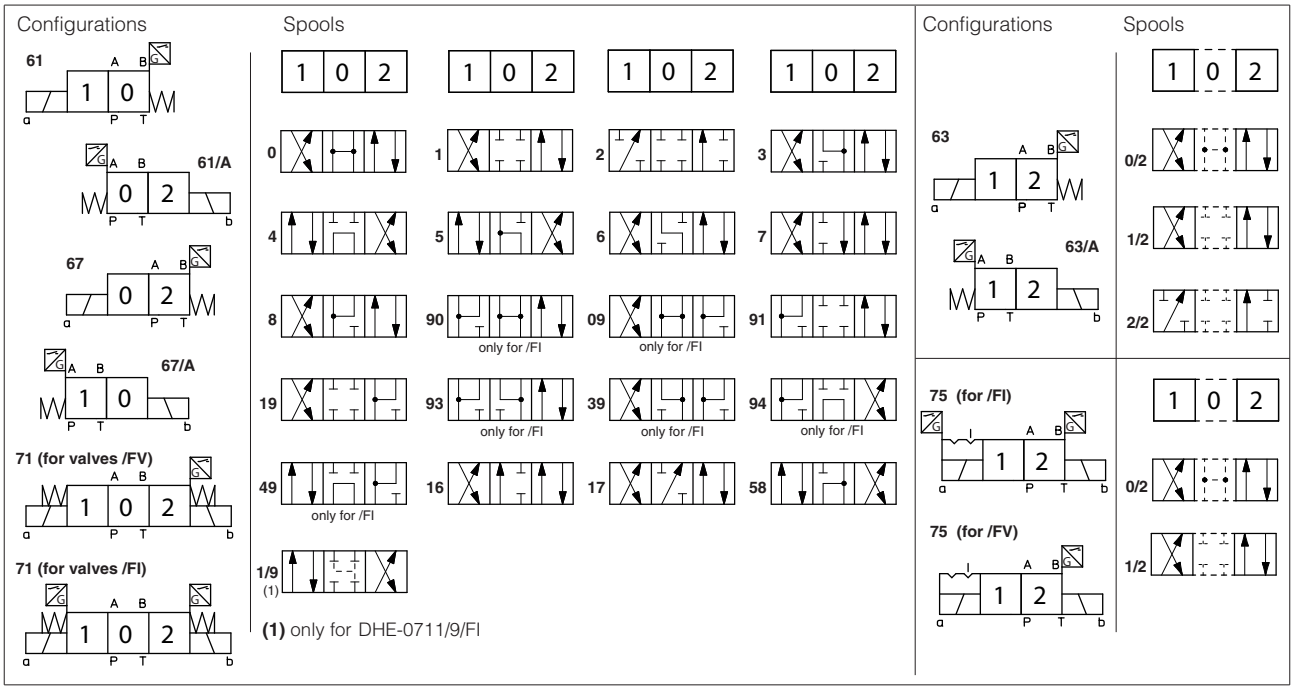
X = without connector, see section 10 for available connectors, to be ordered separately

Voltage code, see section 9

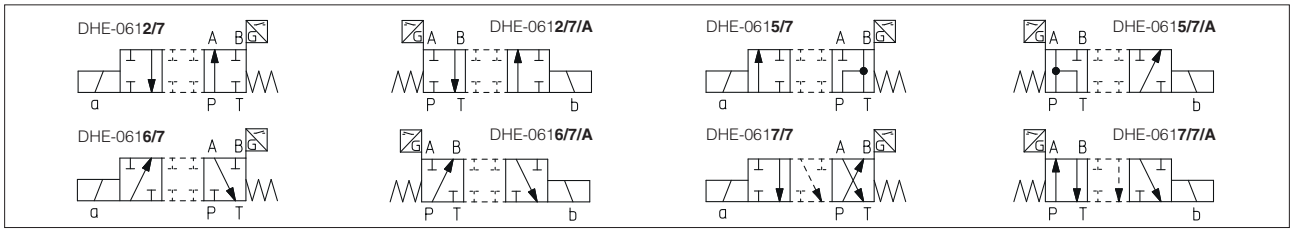
Series number

Seals material see sect. 6,7
- = NBR
PE = FKM

3 CONFIGURATIONS AND SPOOLS (representation according to ISO 1219-1)



3.1 Configuration for spool */7



3.2 Special shaped spools for DHE

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1, 4**, **5** and **58** are also available as **1/1, 4/8, 5/1** and **58/1**.
  They are properly shaped to reduce water-hammer shocks during the swiching.
- spools type **1, 1/2, 3, 8** are available as **1P, 1/2P, 3P, 8P** to limit valve internal leakages.
- Other types of spools can be supplied on request.

3.3 Standard spool availability for DHE - spools not listed in the table are available for all valves models

Valve type	standard spool						
	09	90	39	93	49	94	1/9
DHE/FI	•	•	•	•	•	•	•
DHE/FV							

4 MODEL CODE OF DKE

DKE	- 1	63	1/2	/ A	/ FV	* - X	24DC	** / *

Directional control valve size 10

Size ISO 4401
1 = size 10

Valve configuration, see section 5
61 = single solenoid, central plus external position, spring centered
63 = single solenoid, 2 external positions, spring offset
67 = single solenoid, external plus central position, spring offset
71 = double solenoid, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent

Spool type, see section 5

Options, see section 8

X = without connector, see section 10 for available connectors, to be ordered separately

Voltage code, see section 9

Series number

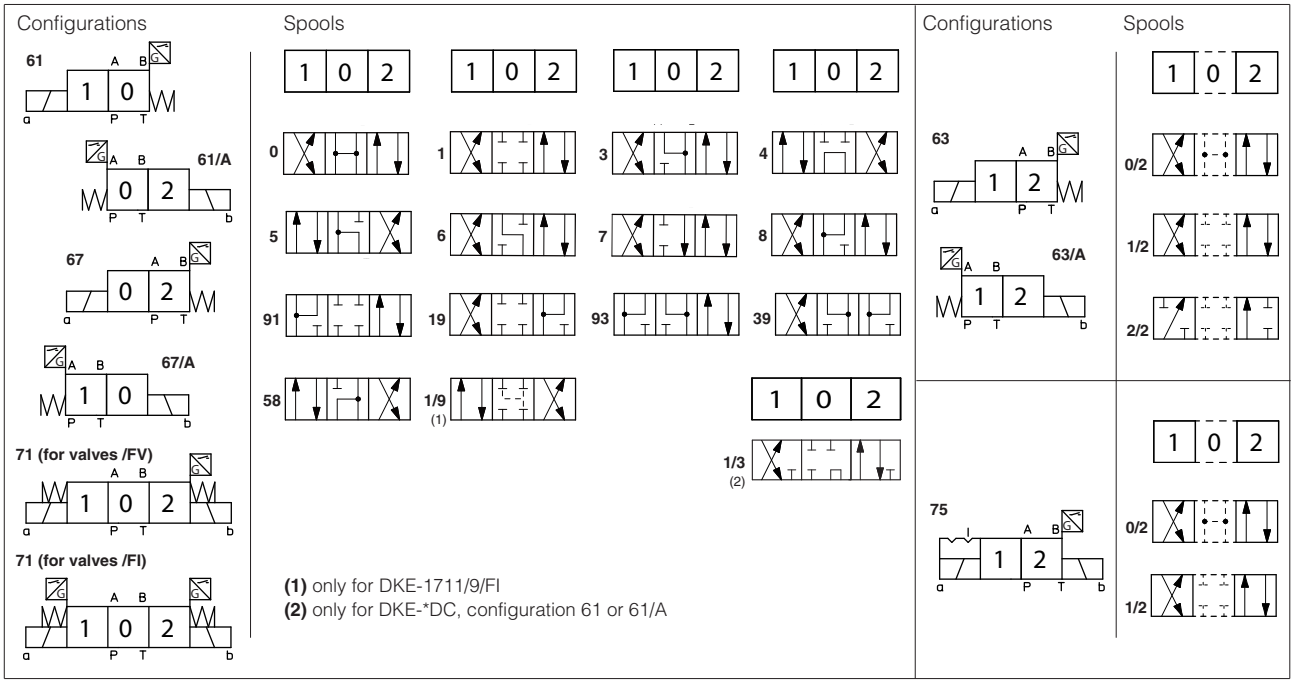
Seals material see sect. 6,7
- = NBR
PE = FKM

Electrical signal - only for **FI** version (1):
/NC = electric contact is closed when the valve is de-energized
/NO = electric contact is open when the valve is de-energized

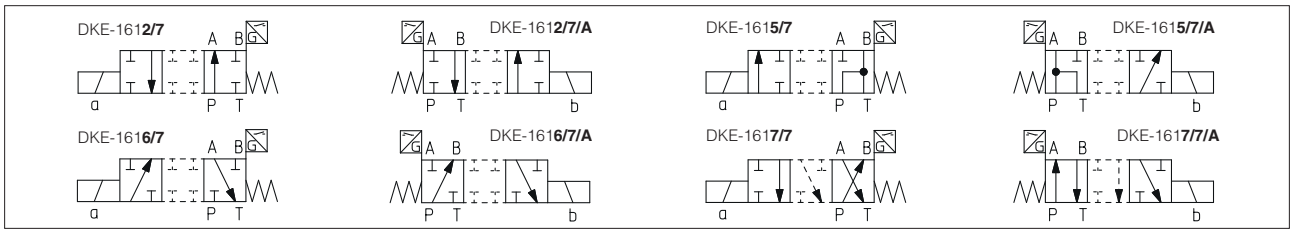
Spool position monitor:
FI = inductive proximity switch
FV = inductive position switch (double contact)

DKE/FI and /FV are always provided with Y drain port
(1) the **FV** inductive position switch provides both NC and NO contacts

5 CONFIGURATIONS AND SPOOLS (representation according to ISO 1219-1)



5.1 Configuration for spool */7



5.2 Special shaped spools for DKE

- spools type **0** and **3** are also available as **0/1** and **3/1** with restricted oil passages in central position, from user ports to tank.
- spools type **1** is also available as **1/1**, properly shaped to reduce the water-hammer shocks during the switching.
- spool type **1/9** has closed center in rest position but it avoids the pressurization of A and B ports due to the internal leakages.
- other types of spools can be supplied on request.

6 MAIN CHARACTERISTICS

Assembly position / location		Any position
Subplate surface finishing		Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)
MTTFd values according to EN ISO 13849		150 years, for further details see technical table P007
Compliance		CE to Machine Directive 2006/42/EC. -EC type-examination certificate for safety components **(1)** -ISO 13849 category 1, PLC in high demand mode CE to Low Voltage Directive 2014/35/EU and Machine Directive 2006/42/EC. RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006
Ambient temperature		**Standard** = -30°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Flow direction		As shown in the symbols of table 3 and 5
Surface protection		Zinc coating with black passivation Coil: zinc nickel coating (DC version) plastic incapsulation (AC version)
Corrosion resistance		Salt spry test (EN ISO 9227) > 200h
Operating pressure	**DHE**	P, A, B = **350 bar** T = **100 bar** (version /FI); **210 bar** (DC solenoid - version /FV); **160 bar** (AC solenoid - version /FV)
	DKE	P, A, B = **350 bar** T = (with Y port not connected to tank) **100 bar** (version /FI); **210 bar** (DC solenoid - version /FV); **120 bar** (AC solenoid - version /FV) T = (with Y port drained to tank) **250 bar**
Rated flow		see diagrams Q/Δp at section 14
Maximum flow	**DHE**	**80 l/min** see section 15
	DKE	**150 l/min** see section 15

(1) The type-examination certificate can be download from www.atos.com

6.1 Coils characteristics

Insulation class	**H** (180°C) for DC coils **F** (155°C) for AC coils Due to the occuring surface temperatures of the solenoid coils, the European standards EN ISO 13732-1 and EN ISO 4413 must be taken into account
Protection degree to DIN EN 60529	**IP 65** (with connectors correctly assembled)
Relative duty factor	100%
Supply voltage and frequency	See electric features 9
Supply voltage tolerance	± 10%
Certification	**cURus** North American standard

7 SEALS AND HYDRAULIC FLUID - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +80°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	15÷100 mm²/s - max allowed range 2,8 ÷ 500 mm²/s		
Max fluid contamination level	ISO4406 class 20/18/15 NAS1638 class 9, see also filter section at www.atos.com or KTF catalog		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

8 OPTIONS

A = Single solenoid valves: solenoid mounted at side of port B. In standard versions the solenoid is mounted at side of port A.
Double solenoid valves DHE/FV(DC), DKE/FV(DC): FV inductive position switch mounted at side of port A. In standard versions the position switch is mounted at side of port B.

WARNING: the manual operation is not permitted for safety valves, than the valve is provided with solenoid blind rings to prevent the access to the manual override. The manual override protected by rubber cup (option /WP) is not available

WARNING: the inobservance of following prescriptions invalidates the certification and may represent a risk for personnel injury
Safety valves must be installed and commissioned only by qualified personnel
Safety valves must not be disassembled
The inductive proximity FI or the inductive position switch FV can be adjusted only by the valve's manufacturer or Atos authorized service centers
Valve's components cannot be interchanged
The valves must operate without switching shocks and spool vibrations

9 ELECTRIC FEATURES

9.1 COILS FOR DHE VALVES

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	30 W	COE-12DC
14 DC	**14 DC**			COE-14DC
24 DC	**24 DC**			COE-24DC
28 DC	**28 DC**			COE-28DC
48 DC	**48 DC**			COE-48DC
110 DC	**110 DC**			COE-110DC
125 DC	**125 DC**			COE-125DC
220 DC	**220 DC**			COE-220DC
110/50 AC	**110/50/60 AC**		58 VA (3)	COE-110/50/60AC
115/60 AC	**115/60 AC**		80 VA (3)	COE-115/60AC
230/50 AC	**230/50/60 AC**		58 VA (3)	COE-230/50/60AC
230/60 AC	**230/60 AC**		80 VA (3)	COE-230/60AC
110/50 AC	**110RC**	669	30 W	COE-110RC
120/60 AC				
230/50 AC	**230RC**			COE-230RC
230/60 AC				

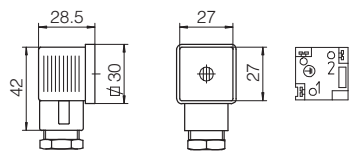
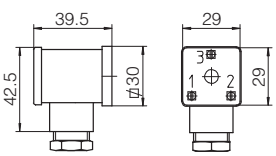
(1) In case of 60 Hz voltage frequency the performances are reduced by 10÷15% and the power consumption is 58 VA
(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

9.2 COILS FOR DKE VALVE

External supply nominal voltage ± 10%	**Voltage code**	Type of connector	Power consumption (2)	Code of spare coil
12 DC	**12 DC**	666 or 667	36 W	CAE-12DC
14 DC	**14 DC**			CAE-14DC
24 DC	**24 DC**			CAE-24DC
28 DC	**28 DC**			CAE-28DC
110 DC	**110 DC**			CAE-110DC
125 DC	**125 DC**			CAE-125 DC
220 DC	**220 DC**			CAE-220DC
110/50/60 AC	**110/50/60 AC**		100 VA (3)	CAE-110/50/60AC (1)
230/50/60 AC	**230/50/60 AC**			CAE-230/50/60AC (1)
115/60 AC	**115/60 AC**		130 VA (3)	CAE-115/60AC
230/60 AC	**230/60 AC**			CAE-230/60AC
110/50/60 AC	**110 DC**	669	36 W	CAE-110DC
230/50/60 AC	**220 DC**			CAE-220DC

(1) In case of 60 Hz voltage frequency the performances are reduced by 10÷15% and the power consumption is 90 VA
(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
(3) When solenoid is energized, the inrush current is approx 3 times the holding current.

10 COILS ELECTRIC CONNECTORS - according to din 43650 (to be ordered separately)

666, 667 (for AC or DC supply)	**669** (for AC supply)	**CONNECTOR WIRING**	
		**666, 667** 1 = Positive ⊕ 2 = Negative ⊖ ⊕ = Coil ground	**669** 1,2= Supply voltage VAC 3 = Coil ground
		SUPPLY VOLTAGES	
		666 All voltages	**667** 24 AC or DC 110 AC or DC 220 AC or DC
			669 110/50 AC 110/60 AC 230/50 AC 230/60 AC

11 TECHNICAL CHARACTERISTICS OF INDUCTIVE PROXIMITY AND POSITION SWITCHES

Type of switch		**/FI** proximity sensor	**/FI** scheme	**/FV** position switch	**/FV** scheme
Supply voltage	[V]	10÷30		20÷32	
Ripple max	[%]	≤ 20		≤ 10	
Max current	[mA]	200		400	
Max peak pressure	[bar]	100		400	
Mechanical life		virtually infinite		virtually infinite	
Switch logic		PNP		PNP	
			1 output signal **2** supply +24 VDC **4** GND	**1** supply +24 VDC **2** output signal	**3** GND **4** output signal

12 CONNECTING SCHEMES OF INDUCTIVE PROXIMITY AND POSITION SWITCHES - FI and FV sensor's connector are always supplied with the valve

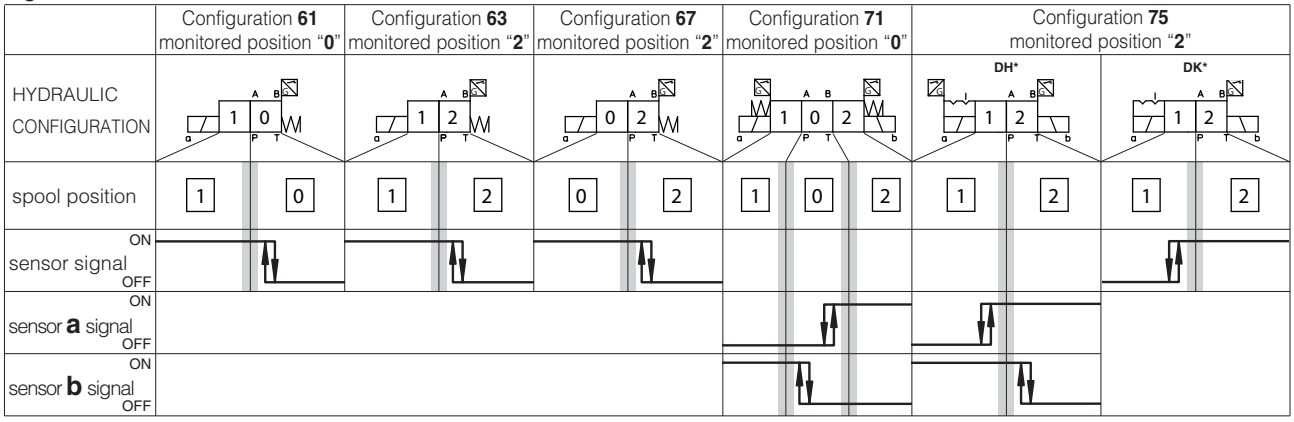
DHE/FI single solenoid / double solenoid (dotted line)	**/FV (all valves)** single solenoid	**/FV (all valves)** double solenoid	**DKE/FI** single solenoid	**DKE/FI** double solenoid
Connector type **345** IP65	Connector type **ZBE-06** IP65	Connector type **ZBE-06** IP65	Connector type **666** IP65	Connector type **664** IP65
1 =output signal 2 =supply +24 VDC 3 = output signal for double solenoid 4 = GND	1 = supply +24 VDC 2 = output signal NC 3 = GND 4 = output signal NO	1 = supply +24 VDC 2 = output signal sol.**b** 3 = GND 4 = output signal sol.**a**	1 = output signal S 2 = supply +24 VDC ⏚ = GND	1 = output signal sol.**a** 2 = supply +24 VDC 3 = output signal sol.**b** ⏚ = GND

NOTE: the /FI proximity and /FV position switch are not provided with a protective earth connection

13 STATUS OF OUTPUT SIGNAL

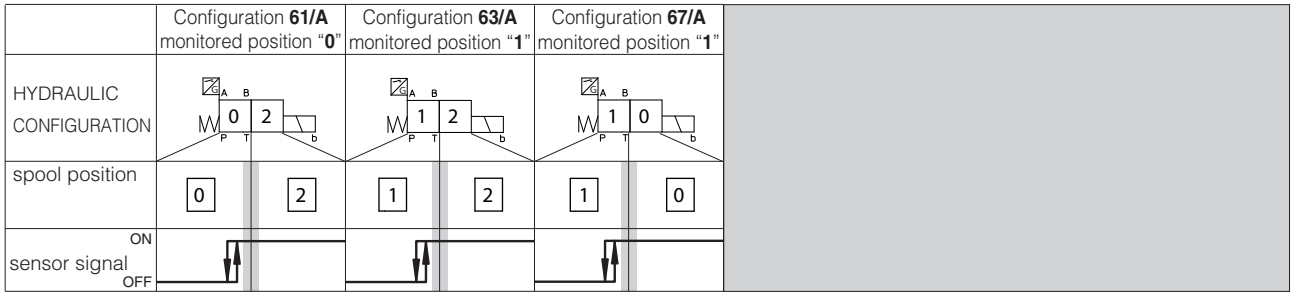
13.1 Signal status for FI versions

Signal status for standard version



Diagrams show the behaviour of the output signal for inductive switches type **FI/NO**.
For inductive switches type **FI/NC** option the behaviour is opposite (high level signal instead of low level signal and viceversa)

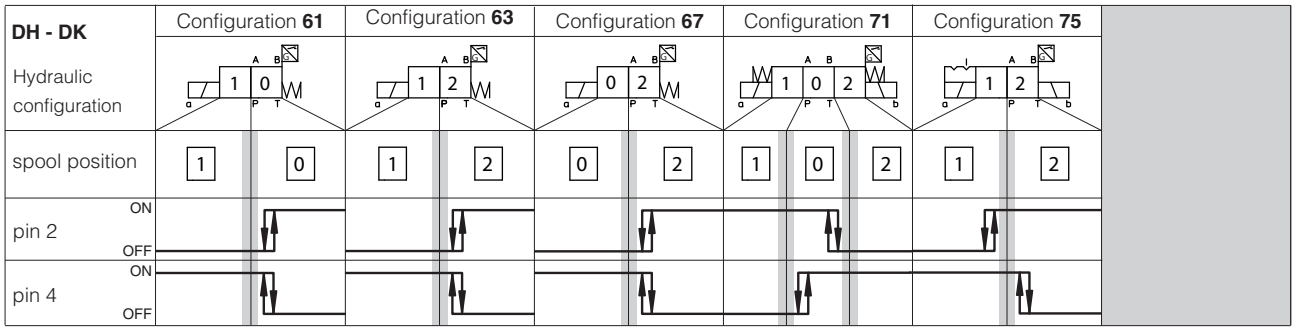
Signal status for option /A



Diagrams show the behaviour of the output signal for inductive switches type **FI/NO**.
For inductive switches type **FI/NC** option the behaviour is opposite (high level signal instead of low level signal and viceversa)

13.2 Signal status for FV versions

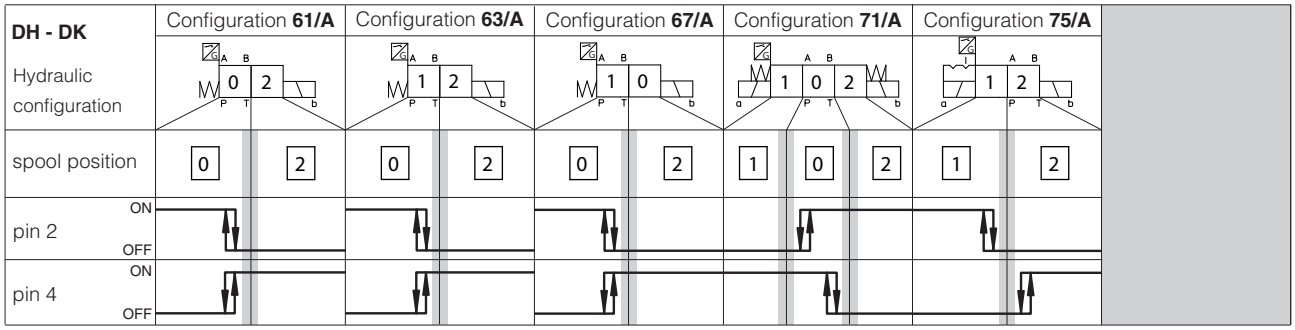
Signal status for standard version



Note: FV position switch can be electrically wired by the customer as NO or NC and then the status of the output signal will be in accordance to the selected configuration

= intermediate spool position corresponding to the hydraulic configuration change

Signal status for option /A



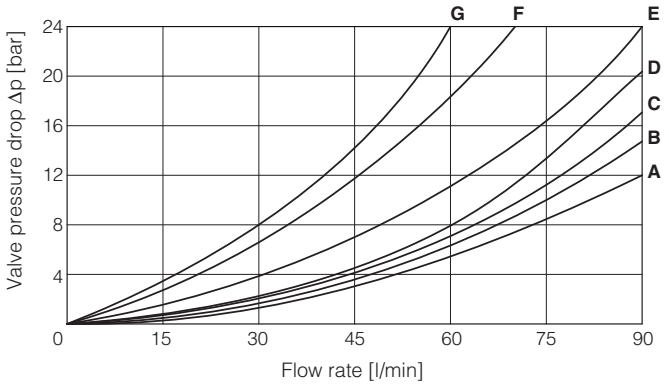
Note: FV position switch can be electrically wired by the customer as NO or NC and then the status of the output signal will be in accordance to the selected configuration

= intermediate spool position corresponding to the hydraulic configuration change

14 **Q/ΔP DIAGRAMS** based on mineral oil ISO VG 46 at 50°C

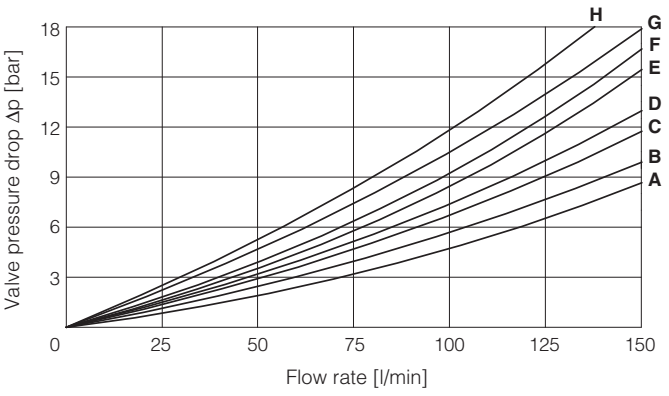
DHE

Flow direction / Spool type	P→A	P→B	A→T	B→T	P→T
0, 0/1	A	A	C	C	D
1, 1/1, 1/9	D	C	C	C	
3, 3/1	D	D	A	A	
4, 4/8, 5, 5/1, 49, 58, 58/1, 94	F	F	G	C	E
1/2, 0/2	D	D	D	D	
6, 7, 16, 17	D	D	D	D	
8	A	A	E	E	
2	D	D			
2/2	F	F			
09, 19, 90, 91	E	E	D	D	
39, 93	F	F	G	G	
2/7	E		E		
5/7	D	E		C	F
6/7		D	E		
7/7		F	F	F	



DKE

Flow direction / Spool type	P→A	P→B	A→T	B→T	P→T	B→A
0, 0/1, 0/2, 2/2	A	A	B	B		
1, 1/1, 1/9, 6, 8	A	A	D	C		
3, 3/1, 7	A	A	C	D		
4	B	B	B	B	F	
5, 58	A	B	C	C	G	
1/2	B	C	C	B		
19, 91	E	E	G	G		H
39, 93	F	F	G	G		H
2/7	G			H		
5/7	D			C	G	
6/7		G	H			
7/7		H	H	H		



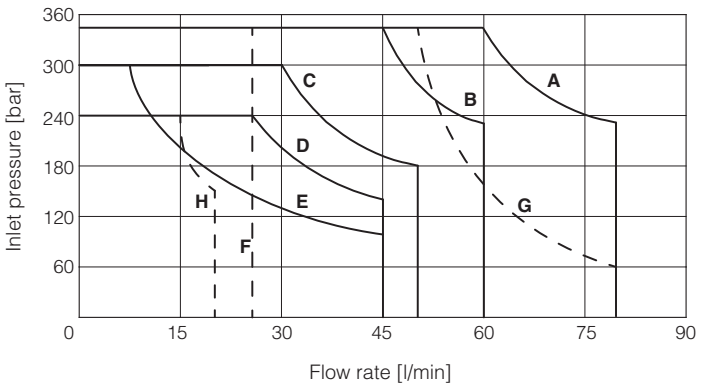
15 **OPERATING LIMITS** based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value (V_{nom} - 10%). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.

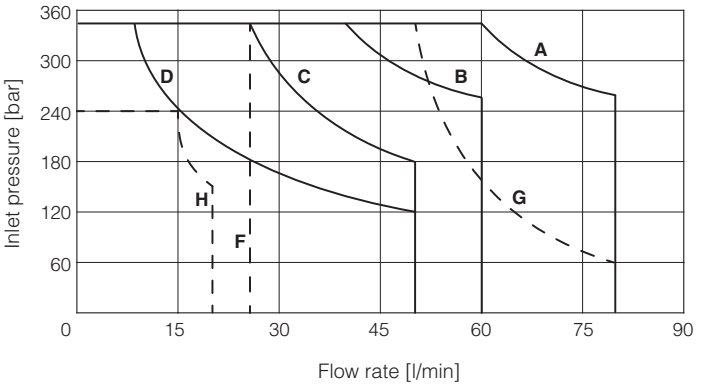
DHE

Curve	Spool type	
	AC	DC
A	1,1/2, 8	0, 0/1, 1, 1/2, 3, 8
B	0, 0/1, 0/2, 1/1, 1/9, 3	0/2, 1/1, 6, 7, 1/9, 19
C	3, 3/1, 6, 7	3/1, 4, 4/8, 5, 5/1, 16, 17, 19, 39, 49, 58, 58/1, 09, 90, 91, 93, 94
D	4, 4/8, 5, 5/1, 16, 17, 19, 39, 58, 58/1, 09, 90, 91, 93, 94	2, 2/2
E	2, 2/2	-
F	2/7, 6/7	2/7, 6/7
G	5/7	5/7
H	7/7	7/7

DHE - AC



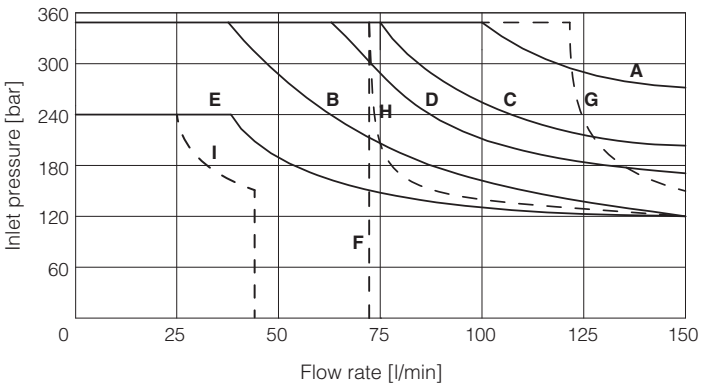
DHE - DC



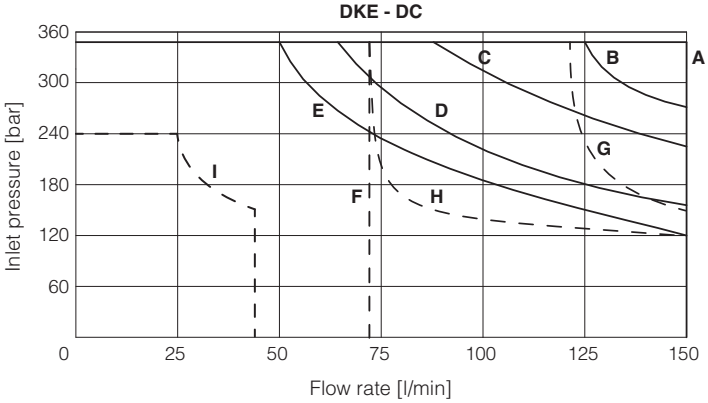
DKE

Curve	Spool type	
	AC	DC
A	0/1	0, 0/1, 1, 1/1, 3, 3/1, 1/2, 0/2, 8
B	4, 5, 19, 91	6, 7
C	0, 1/1, 3, 3/1	19, 91
D	1, 1/2, 0/2	4, 5
E	6, 7, 8, 2/2	2/2
F	2/7	2/7
G	5/7	5/7
H	6/7	6/7
I	7/7	7/7

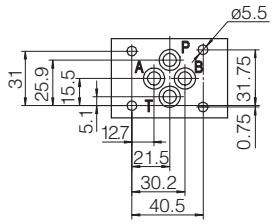
DKE - AC



DKE - DC



16 DIMENSIONS FOR DHE SOLENOID SAFETY VALVES [mm]



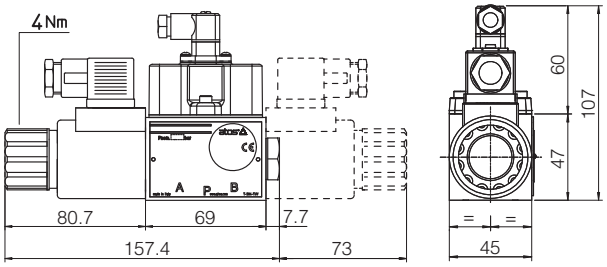
valve's bottom view

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05
Fastening bolts:
4 socket head screws M5x30 class 12.9
Tightening torque = 8 Nm
Seals: 4 OR 108
Ports P,A,B,T: Ø = 7.5 mm (max)

P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT

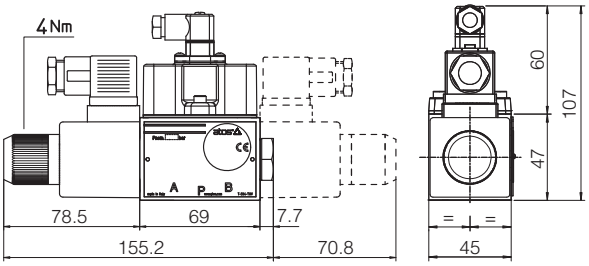
option /A
Single solenoid valves: solenoid mounted at side of port B.
Double solenoid valves DHE/FV(DC): FV inductive position switch mounted at side of port A

DHE-06*/FI (DC)
DHE-07*/FI (DC) dotted line



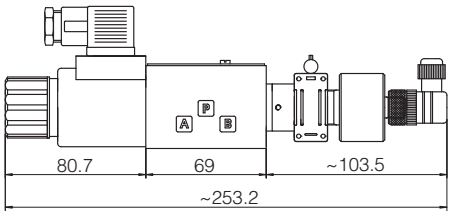
Mass:
kg 1,85 (one solenoid)
kg 2,1 (two solenoids)

DHE-06*/FI (AC)
DHE-07*/FI (AC) dotted line



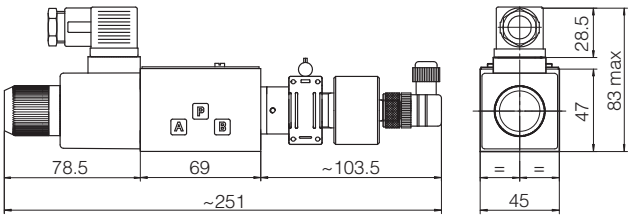
Mass:
kg 1,85 (one solenoid)
kg 2,1 (two solenoids)

DHE-06*/FV (DC)



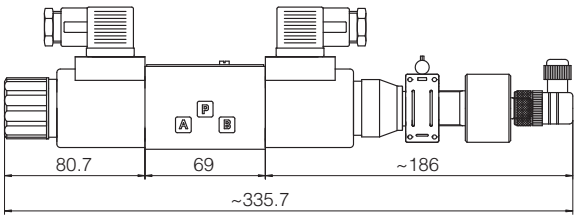
Mass: kg 1,95

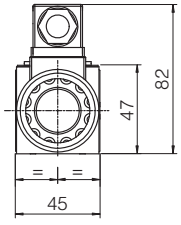
DHE-06*/FV (AC)



Mass: kg 1,8

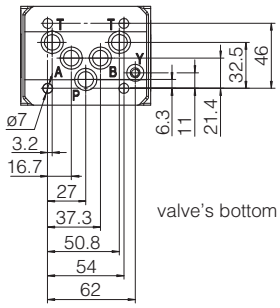
DHE-07*/FV (DC)





Mass: kg 2,2

17 DIMENSIONS OF DKE SOLENOID SAFETY VALVES [mm]



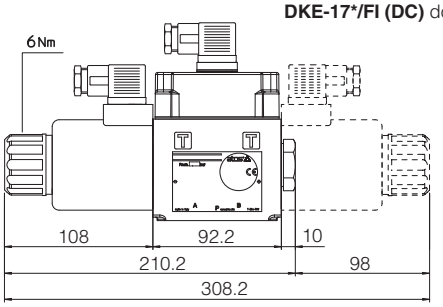
valve's bottom view

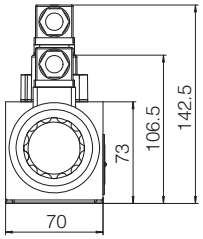
ISO 4401: 2005
Mounting surface:
4401-05-05-0-05
(without port X)
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050. 1 OR 108
Ports P,A,B,T: Ø = 11.5 mm (max)
Ports Y: Ø = 5 mm

P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
Y = DRAIN PORT

option /A
Single solenoid valves: solenoid mounted at side of port B.
Double solenoid valves DKE/FV(DC): FV inductive position switch mounted at side of port A

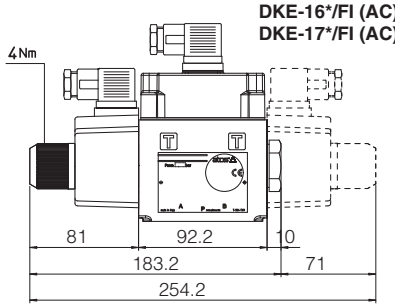
DKE-16*/FI (DC)
DKE-17*/FI (DC) dotted line

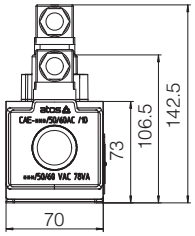




Mass:
kg 4,4 (one solenoid)
kg 5,8 (two solenoids)

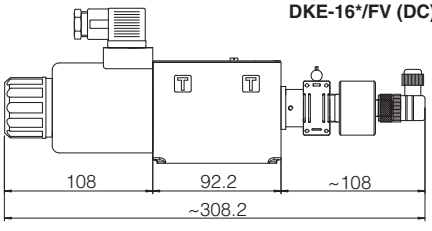
DKE-16*/FI (AC)
DKE-17*/FI (AC) dotted line





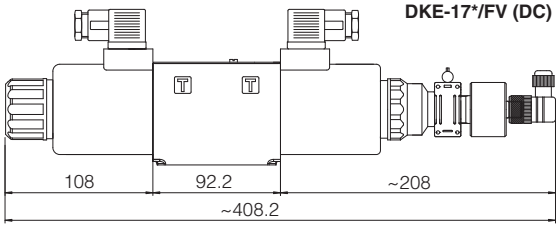
Mass:
kg 3,7 (one solenoid)
kg 4,4 (two solenoids)

DKE-16*/FV (DC)



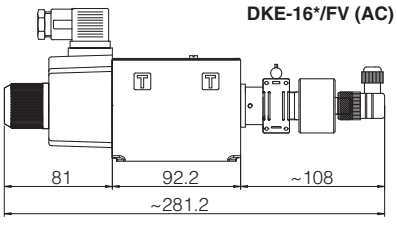
Mass: kg 4,4

DKE-17*/FV (DC)



Mass: kg 5,9

DKE-16*/FV (AC)



Mass: kg 3,8