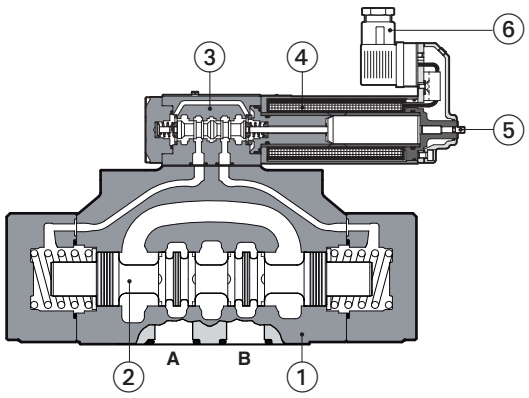
Intrinsically safe solenoid directional valves

on-off spool type, piloted - **ATEX** or **IECEx**



DPHW-461*

① main body
② main spool
③ pilot valve
④ intrinsically safe solenoid
⑤ manual override
⑥ electrical connector

DPHW

On-off spool type, piloted directional valves equipped with intrinsically safe solenoids certified for safe operation in hazardous environment with potentially explosive atmosphere.

Certifications:

- **ATEX** or **IECEx**:
  II 1G Ex ia IIC, IIB, IIA
  surface plants zone 0, 1 and 2
- **ATEX** or **IECEx**:
  IM2 Ex ia IMb, Ex ib IMb
  surface, tunnels or mining plants

See section 7 for certification data

The valves must be electrically powered through specific “safety barriers” limiting the max current to the solenoid, see section 12

Size: **10, 16** and **25**
Max flow: up to **160, 300** and **700 l/min**
Max pressure: **350 bar**

1 MODEL CODE

DPHW	/	*	-	2	61	1	/	*	/	6	*	/	*

Intrinsically safe directional valve, piloted

Certification type:
- = Omit for Atex Group II
M = Atex Group I (mining)
IE = IECEx Group II
IEM = IECEx Group I (mining)

Valve size (ISO 4401):
1 = 10 **2** = 16 **4** = 25

Configuration, see section 2

Spool type, see section 2

Options (2):
A = solenoid at side of port B (for single solenoid valves)
WP = ⚠ manual override protected by metallic cap
D = Internal drain
E = external pilot pressure
H = adjustable chokes (meter-out to the pilot chambers of the main valve)
L9 = (only for DPHW-2 and DPHW-4) plug with calibrated restrictor on port P of pilot valve

Connector type
6 = DIN 43650 (standard)

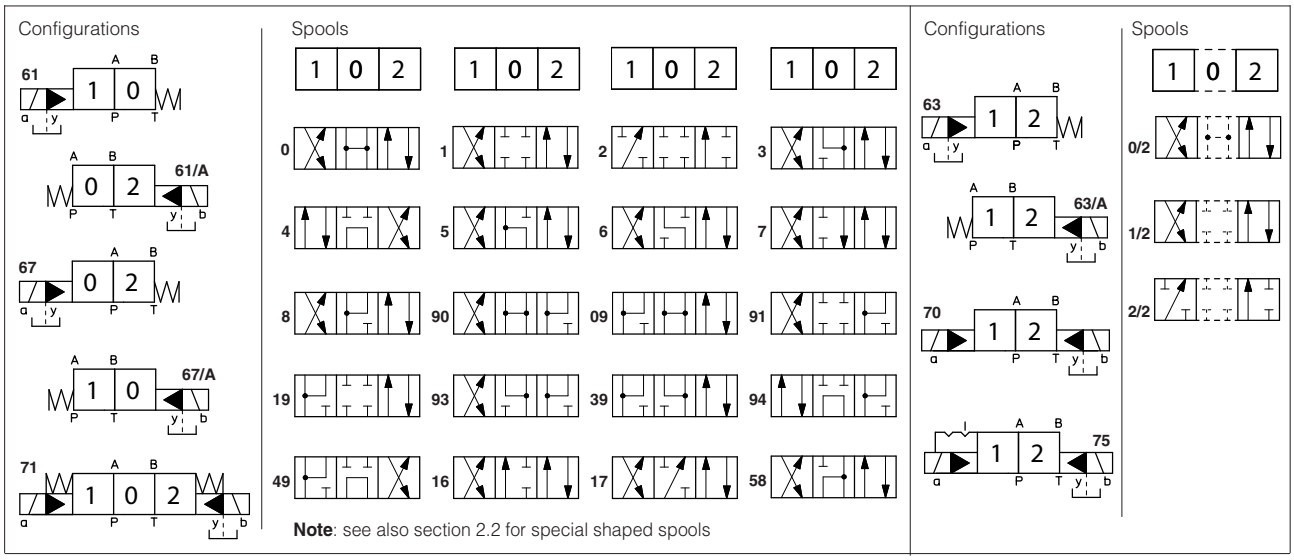
Series number

Seals material, see section 7:
- = NBR
PE = FKM
BT = HNBR **(1)**

(1) Not for certification **M** and **IEM**, Group I (mining)
(2) Possible combined options: all combinations are available

⚠ The pressure at T port makes difficult the manual override operation that can be possible only if its value is lower than 50 bar

2 CONFIGURATIONS and SPOOLS (representation according to ISO 1219-1)



2.1 Standard spools availability

- DPHW-1 are available only with spools **0, 0/2, 1, 1/2, 3, 4, 5, 58, 6, 7**
- DPHW-2 and DPHW-4 are available with all spools shown in the above table

2.2 Special shaped spools

- 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, 58, 6** and **7** are also available as **1/1, 4/8, 5/1, 58/1, 6/1** and **7/1** that are properly shaped to reduce water-hammer shocks during the switching.

2.3 Special spool availability

Valve size	standard spools							
	0/1	3/1	1/1	4/8	5/1	58/1	6/1	7/1
DPHW-1	•	•		•				
DPHW-2, DPHW-4	•	•	•	•	•	•	•	•

3 DEVICES FOR MAIN SPOOL SWITCHING CONTROL

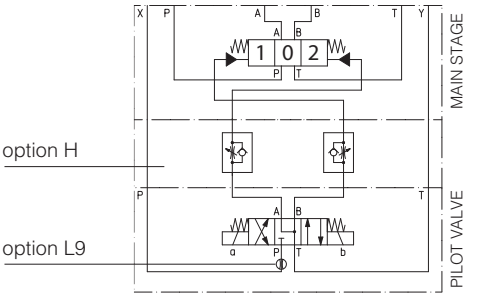
Folowing options are suggested to reduce the hydraulic shocks at the valve operation

/H = Adjustable chokes (meter-out to the pilot chambers of the main valve).

/L9 (only for DPHW-2 and DPHW-4) plug with calibrated restictor in P port of pilot valve

Suggested for pilot pressure higher than 210 bar or to limit the hydraulics shocks caused by the fast main spool switching

FUNCTIONAL SCHEME (config. 71)
example of switching control options



4 GENERAL CHARACTERISTICS

Assembly position / location	Horizontal position only
Subplate surface finishing to ISO 4401	Acceptable roughness index, Ra ≤0,8 recommended Ra 0,4 - flatness ratio 0,01/100
MTTFd values according to EN ISO 13849	75 years, for further details see technical table P007
Ambient temperature	**Standard** = -20°C ÷ +60°C **/PE** option = -20°C ÷ +60°C **/BT** option = -40°C ÷ +60°C
Storage temperature range	**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Surface protection	Zinc coating with black passivation - salt spray test (EN ISO 9227) > 200h
Compliance	Intrinsically safe protection "Ex ia", see section 8 RoHs Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

5 HYDRAULIC CHARACTERISTICS

Operating pressure	P, A, B, X = **350 bar** T = **250 bar** with external drain (standard) T and Y = **160 bar** with internal drain (option /D) Minimum pilot pressure for correct operation is = **8 bar**
Rated flow	See diagrams Q/Δp at section 10
Maximum flow	DPHW-1: **160 l/min;** DPHW-2: **300 l/min;** DPHW-4: **700 l/min;** see Q/Δp diagrams at section 10 and operating limits at section 11

6 ELECTRICAL CHARACTERISTICS - see also section 8

Nominal resistance at 20°C	150 Ω
Coil insulation	Class H
Working voltage	12 ÷ 26 V
Minimum supply current	65mA, from I.S. barriers
Protection degree	IP66
Duty factor	100%
Electrical connector	DIN 43650 2 pin+GND

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

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°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, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

⚠ The ignition temperature of the hydraulic fluid must be 50°C higher than the max solenoid surface temperature

(1) Performance limitations in case of flame resistant fluids with water:
-max operating pressure = 210 bar
-max fluid temperature = 50°C

8 CERTIFICATION DATA

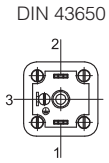
Valve type		DPHW		DPHW/**IE**			DPHW/**M**			DPHW/**IEM**		
Certification		**ATEX** (Group II)		**IECEx** (Group II)			**ATEX (mining)** (Group I)			**IECEx (mining)** (Group I)		
Solenoid code		**OW-18/6**		**OWI-18/6**			**OWM-18/6**			**OWIM-18/6**		
Type examination certificate **(1)**		CESI 02 ATEX 013		IECEx CES 12.0017			CESI 02 ATEX 013			IECEx CES 12.0017		
Method of protection		**Ex II 1G Ex ia**					**Ex I M2**		**Ex ia I Mb**		**Ex ib I Mb**	
		IIA T5 Ga	**IIB T6 Ga**	**IIC T6 Ga**								
Electrical characteristics (max values)	Ui [V]	28	28	27	19,5	19,11	28	28	27	19,5	19,11	12,4
	Ii [mA]	396	250	130	360	360	396	250	130	360	360	2200
	Pi [W]	2,8	1,8	0,9	1,64	1,72	2,8	1,8	0,9	1,64	1,72	6,82
	Ci , Li	≅ 0	≅ 0				≅ 0					
Temperature class		**T5**	**T6**				–					
Surface temperature (ambient temp. +60°C)		≤ 100°C	≤ 85°C				≤ 150°C					
Ambient temperature		-20 ÷ +60°C	-40 ÷ +60°C **(2)**				-20 ÷ +60°C					
Applicable standards		EN 60079-0 EN 60079-11 EN 60079-26		IEC 60079-0 IEC 60079-11 IEC 60079-26								

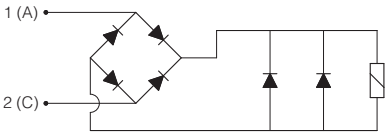
(1) The type examinator certificates can be downloaded from www.atos.com
(2) Only for **/BT** option

⚠ **WARNING: service work performed on the valve by the end users or not qualified personnel invalidates the certification**

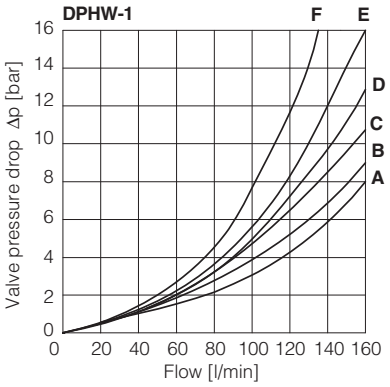
9 SOLENOIDS WIRING

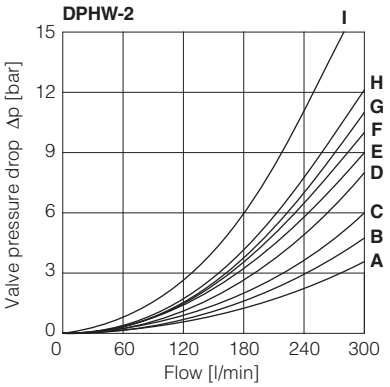
Connector wiring	
/6	Connections
1	Coil
2	Coil
3	GND

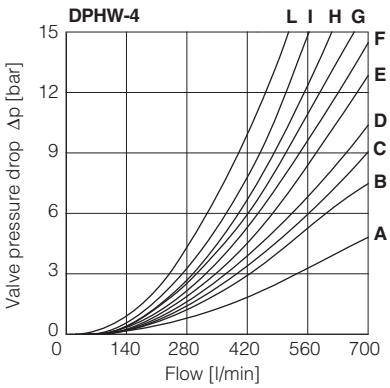




10 FLOW VERSUS PRESSURE DIAGRAMS Based on mineral oil ISO VG 46 at 50°C







DPHW-1

Spool type \ Flow direction	P→A	P→B	A→T	B→T	P→T
0/2, 1/2	D	E	D	C	-
0	D	E	C	C	E
1	A	B	D	C	-
3, 6, 7	A	B	C	C	-
4, 4/8	B	C	D	D	-
5, 58	A	E	C	C	F

DPHW-2

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

DPHW-4

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

11 OPERATING LIMITS

For a correct valve operation do not exceed the max recommended flow rates (l/min) shown in the below tables

DPHW-1

Spool type	Inlet pressure [bar]			
	70	160	210	350
	Flow rate [l/min]			
0, 1, 3, 6, 7	160	160	160	145
4, 4/8	160	160	135	100
5, 58	160	160	145	110
0/1, 0/2, 1/2	160	160	145	135

DPHW-4

Spool type	Inlet pressure [bar]			
	70	140	210	350
	Flow rate [l/min]			
1, 6, 7, 8	700	700	700	600
2, 4, 4/8	500	500	450	400
5, 0/1, 0/2, 1/2	600	520	400	300
0, 3	700	700	600	540
16, 17, 58, *9, 9*	500	500	500	450

DPHW-2

Spool type	Inlet pressure [bar]			
	70	140	210	350
	Flow rate [l/min]			
0, 1, 3, 6, 7, 8	300	300	300	300
2, 4, 4/8	300	300	240	140
5	260	220	180	100
0/1, 0/2, 1/2	300	250	210	180
16, 17, 56, *9, 9*	300	300	270	200

12 INTRINSICALLY SAFE BARRIERS - see tech. table **GX010**

Intrinsically safe valves must be powered through safety barriers certified according to Ex-ie protection mode, limiting the energy to the solenoid.

To select the proper intrinsically safe barriers following data must be considered:

1) Vmax and Imax of the solenoid as specified in section 8 must not be exceeded also in fault conditions;
2) the resistance of the solenoid is 150 Ω and the current supplied by the barrier, in normal operation condition, must be over the min. limit (65 mA) to ensure the valve correct operation (over 70 mA for max performances).

The barriers type **Y-BXNE 412** are galvanically isolated electronic devices, complying with European Norms EN60079-0/06, EN60079-11/07 and ATEX certified according to protection mode Ex ia IIC.
These barriers ensure the optimized functioning of the Atos valves up to the max operating limits specified in section 11

The barriers Y-BXNE-412 are double channel type, suitable to operate valves with double or single solenoid. Two single solenoid valves can be connected to the barrier (one to each channel) but they cannot be contemporary operated.

MODEL CODE OF I.S. BARRIER

Y-BXNE 412 00	*

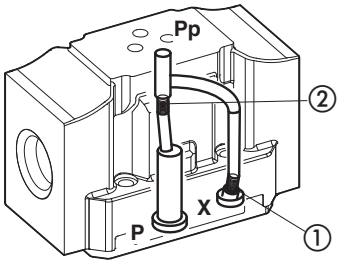
Supply voltage
E = 110/230 VAC
2 = 24÷48 VDC

13 PLUGS LOCATION FOR PILOT/DRAIN CHANNELS

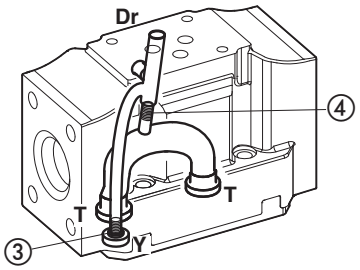
Depending on the position of internal plugs, different pilot/drain configurations can be obtained as shown below.
To modify the pilot/drain configuration, proper plugs must only be interchanged. The plugs have to be sealed using loctite 270.
Standard valves configuration provides internal pilot and external drain

DPHW-1

Pilot channels



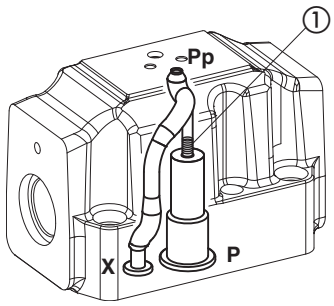
Drain channels



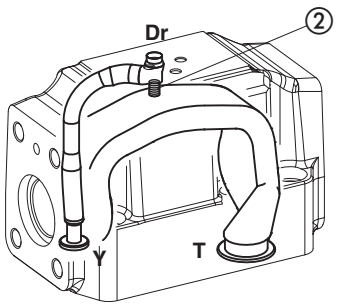
Internal piloting: blinded plug SP-X300F ① in X; plug SP-X310F ② in Pp;
External piloting: blinded plug SP-X300F ② in Pp; plug SP-X310F ① in X;
Internal drain: blinded plug SP-X300F ③ in Y;
External drain: blinded plug SP-X300F ④ in Dr.

DPHW-2

Pilot channels

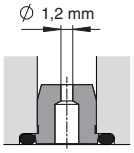


Drain channels



Internal piloting: Without blinded plug SP-X300F ①;
External piloting: Add blinded plug SP-X300F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

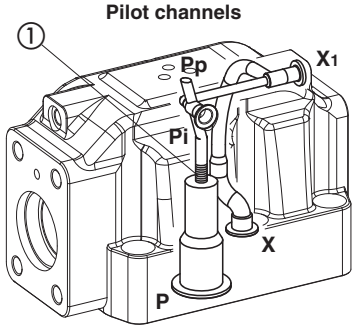
Option L9
This option provides a calibrated restrictor PLUG-H-12A (Ø 1,2 mm) in the P port of the pilot valve



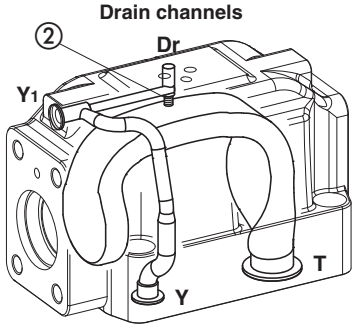
PLUG-12A

DPHW-4

Pilot channels

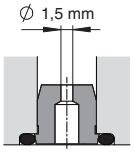


Drain channels



Internal piloting: Without blinded plug SP-X500F ①;
External piloting: Add blinded plug SP-X500F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

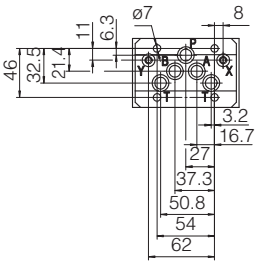
Option L9
This option provides a a calibrated restrictor PLUG-H-15A (Ø 1,5 mm) in the P port of the pilot valve



PLUG-15A

DPHW-1*

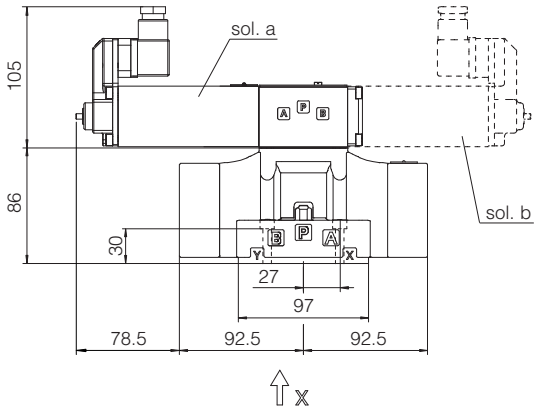
ISO 4401: 2005 (see table P005)
Mounting surface: 4401-05-05-0-05
Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Diameter of ports A,B, P, T: Ø = 11 mm;
Diameter of ports X, Y: Ø = 5 mm;
Seals: 5 OR 2050, 2 OR 108

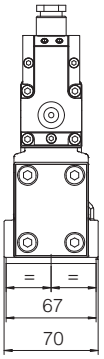


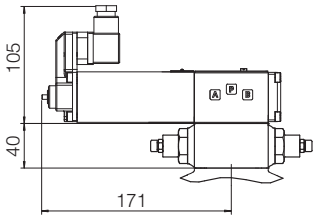
P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL PILOT PORT
Y = DRAIN PORT

Mass [kg]	
DPHW-16	8,0
DPHW-17	9,5
Option /H	+1,0

DPHW-16
DPHW-17 (dotted line)

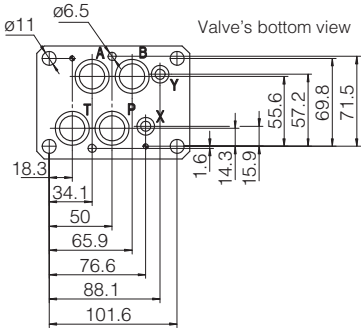






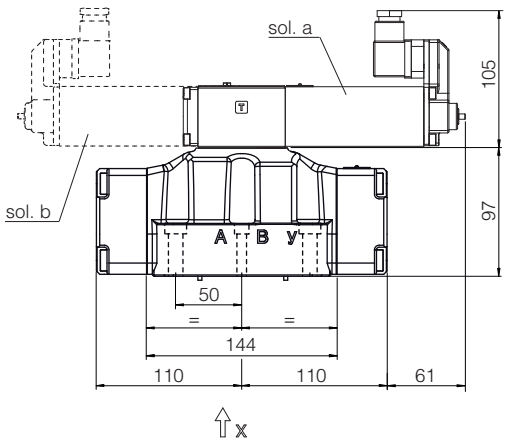
DPHW-2*

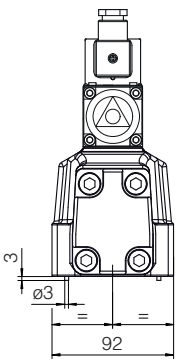
ISO 4401: 2005 (see table P005)
Mounting surface: 4401-07-07-0-05
Fastening bolts:
4 socket head screws M10x50 class 12.9
Tightening torque = 70 Nm
2 socket head screws M6x45 class 12.9
Tightening torque = 15 Nm
Diameter of ports A, B, P, T: Ø = 20 mm;
Diameter of ports X, Y: Ø = 7 mm;
Seals: 4 OR 130, 2 OR 2043

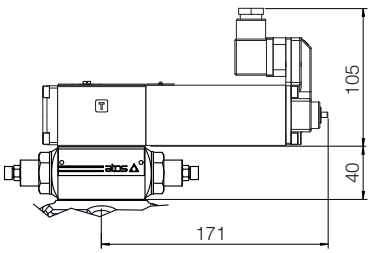


P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
X = EXTERNAL PILOT PORT
Y = DRAIN PORT

Mass [kg]	
DPHW-26	11
DPHW-27	12,5
Option /H	+1,0

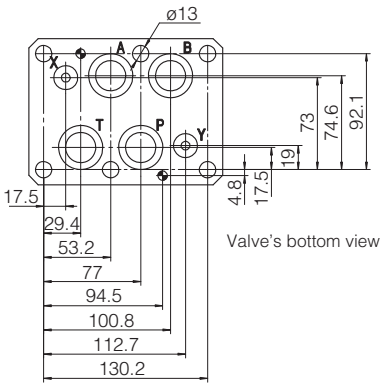






DPHW-4*

ISO 4401: 2005 (see table P005)
Mounting surface: 4401-08-08-0-05
Fastening bolts:
6 socket head screws M12x60 class 12.9
Tightening torque = 125 Nm
Seals: 4 OR 4112; 2 OR 3056
Diameter of ports A, B, P, T: Ø = 24 mm;
Diameter of ports X, Y: Ø = 7 mm;

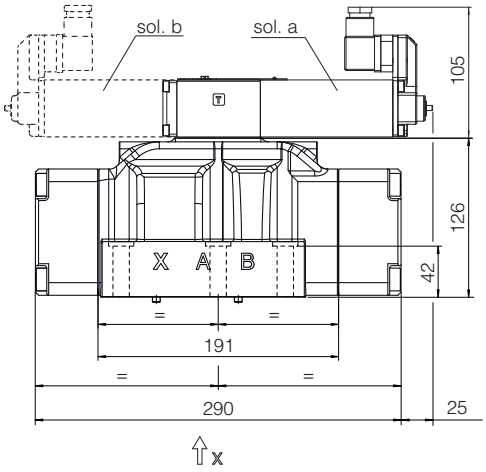


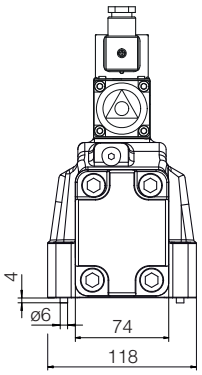
Valve's bottom view

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

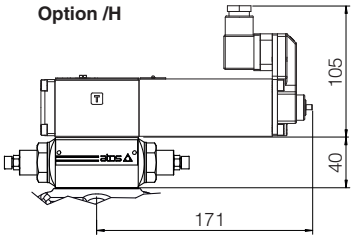
Mass [kg]	
DPHW-46	18,5
DPHW-47	20
Option /H	+1,0

DPHW-46
DPHW-47 (dotted line)



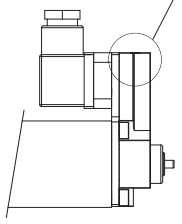


Option /H

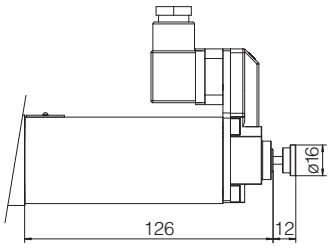


Options for all sizes of DPHW

Pilot of DPHW **/M** and **/IEM**
(different cover shape)



Pilot of DPHW **/WP**



Note: the connector is supplied with the valve

15 RELATED DOCUMENTATION

X010	Basics for electrohydraulics in hazardous environments
X050	Summary of Atos intrinsically safe components certified to ATEX, IECEx
EX950	Operating and maintenance information for intrinsically safe valves
P005	Mounting surfaces for electrohydraulic valves