

| **WANDFLUH of AMERICA**

Wandfluh Proportional Flow Products – Technical Review

PROPORTIONAL PRODUCTS REVIEW

- **State of the art facility – Frutigen CH**
- **ALL products designed, produced here**
- **ALL products 100% tested before shipping**
- **Weekly shipment to Wandfluh U.S.**
- **Weekly shipment to N.A. sales channels**
- **6-12 weeks standard delivery – expedite available !**



PROPORTIONAL PRODUCTS REVIEW

Our Focus Market Sectors...



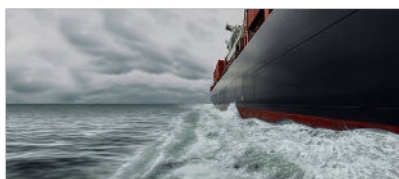
INDUSTRIAL



MOBILE



OIL & GAS

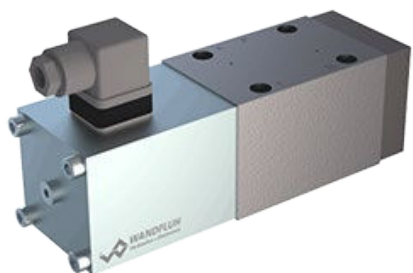
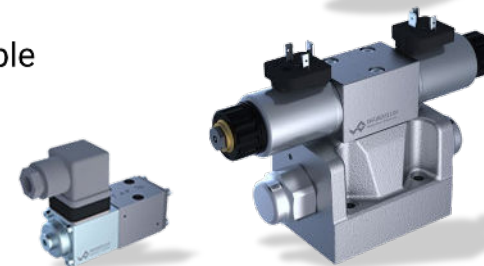


MARINE



ENERGY

- From 1 lpm (~0.3 GPM) to ~3500 lpm (+900 GPM)
- Product formats:
 - Flange style
 - Sandwich body
 - Cartridge (screw-in – ISO & UNF)
 - 2-port slip-in cartridge valves
- Large array of special versions/options available
- Constant release of new/updated products
- Open to customer specific solutions



Flange/manifold
mount



Sandwich valves



Cartridge
ISO / UNF



Ex Proof
ATEX/CSA/UL



Industrial



Mobile



On-Coil



OBE

PROPORTIONAL VALVE RANGE

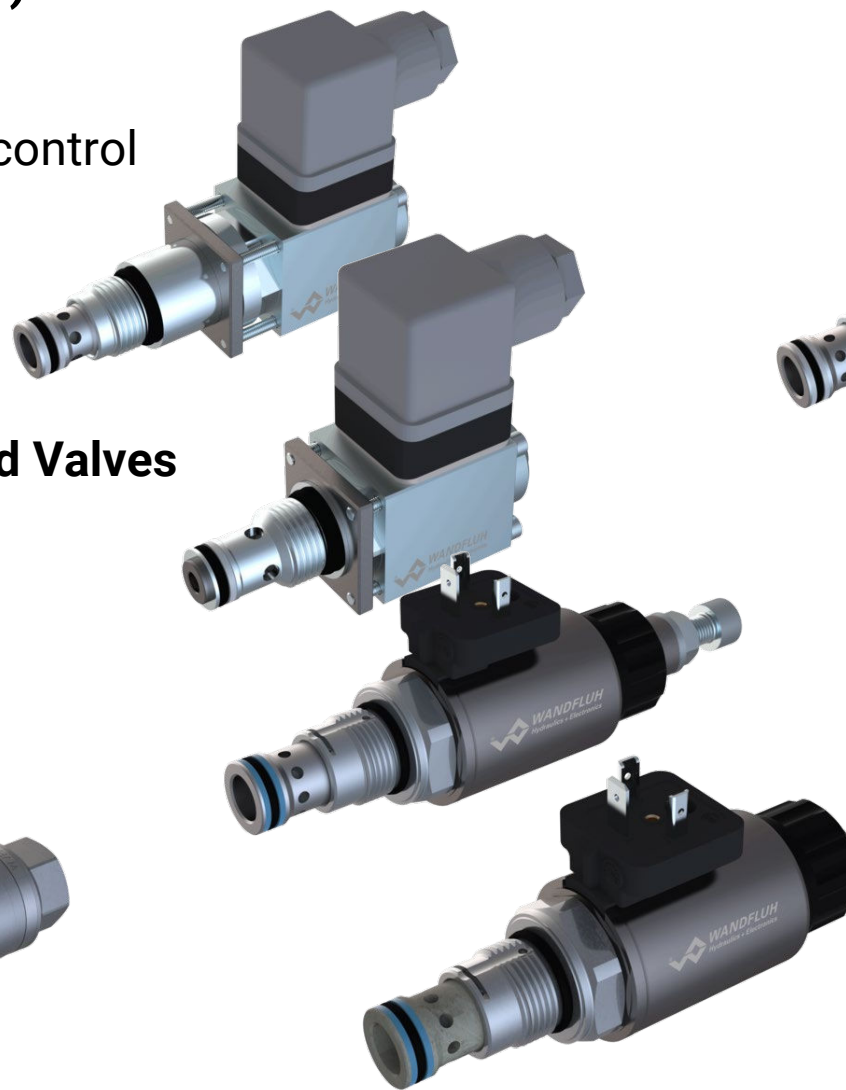
SCREW-IN CARTRIDGE TYPE (ISO & UNF)

- 0.1 lpm to 400 lpm
- Pressure control, Flow control, Directional control
- Exp Proof, and OBE (DSV) Optional

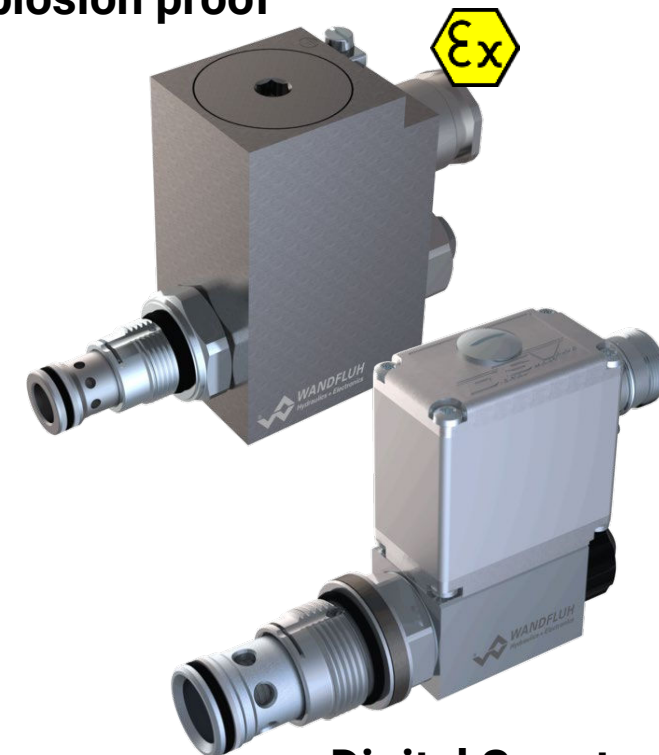


Standard Valves

Standard Valves



Explosion proof



Digital Smart Valve (OBE)

PROPORTIONAL PRODUCTS REVIEW



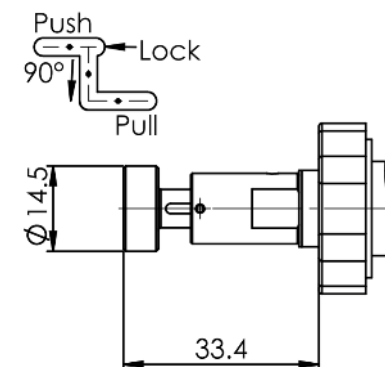
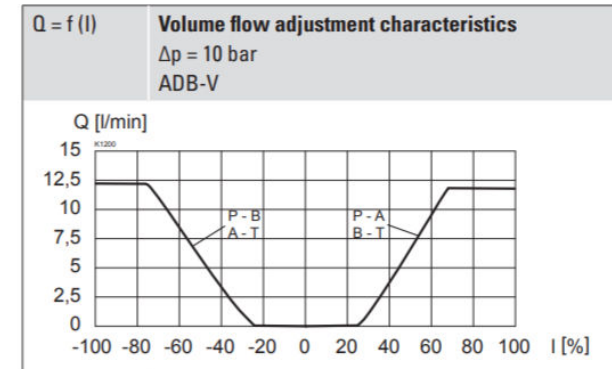
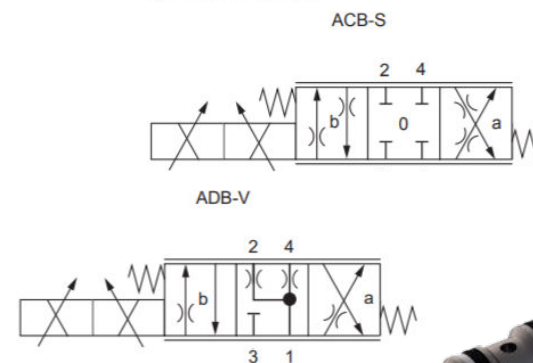
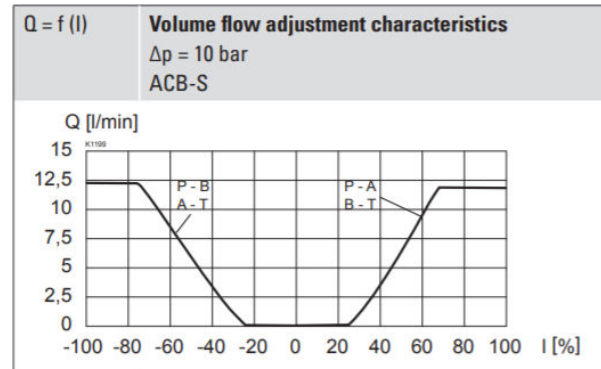
[QSPPM Data Sheet](#)

- Flow control
- Pressure compensator
- Check valve
- **Specifically for lift & lower**

- **ATEX/UL/CSA**
- Coil Certified alone
- Used across valve types
- 12/24 VDC
- 115/230 VAC
- Various wattages

[Solenoid coil MKY45/18x60](#)

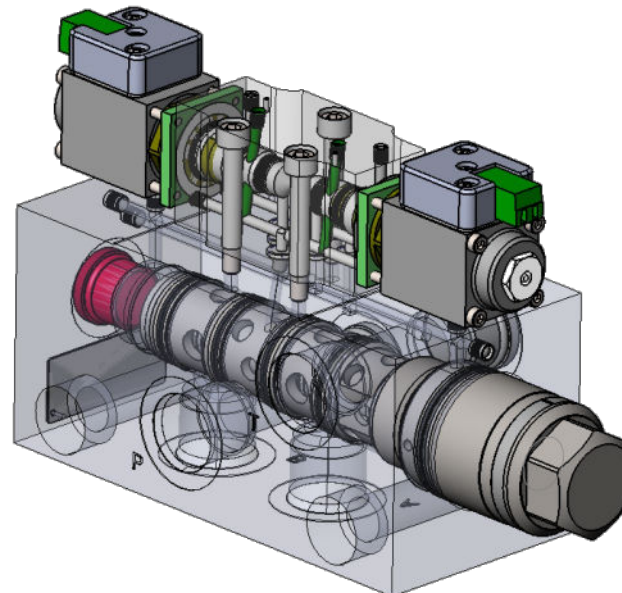
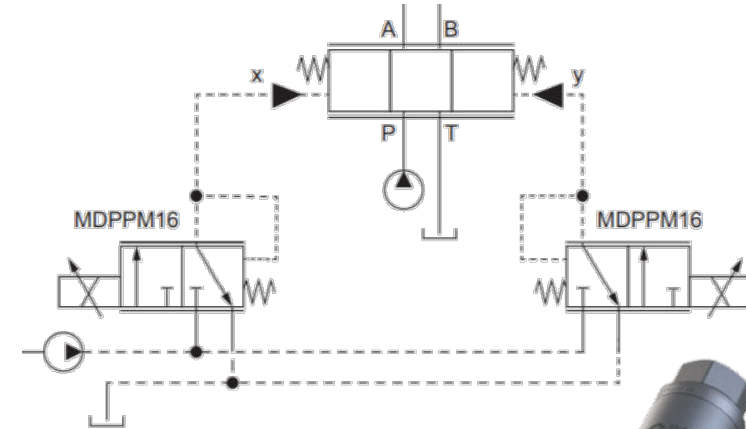
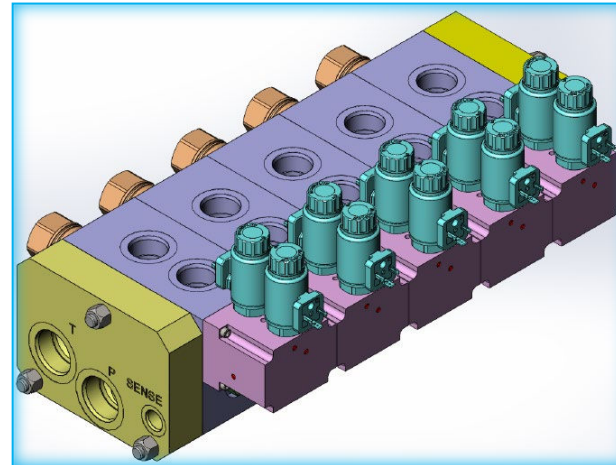
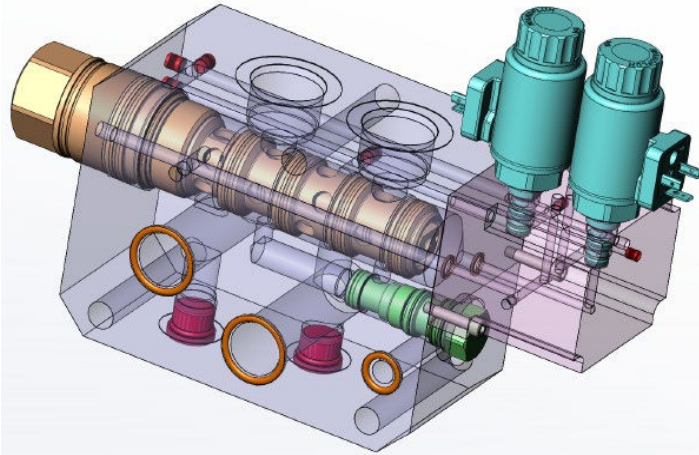
[Solenoid coil MKU45/18x60](#)



[WDPPU08 Data Sheet](#)

[WDPPU10 Data Sheet](#)

PROPORTIONAL PRODUCTS REVIEW



Size:
Format:
Type:
Functionality:
Data sheet:

M33 & M42 sizes

Screw-in cartridge
Piloted Proportional flow control

2P/4W and 3P/4W

[WVPPM33 Data Sheet](#)

[WVPPM42 Data Sheet](#)

[MDPPM16 Data Sheet](#)

PROPORTIONAL FAN DRIVES

BDIPM22

Valve Type	Inverse Pressure Relief
Operation	Direct operated
Size / Cavity	M22 / ISO
Max flow	25 l/min / 6.6 GPM
Max Pressure	400 bar
Pressure Ranges	20/100/160/200/315/350 bar
Features	Set max default pressure



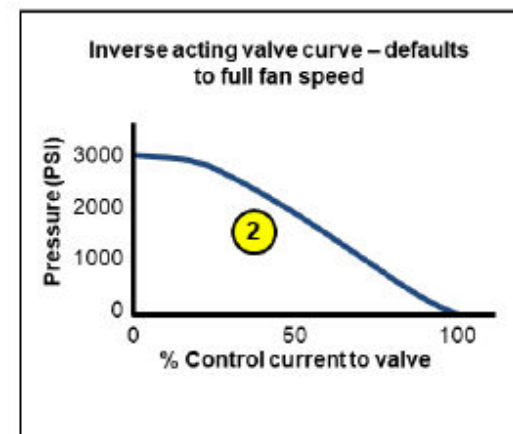
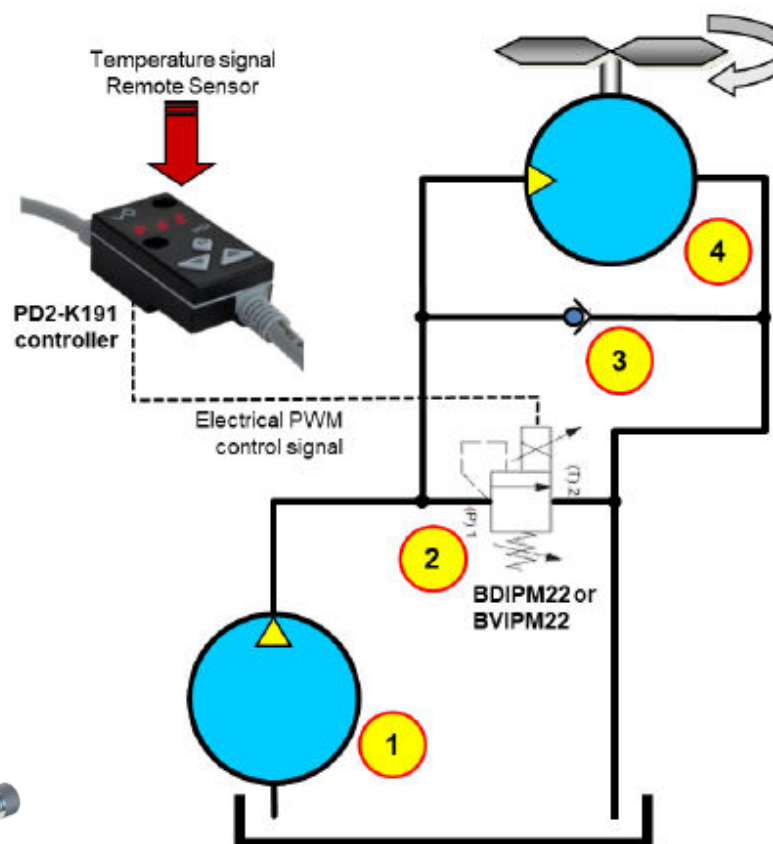
BVIPM22

Valve Type	Inverse Pressure Relief
Operation	Pilot operated
Size / Cavity	M22 / ISO
Max flow	100 l/min / 26.5 GPM
Max Pressure	400 bar
Pressure Ranges	20/63/100/160/200/275/350 bar
Features	Set max default pressure



Example Hydraulic Circuits:

Uni-Direction



Uni-direction, fixed displacement system with pressure speed control.

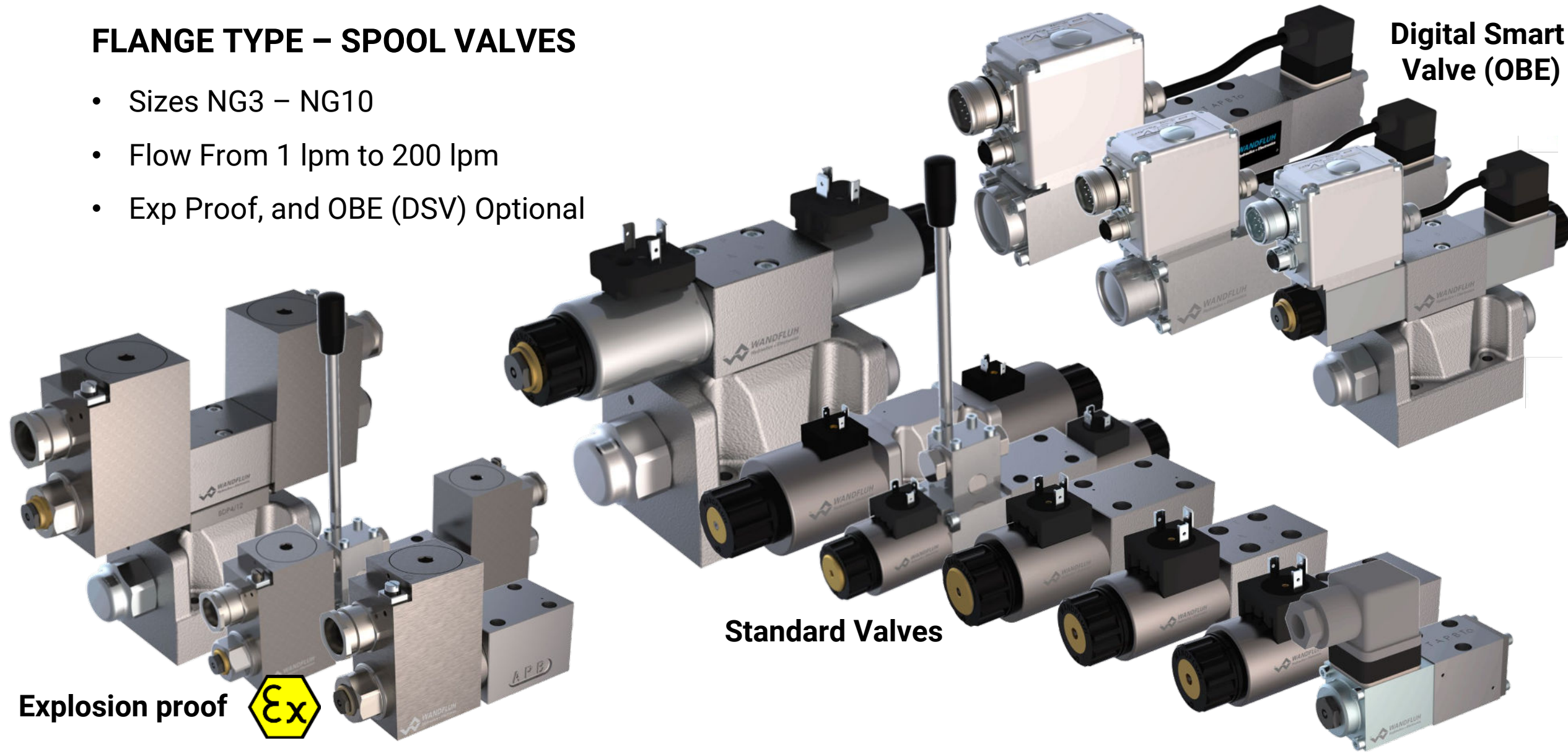
1. Fixed displacement pump
2. Proportional pressure control valve
3. Anti-Cavitation check valve
4. Fixed displacement motor.

PROPORTIONAL VALVE RANGE

FLANGE TYPE – SPOOL VALVES

- Sizes NG3 – NG10
- Flow From 1 lpm to 200 lpm
- Exp Proof, and OBE (DSV) Optional

**Digital Smart
Valve (OBE)**



Standard Valves

Explosion proof

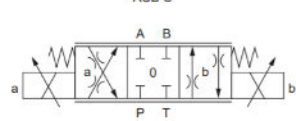


NG3 – MINI PROPORTIONAL VALVES

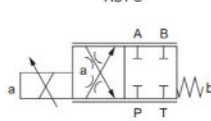
Direct Operated Open Loop

Symmetrical control

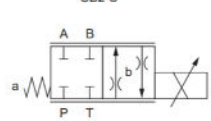
ACB-S



AC1-S

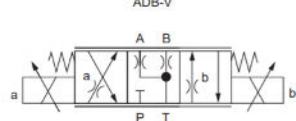


CB2-S

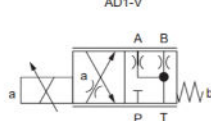


Meter-in control

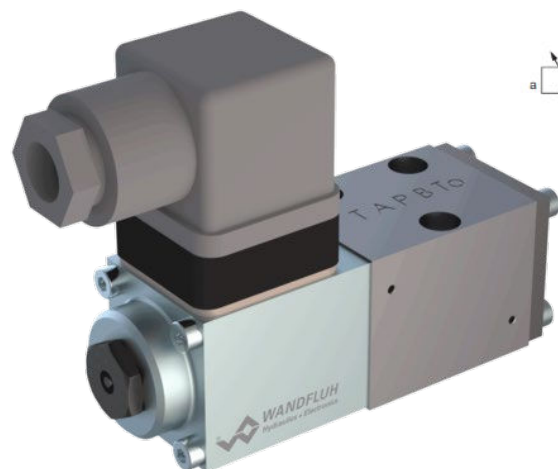
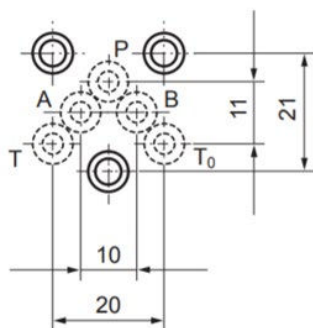
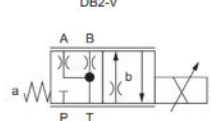
ADB-V



AD1-V



DB2-V

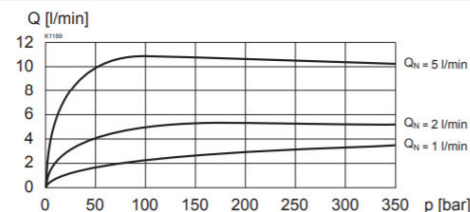


Oil viscosity $\nu = 30 \text{ mm}^2/\text{s}$

$Q = f(p)$

Volume flow pressure characteristics

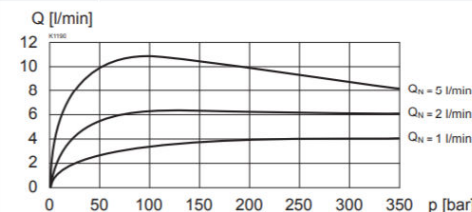
$I = I_G$
ACB-S, AC1-S, CB2-S



$Q = f(p)$

Volume flow pressure characteristics

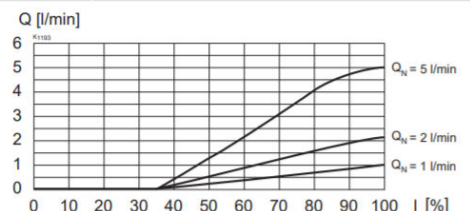
$I = I_G$
ADB-V, AD1-V, DB2-V



$Q = f(I)$

Volume flow adjustment characteristics

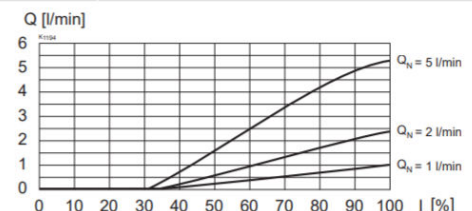
$\Delta p = 10 \text{ bar}$
ACB-S, AC1-S, CB2-S



$Q = f(I)$

Volume flow adjustment characteristics

$\Delta p = 10 \text{ bar}$
ADB-V, AD1-V, DB2-V



Size:
Format:
Type:
Functionality:
Data sheet:

NG3-Mini – Wandfluh differentiator
Surface mount to manifold
Proportional Direct Operated spool valve
2P/4W and 3P/4W
[NG3-Mini data sheet](#)

- **Ultra compact ++ manifold design**
- **Valve + subplate – replace NG6 valves**
- **Higher resolution for lower flows**

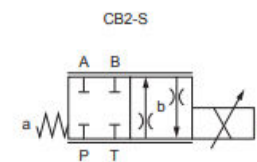
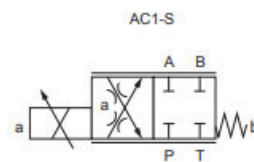
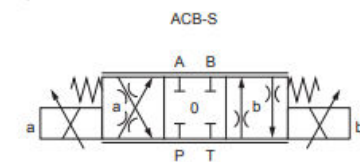
NG4 – MINI VALVES

Direct Operated Open Loop

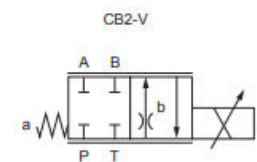
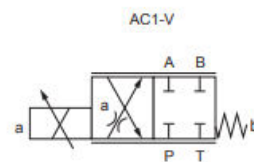
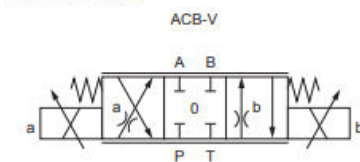


SYMBOL

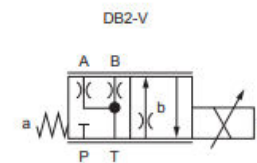
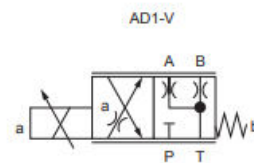
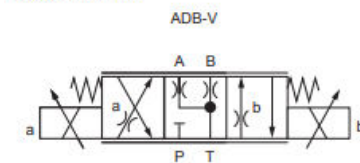
Symmetrical control



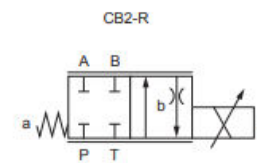
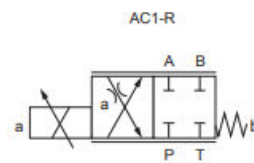
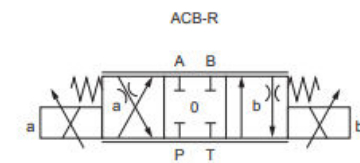
Meter-in control



Meter-in control



Meter-out control

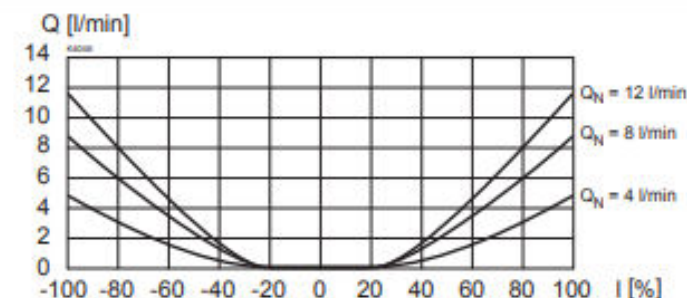


$Q = f(l)$

Volume flow adjustment characteristics

$\Delta p = 10 \text{ bar}$

ACB-V, AC1-V, CB2-V, ADB-V, AD1-V, DB2-V

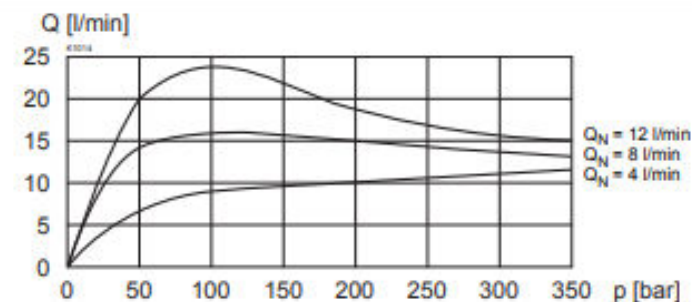


$Q = f(p)$

Volume flow pressure characteristics

$l = l_G$

ACB-R, AC1-R, CB2-R



Size:

Format:

Type:

Functionality:

Data sheet:

NG-4 & NG4-Mini – Wandfluh differentiator

Flange - Surface mount

PROPORTIONAL – spool valves

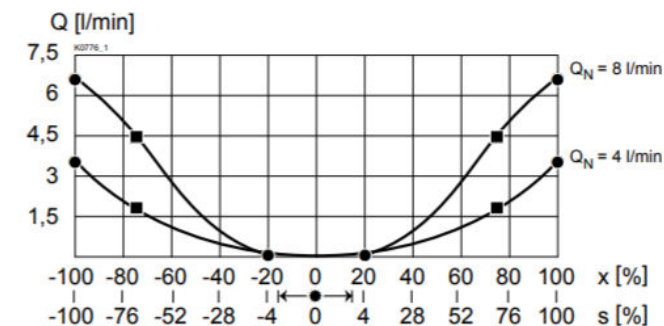
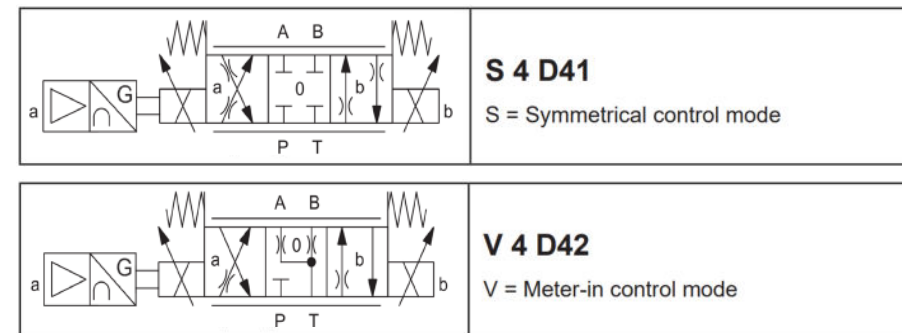
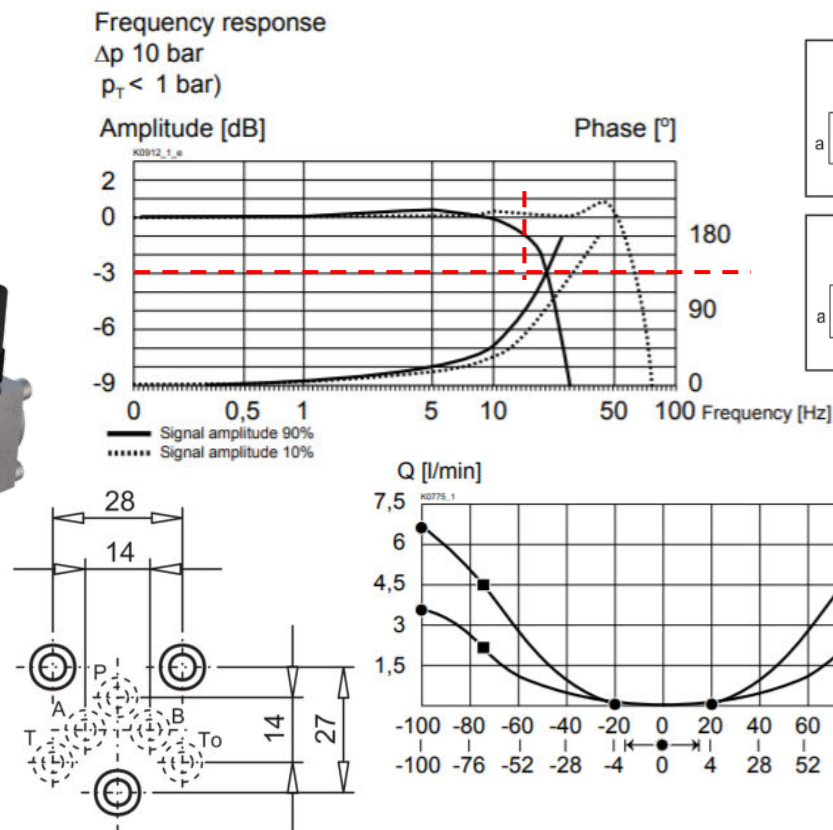
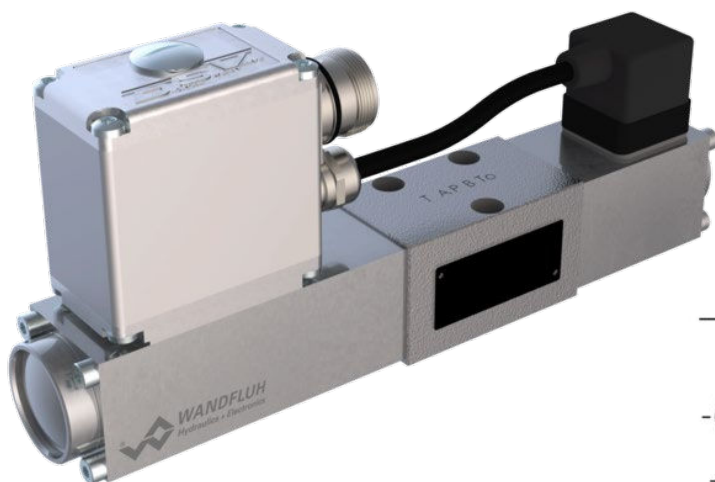
2P/4W and 3P/4W

[NG4-Mini data sheet](#)

- **Very High resolution for low flow apps**
- **Ultra compact manifold design**
- **Valve + subplate – replace NG6 valves**

NG4 – MINI VALVES

Direct Operated Closed Loop – 3P/4W

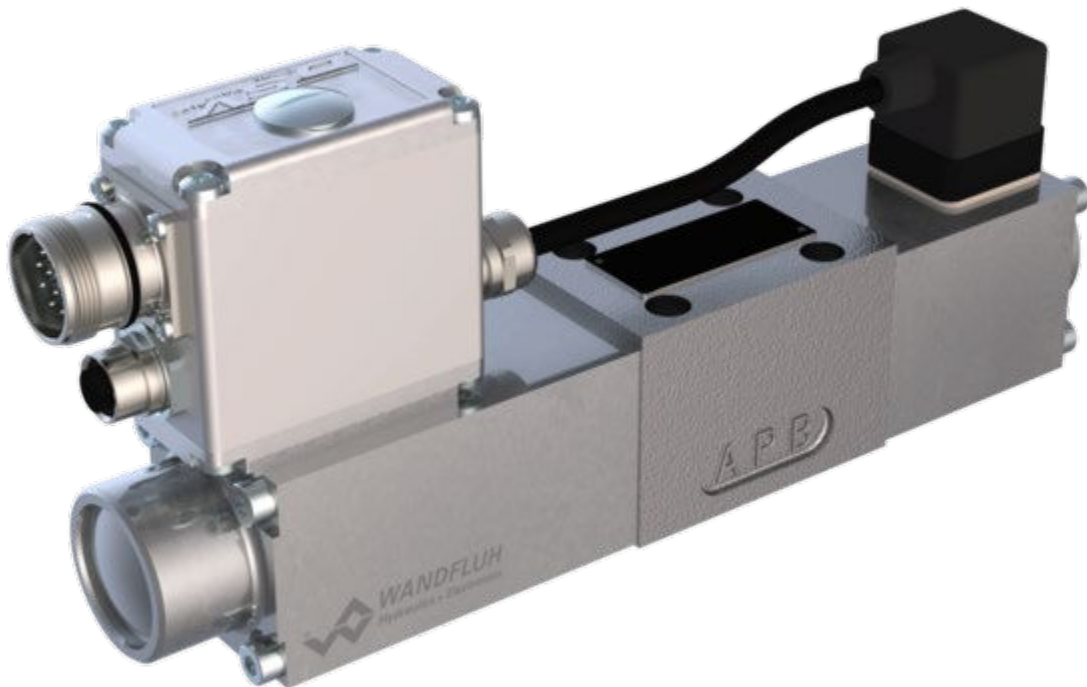


Size: NG4-Mini – Wandfluh differentiator
Format: Flange - Surface mount
Type: PROPORTIONAL – spool valves
Functionality: 3P/4W
Data sheet: [WDPFA04 data sheet](#)

- **>20Hz frequency response**
- **OBE - always has inner closed loop round valve**
- **Options for external outer closed loop**

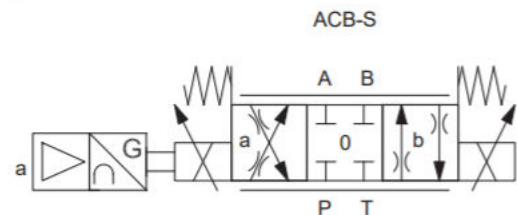
NG6 - VALVES

Direct Operated Closed Loop – 3P/4W



Size: NG6 – closed loop
Format: Flange - Surface mount
Type: PROPORTIONAL – spool valves
Functionality: 2P/4W
Data sheet: [WDRFA06 data sheet](#)

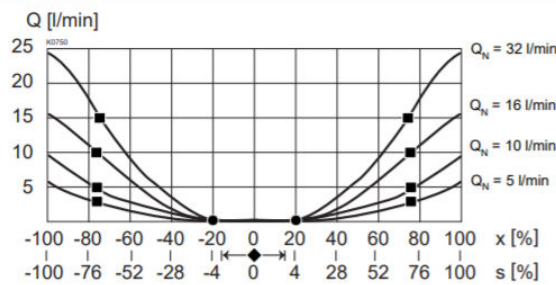
Symmetrical control



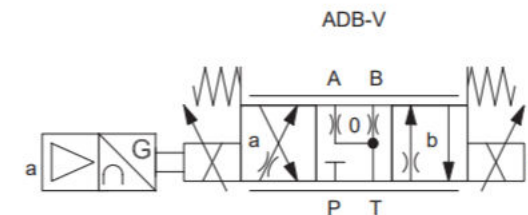
$Q = f(s, x)$

Volume flow adjustment characteristics

$\Delta p = 10$ bar, s = Command value signal, x = spool stroke
ACB-S



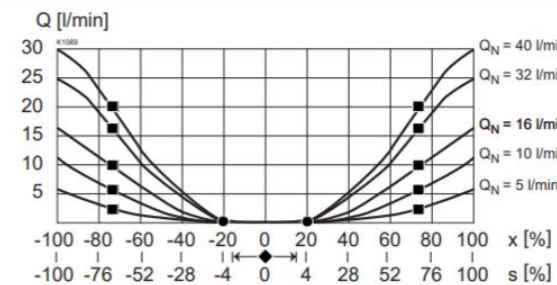
Meter-in control



$Q = f(s, x)$

Volume flow adjustment characteristics

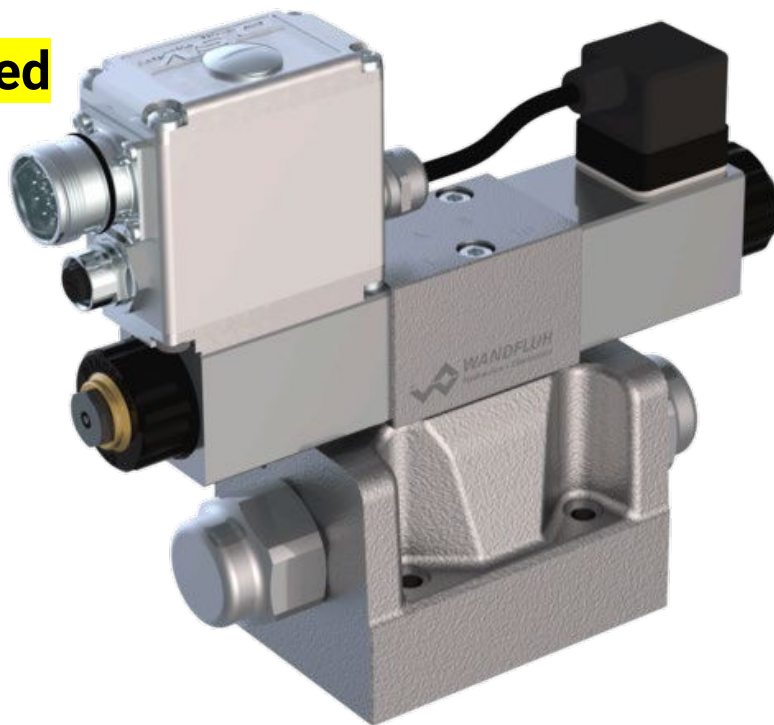
$\Delta p = 10$ bar, s = Command value signal, x = spool stroke
ADB-V



- **+/-0.4% Hysteresis & +/- 0.4% Repeatability**
- **Multiple spools to dial in closest flow rate**
- **Inner & Outer closed loop capabilities**

NG10 - VALVES

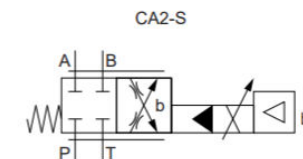
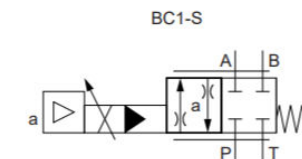
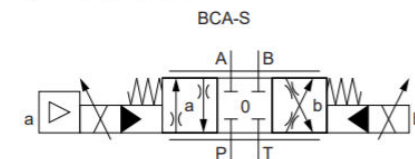
**Pilot
operated**



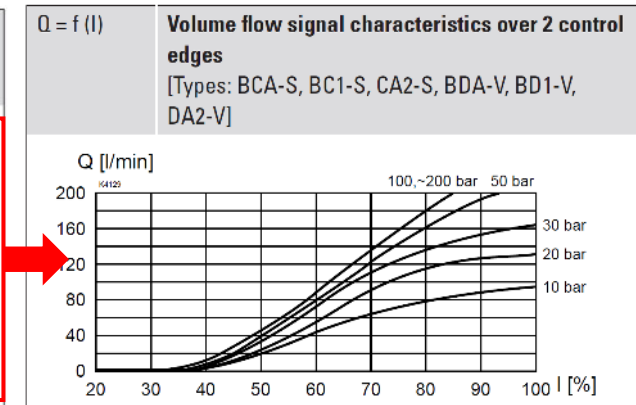
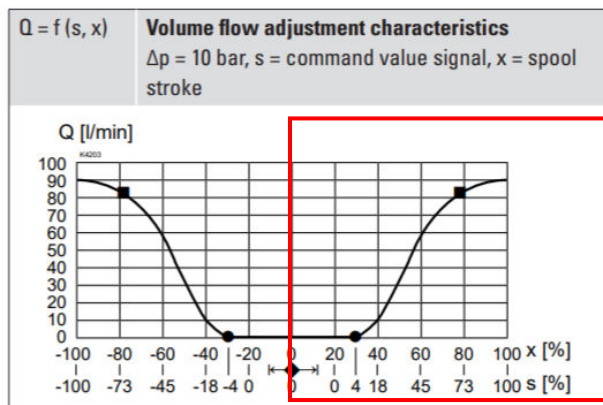
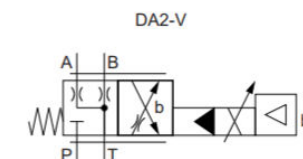
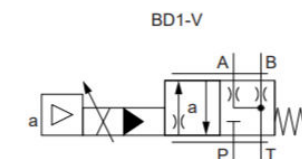
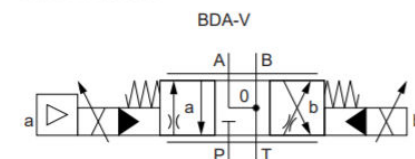
Size:
Format:
Type:
Functionality:
Data sheet:

NG10 – Open Loop piloted
Flange - Surface mount
PROPORTIONAL – spool valves
2P/4W and 3P/4W
[WVPFA10 data sheet](#)

Symmetrical control

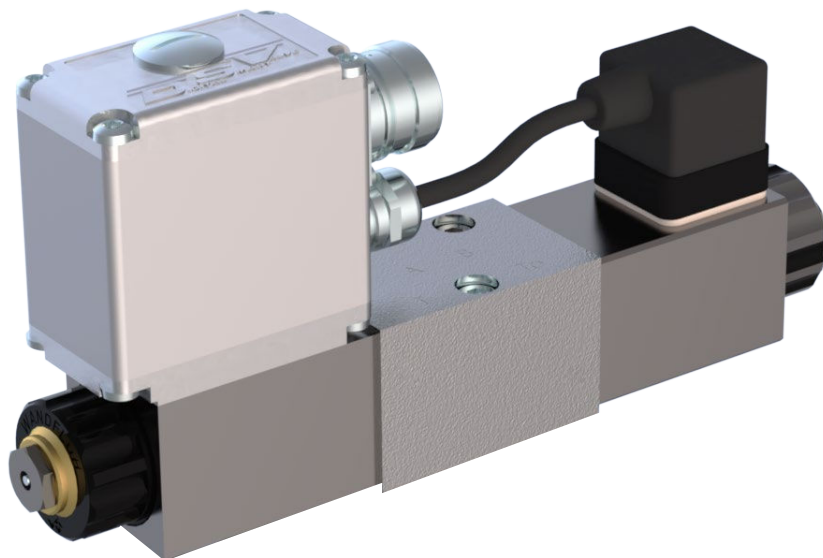


Meter-in control

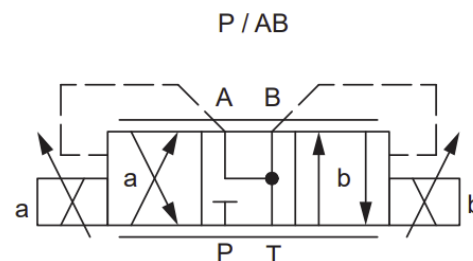


- **Industry standard, Waterproof connectors**
- **Big flows, high accuracy and repeatability**

PROPORTIONAL PRODUCTS REVIEW

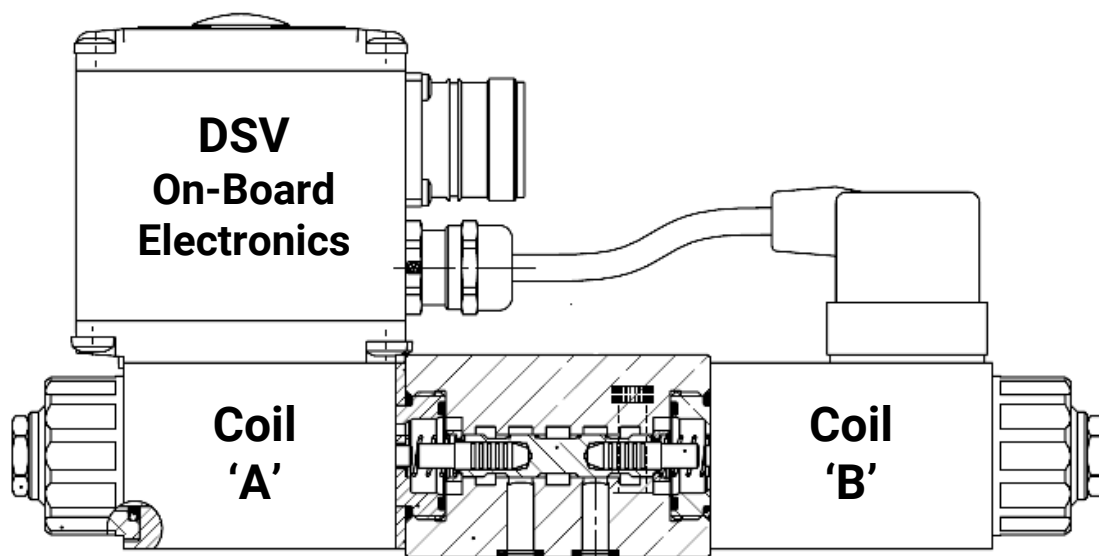
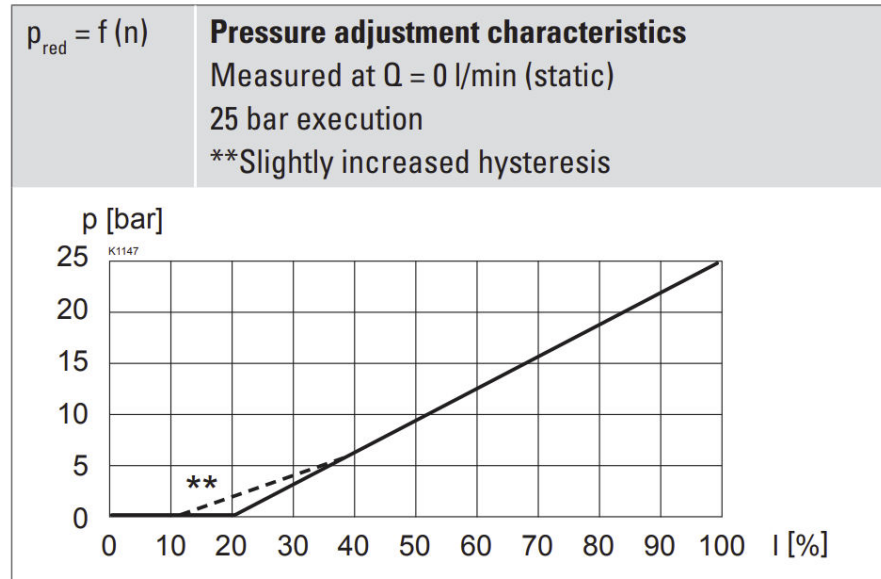


SYMBOL



[MDPFA04 Data Page](#)

[MDPFA04 Data sheet](#)



- NG4 mini valve body – 350bar capability in inlet
- Dual pressure reducer pilot stage
- Manual Overrides – emergency actuation if needed
- Use as Pilot valve & Hydrostatic Pumps, Motors
- DSV – OBE amplifier fully adaptable to application

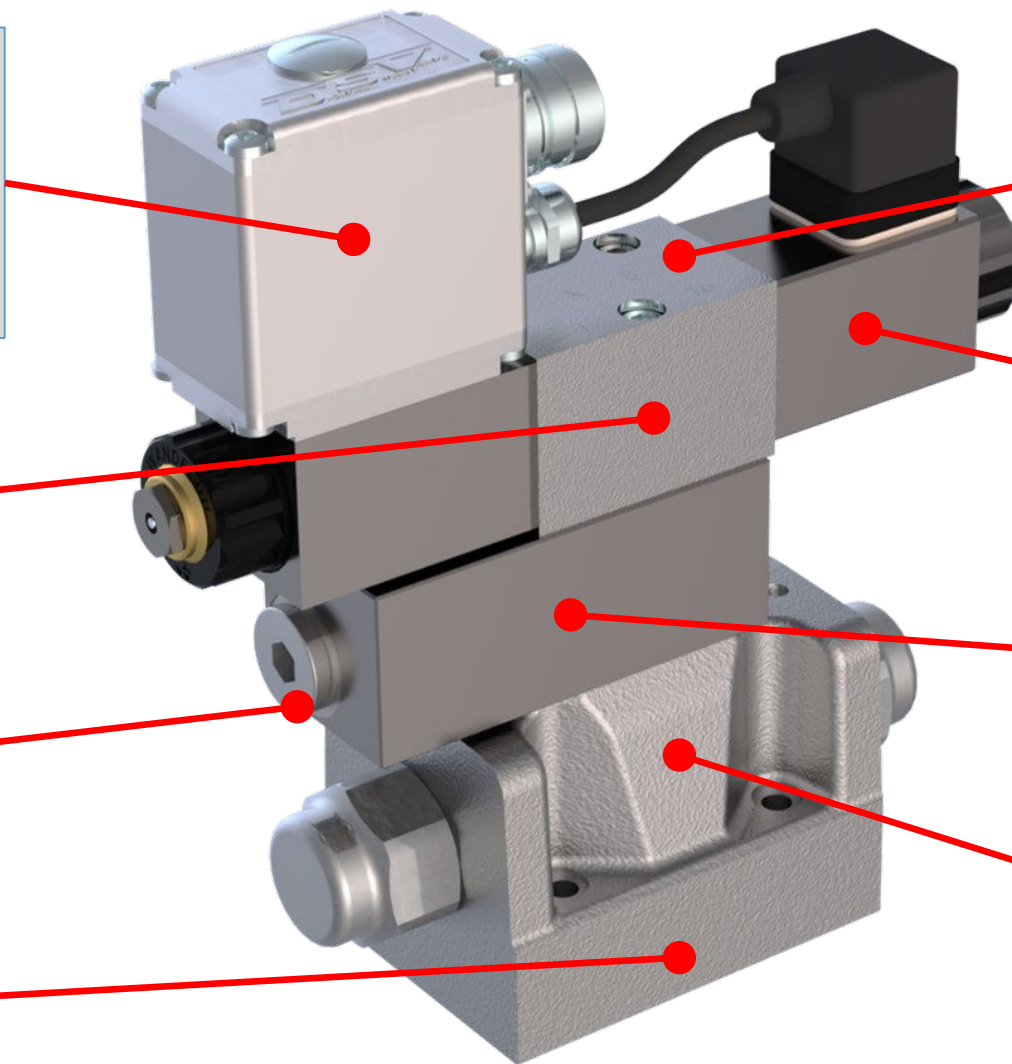
NG10 ALL-IN-ONE 'FAST SOLUTION'

- DSV controller
- Fully 'Potted' electronics
- Digital for dependability
- Configured by PASO
- No external adjustments

- NG4-Mini valve body
- Dual Pressure reducers

- ***User accessible part***
- Filter Access
- Field serviceable

- NG10 Interface
- Industry standard



- Valve stack - ready to use
- Factory assembled
- Factory tested as 'ONE'
- Arrives ready to use

- Slip on solenoids
- Manual override(s)

- Integrated filter slice
- Stainless - 25 Micron
- Reusable

- Main stage – cast body
- Long life – >10M cycles
- High flow spool valve
- High efficiency body
- Spool function options

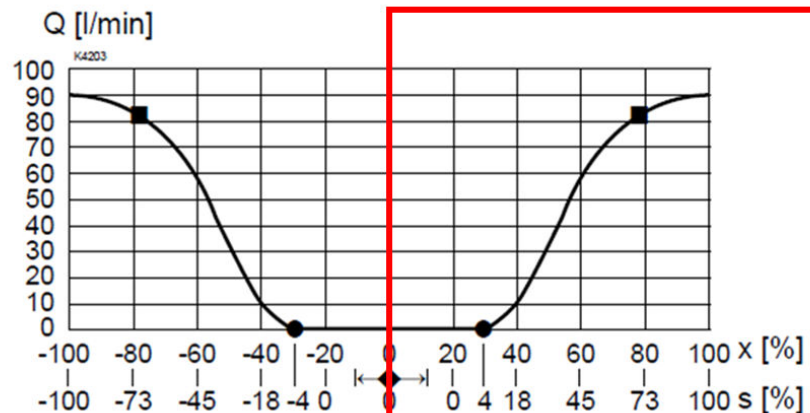
WVPFA10-BCA-S-90-ti-G24/MEA2-BF

WVPFA10-BCA-S-90-ti-G24/MEA2-BF

$Q = f(s, x)$

Volume flow adjustment characteristics

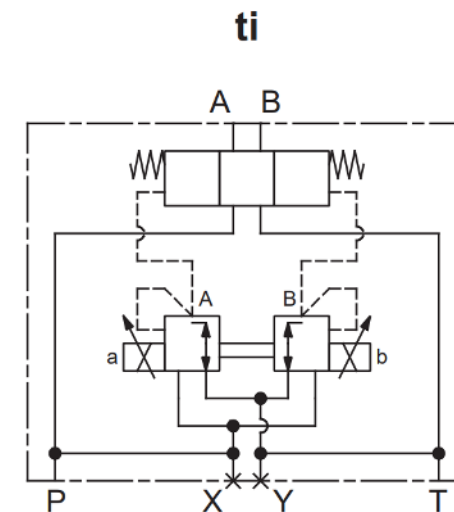
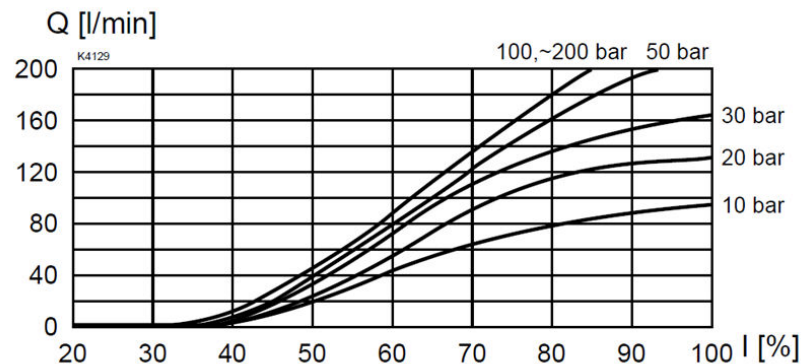
$\Delta p = 10 \text{ bar}$, s = command value signal, x = spool stroke



$Q = f(I)$

Volume flow signal characteristics over 2 control edges

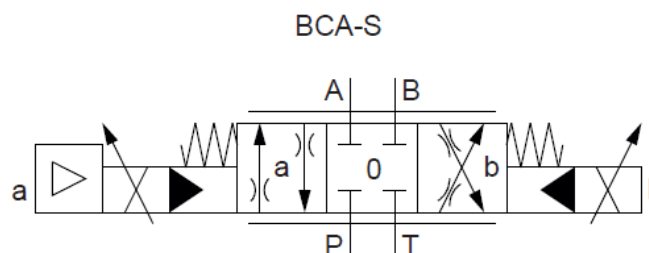
[Types: BCA-S, BC1-S, CA2-S, BDA-V, BD1-V, DA2-V]



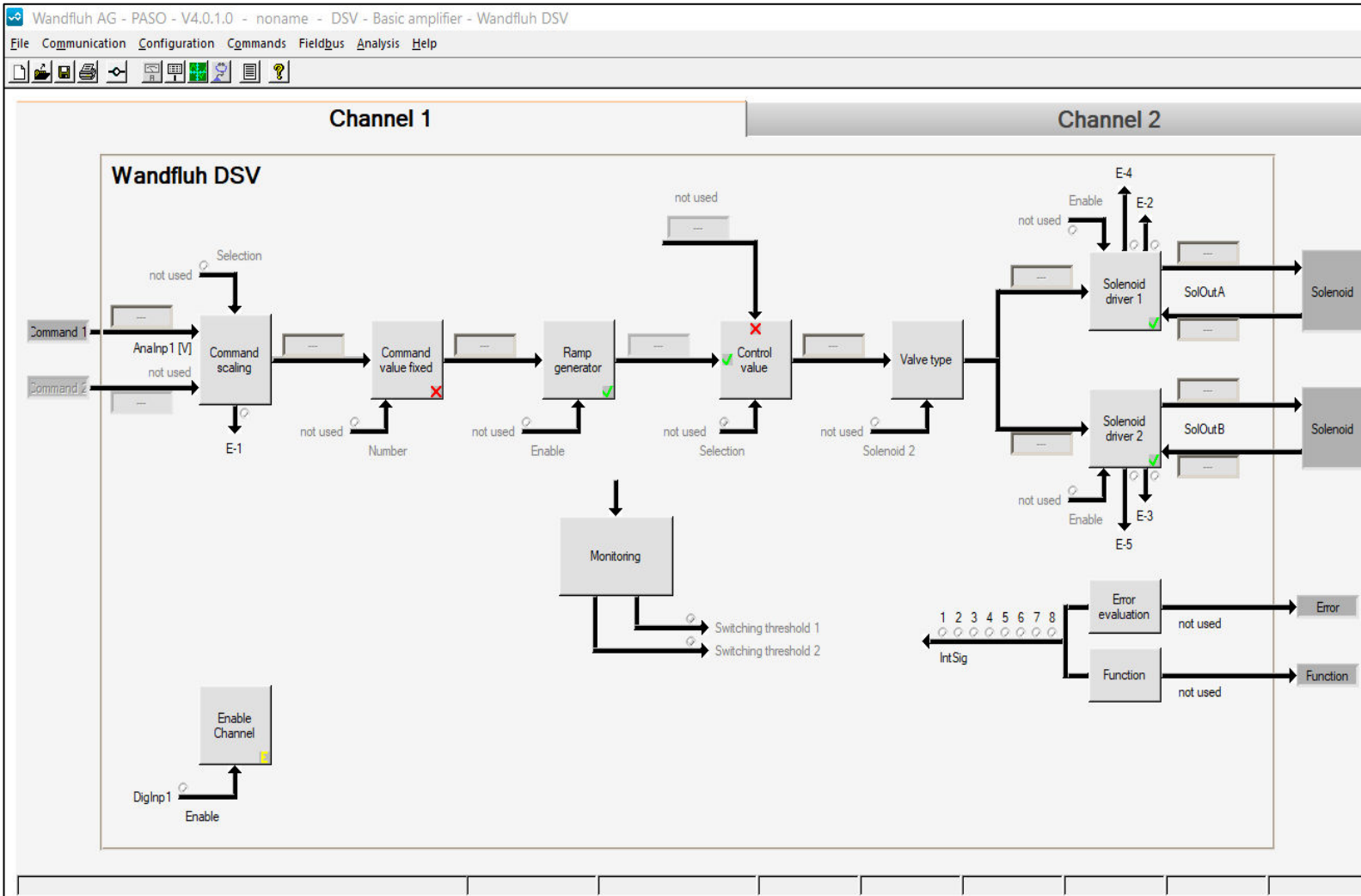
- NG10 flange format
- Pilot operated main stage
- >200 l/min max flow rate
- Highly repeatable flow curves

SYMBOL

Symmetrical control



DSV
On-Board
Electronics



- **PASO configuration software**
- Used across Wandfluh electronics
- ***Learn once and done !***
- Simple, easy to understand & use
- *Training available from Wandfluh*
- **Integrated 'Real-Time' diagnostics**
- Real-time valve amplifier data
- Create, update & edit DSV files
- Allows manual control of DSV

[**PASO download link**](#)

ADVANCED CORROSION PROTECTION



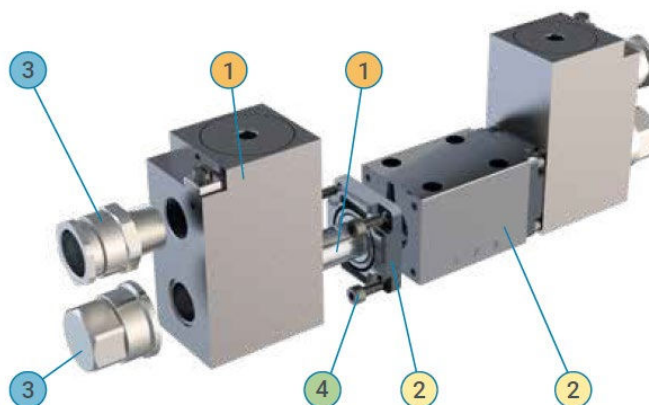
Zinc-nickel to 1000 hours to part (NOT TOKEN)

Pos	Corrosion protection
1	Zinc-nickel coated
2	Stainless steel AISI 316L
3	Nickel coated brass
4	Stainless steel screws
5	Zinc coated screws

K8: 500 -1000 H SALT SPRAY TEST

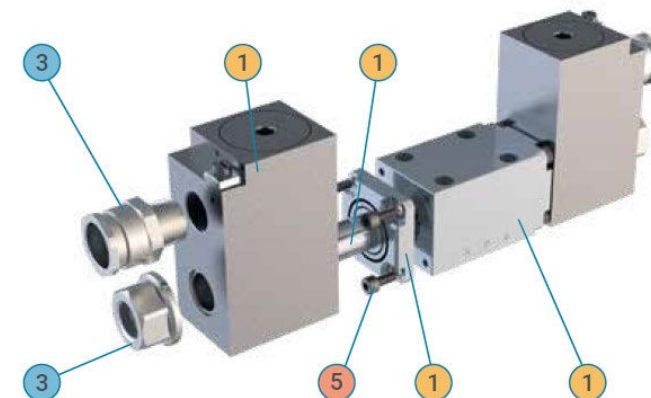
All elements on the valve which are in contact with the environment are surface-treated with a zinc-nickel coating or are made of stainless materials. Control knobs and partially knurled nuts are made of plastic.

K8 will increasingly become the normal standard in the future. Only the valve flange bodies are painted and the screws zinc coated.



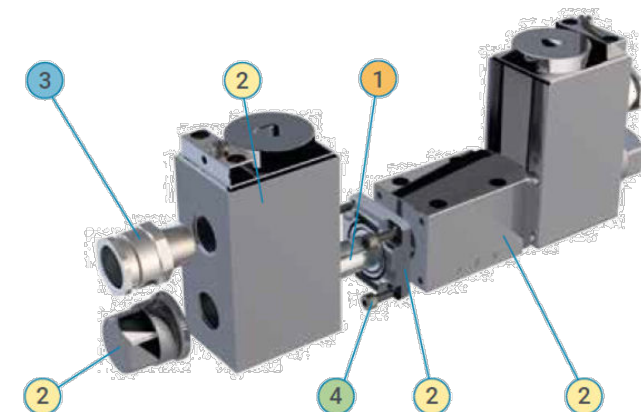
K10: > 1000 H SALT SPRAY TEST

All elements are made of stainless materials or coated with stainless materials. Stainless, acid-resistant AISI 316L high-grade steels are used if feasible.



K9: > 1000 H SALT SPRAY TEST

All elements, apart from the solenoids, are made of stainless materials. Stainless, acid-resistant AISI 316L high-grade steels are used if feasible. The solenoids are zinc-nickel coated.



CUSTOM MANIFOLDS

Manifold Solutions



THANK YOU!

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SOLUTIONS **SINCE 1946**

FILTER – RECCOMENDATION

Cleaner fluid... Longer component & fluid life = MORE uptime !

SELECTION OF FILTER/RECOMMENDATION

In the following table, the degrees of contamination (extract) in accordance with ISO 4406:1999 with number of particles/100 ml, as well as hydraulic valve groups with the filter fineness recommended for them are indicated.

Contamination classes	Number of particles per 100 ml		Recommended filter fineness $\beta_x \geq 75$ ($x = \mu\text{m}$)	Control valves	Prop. valves in control systems	Prop. valves in general	Valves with control plunger	Soft shift valves	Poppet valves	Valves in general > 160 bar	Valves in general < 160 bar
	over 5 μm	over 15 μm									
16/14/11	> 8000...16000	> 1000...2000	$\beta_{3...6}$								
18/16/13	> 32000...64000	> 4000...8000	$\beta_{6...10}$								
20/18/14	> 130000...250000	> 8000...16000	$\beta_{10...16}$								
21/19/15	> 250000...500000	> 16000...32000	$\beta_{16...25}$								
				Pressure filter required			Pressure filter recommended		return line filter		

ISO 4406 CLASSIFICATION

ISO CODE (to ISO 4406)	Particle Quantity / 100 ml fluid	
	From	to
5	16	32
6	32	64
7	64	130
8	130	250
9	250	500
10	500	1,000
11	1,000	2,000
12	2,000	4,000
13	4,000	8,000
14	8,000	16,000
15	16,000	32,000
16	32,000	64,000
17	64,000	130,000
18	130,000	260,000
19	260,000	500,000
20	500,000	1,000,000
21	1,000,000	2,000,000
22	2,000,000	4,000,000
23	4,000,000	8,000,000
24	8,000,000	16,000,000
25	16,000,000	32,000,000
26	32,000,000	64,000,000
27	64,000,000	130,000,000
28	130,000,000	250,000,000

18 / 16 / 13
>4µm >6µm >14µm

Example of contamination
recommendation

HIGHER FILTRATION NEEDED

- This is the European standard typically used in the industrial market segment.
- The contamination sizes is limited to 3 being 4µm, 6µm and 14µm respectively.
- The number indicates the quantity of particles of the size allowed in the 100 ml system fluid sample.
- The first number represents the 4µm, second number the 6µm and the final number the 14µm particles.

SAE AS 4059 CLASSIFICATION

Dimensions Code		A	B	C	D	E	F
Particle dimension		>4µm	>6µm	>14µm	>21µm	>38µm	>70µm
		Particle quantity / 100 ml					
Contamination Classes	000	195	76	14	3	1	-
	00	390	152	27	5	1	-
	0	780	304	54	10	2	-
	1	1,560	609	109	20	4	1
	2	3,120	1,220	217	39	7	1
	3	6,250	2,430	432	76	13	2
	4	12,500	4,860	864	152	26	4
	5	25,000	9,730	1,730	306	53	8
	6	50,000	19,500	3,460	612	106	16
	7	100,000	38,900	6,920	1,220	212	32
	8	200,000	77,900	13,900	2,450	424	64
	9	400,000	156,000	27,700	4,900	848	128
	10	800,000	311,000	55,400	9,800	1,700	256
	11	1,600,000	623,000	111,000	19,600	3,390	1,020
	12	3,200,000	1,250,000	222,000	39,200	6,780	

HIGHER FILTRATION NEEDED

- Typically used in NA particularly in the Aerospace industry segment.
- The contamination level is classified by a combination of 3 codes consisting of a Letter and number... e.g. 7B/6C/5D
- The letter identifies the particle size while the number gives the quantity of contaminants allowable in 100 ml sample of system fluid.

NAS 1638 CLASSIFICATION

Class	Maximum particles / 100 ml of fluid in specified range (µm)				
	5-15µm	15-25µm	25-50µm	50-100µm	>100µm
Particle quantity / 100 ml					
00	125	22	4	1	0
0	250	44	8	2	0
1	500	89	16	3	1
2	1,000	178	32	6	1
3	2,000	356	63	11	2
4	4,000	712	126	22	4
5	8,000	1,425	253	45	8
6	16,000	2,850	506	90	16
7	32,000	5,700	1,012	180	32
8	64,000	11,400	2,025	360	64
9	128,000	22,800	4,050	720	128
10	256,000	45,600	8,100	1,440	256
11	512,000	91,200	16,200	2,880	512
12	1,024,000	182,400	32,400	5,760	1,024

HIGHER FILTRATION NEEDED

Comparison chart

ISO 4406	SAE AS 4059	NAS 1538
14/12/09	4A/3B/3C	3
15/13/10	5A/4B/4C	4
16/14/11	6A/5B/5C	5
17/15/12	7A/6B/6C	6
18/16/13	8A/7B/7C	7
19/17/14	9A/8B/8C	8
20/18/15	10A/9B/9C	9
21/19/16	11A/10B/10C	10
22/20/17	12A/11B/11C	11
23/21/18	13A/12B/12C	12

Note:

- NAS 163 (National Aerospace Standard) is typically also seen in N.A.
- It divides the particle size into intervals i.e. 5-15µm, 15-25µm, 25-50µm etc

- Comparisons are nearest values

Cleaner fluid... Longer component & fluid life = MORE uptime !

Filter Micron Ratings:

A: Nominal Micron Rating (NMR) NMR usually means the filter can capture a given percentage of particles of the stated size. For example, a filter might be said to have a nominal rating of 90% at 10 micron.

B: Absolute Micron Rating (AMR) AMR is a single pass test and is obtained by passing fluid containing glass beads through a flat sheet of filter material. Any beads that pass through are captured and measured.

Recommendations from Wandfluh:

- Use filters of high quality
- Obtain filters from reliable suppliers
- Pay close attention to service intervals and good service practices for best system reliability and economy of operation.
- Be aware of changes in system that require filter change/check i.e. hose change, oil replenishment etc.

PARTICAL SIZE

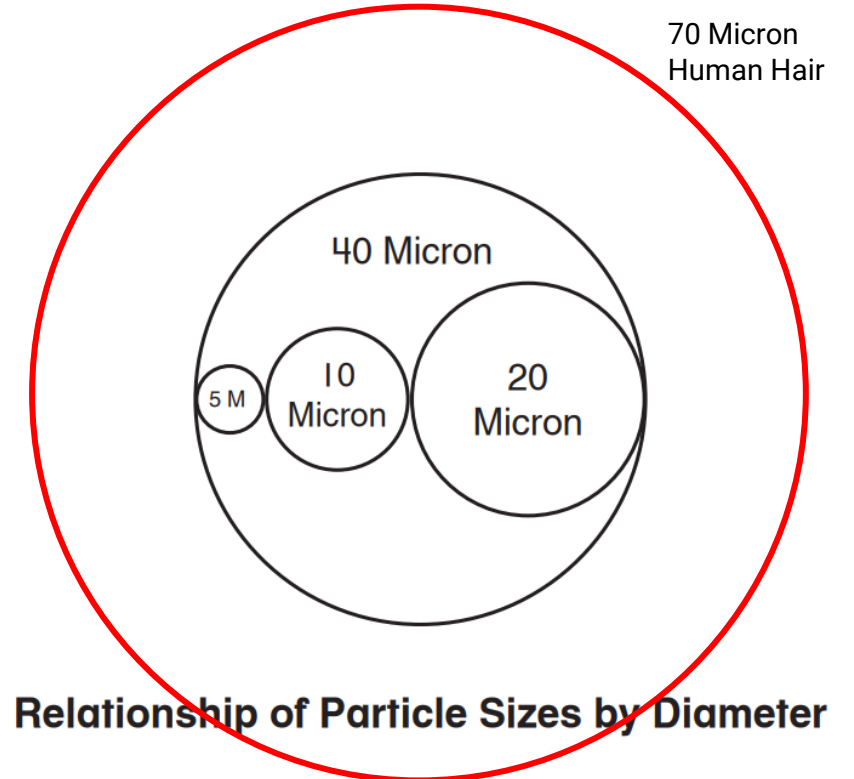
UNDERSTANDING ISO CODES

Understanding ISO Codes - The ISO cleanliness code (per ISO4406-1999) is used to quantify particulate contamination levels per milliliter of fluid at 3 sizes 4μm[c], 6μm[c] and 14μm[c]. The ISO code is expressed in 3 numbers (example: 19/17/14). Each number represents a contaminant level code for the correlating particle size. The code includes all particles of the specified size and larger. It is important to note that each time a code increases the quantity range of particles is doubling and inversely as a code decreases by one the contaminant level is cut in half.

ISO 4406:1999 Code Chart		
Range Code	Particles per Milliliter	
	More Than	Up To/Including
24	80000	160000
23	40000	80000
22	20000	40000
21	10000	20000
20	5000	10000
19	2500	5000
18	1300	2500
17	640	1300
16	320	640
15	160	320
14	80	160
13	40	80
12	20	40
11	10	20
10	5	10
9	2.5	5
8	1.3	2.5
7	0.64	1.3
6	0.32	0.64

Particle Size	Particles per Milliliter	ISO 4406 Code Range	ISO Code
4μm _[c]	151773	80000~160000	24
4.6μm _[c]	87210		
6μm _[c]	38363	20000~40000	22
10μm _[c]	8229		
14μm _[c]	3339	2500~5000	19
21μm _[c]	1048		
38μm _[c]	112		
68μm _[c]	2		

Particle Size	Particles per Milliliter	ISO 4406 Code Range	ISO Code
4μm _[c]	69	40~80	13
4.6μm _[c]	35		
6μm _[c]	7	5~10	10
10μm _[c]	5		
14μm _[c]	0.4	0.32~0.64	6
21μm _[c]	0.1		
38μm _[c]	0.0		
68μm _[c]	0.0		



Relationship of Particle Sizes by Diameter

1 Micron = 1 Millionth of a Meter.

1 Micron = 1 Thousandth of a Millimeter.

1 Micron = 39 Millionth of an Inch (0.000039).

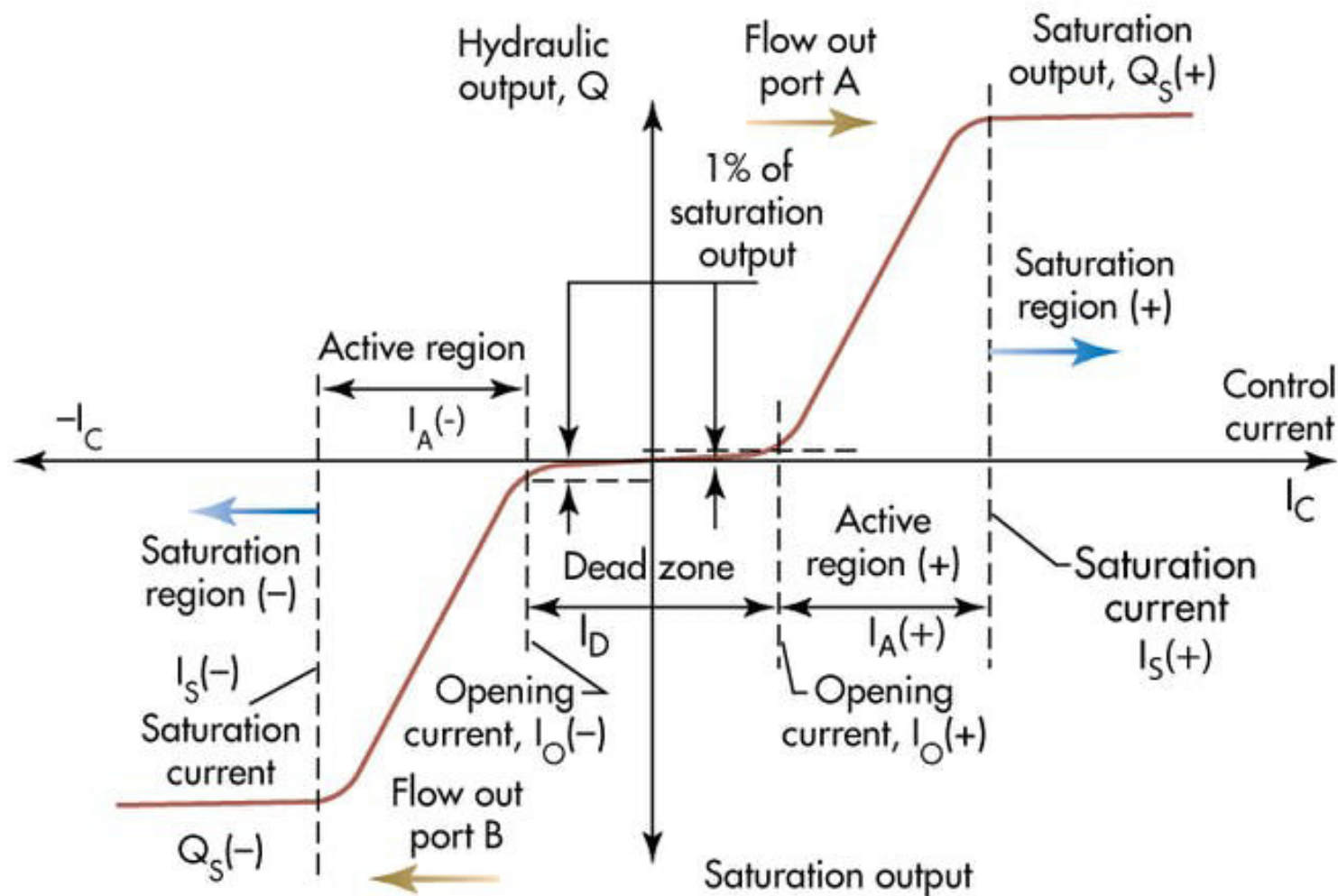
25.4 Micron = 1 Thousandth of an Inch (0.001).

40 Microns = Visible with Magnification.

40 to 90 Microns = Diameter of a Human Hair.

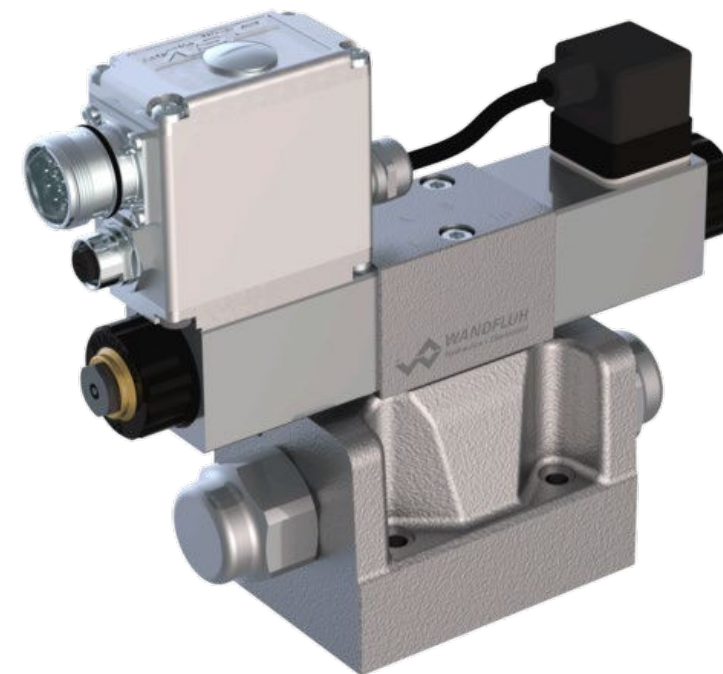
PROPORTIONAL VALVE

FLOW METERING CHARACTERISTICS



[Fluid Power Explanations:](#)

[Meter-IN Vs Meter-Out Video](#)



METER-IN V'S METER-OUT

A **meter-out** flow control system is one in which the flow control valve is placed in the outlet line of the hydraulic cylinder. Thus, a meter-out flow control system controls the oil flow rate out of the cylinder.

Meter-in systems are used primarily when the external load opposes the direction of motion of the hydraulic cylinder.

- When a load is pulled downward due to gravity, a meter-out system is preferred.
- If a meter-in system is used in this case, the load would drop by pulling the piston rod, even if the flow control valve is completely closed.
- One drawback of a meter-out system is the excessive pressure build-up in the rod end of the cylinder while it is extending. In addition, an excessive pressure in the rod end results in a large pressure drop across the flow control valve. This produces an undesirable effect of a high heat generation rate with a resulting increase in oil temperature.