MANNESMANN REXROTH

# 4/2 and 4/3 Proportional Directional Valve Direct Operated, Model 4 WRE (Series 1X) with Spool Position Feedback

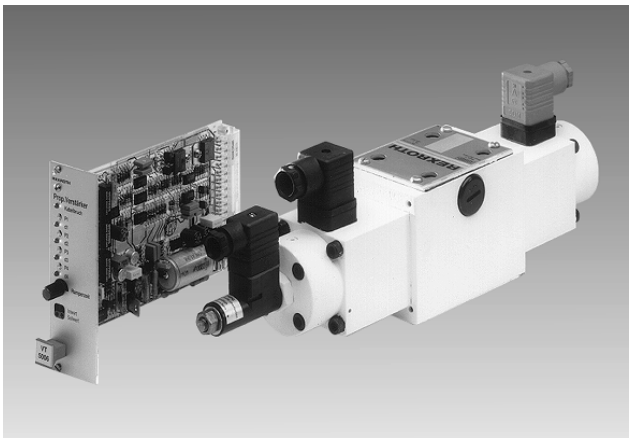
| Sizes 6 and 10 | ... 4600 PSI (315 bar) | ... 70 GPM (260 L/min) |
|---|---|---|

**RA 29 060/06.98**

**Replaces: 05.94**

- Valve for controlling both direction and flow of a hydraulic fluid
- Operation by means of proportional solenoid
- Mounts on standard ISO 4401**-3** and **-5**, NFPA T3.5.1M R1 and ANSI B 93.7 **D 03** and **05** interface
- Electrical feedback
- Spring centered control spool
- For control of:
  electrical amplifier (ordered separately),
  see page 3

H/A 1767



Model 4 WRE 10...-1X/24 Z4...
with appropriate electronic control (ordered separately)

## Order codes

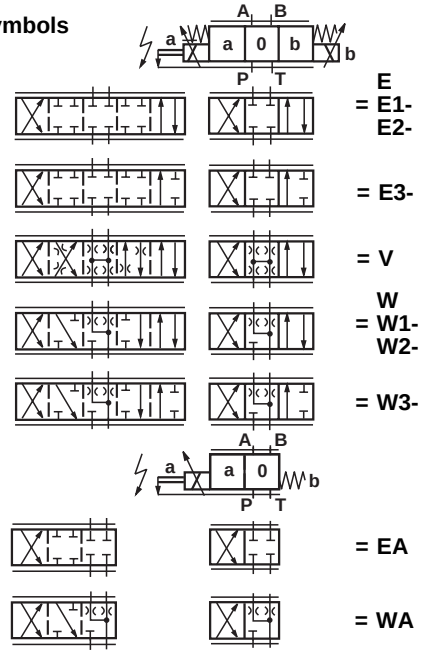
| 4 | WRE | | | –1X / | Z4 | | * |
|---|---|---|---|---|---|---|---|

4-way = **4**

Proportional directional control valve, direct operated, with LVDT feedback = **WRE**

Size 6 NFPA/ANSI D 03 = **6**
Size 10 NFPA/ANSI D 05 = **10**

**Symbols**




= **E**
= **E1-**
**E2-**
= **E3-**
= **V**
= **W**
= **W1-**
**W2-**
= **W3-**
= **EA**
= **WA**

**Note:**
Spools “W”, “W1-”, “W2-”, “W3-” and “WA” in the center position “0” provide 3 % opening of the nominal flow area from A to T and B to T.

Further details to be written in clear text

**M =** NBR seals suitable for Petroleum oils (HM, HL, HLP)

**V =** FPM seals suitable for phosphate ester fluids (HFD-R)

**Z4 =** Angled plug for cable

Supply voltage to electronic amplifier
**12 =** 12 V DC (only size 10 *)
**24 =** 24 V DC
* (For size 6 valves only, use the 24 V solenoid for 12 V or 24 V. 12 V use requires a suitable amplifier (not VT 5005 or VT 5006).

**1X =** Series 10 to 19 (10 to 19: externally interchangeable)

Flow at 145 PSI (10 bar) pressure drop

| | | |
|---|---|---|
| **08** = 2.65 GPM (10 L/min) | Size 6 | * E1-, E2-, E3-, W1-, W2-, W3- only with flow $Q_{max}$ |
| **16** = 5.55 GPM (21 L/min) | | |
| **32** = 8.45 GPM (32 L/min)* | | |
| **16 =** 7.15 GPM (27 L/min) | Size 10 | |
| **32 =** 11.10 GPM (42 L/min) | | |
| **64 =** 16.40 GPM (62 L/min)* | | |

For spools E1- and W1-:
P → A: $Q_{max}$ B → T: $Q/2$
P → B: $Q/2$ A → T: $Q_{max}$

For spools E2- and W2-:
P → A: $Q/2$ B → T: $Q_{max}$
P → B: $Q_{max}$ A → T: $Q/2$

For spools E3- and W3-:
P → A: $Q_{max}$ B → T: blocked
P → B: $Q/2$ A → T: $Q_{max}$

(for regenerative circuit, connect cylinder head to port A)

## Description of Function, Section

Proportional directional control valves Model 4 WRE are direct operated spool valves. They control the start, stop, direction and quantity of a fluid flow for smooth acceleration and deceleration of an actuator. The direction control is shifted to the desired position by a 0 ± 9 V (or a 0 ± 10 V differential) input signal to the associated electronic amplifier card.

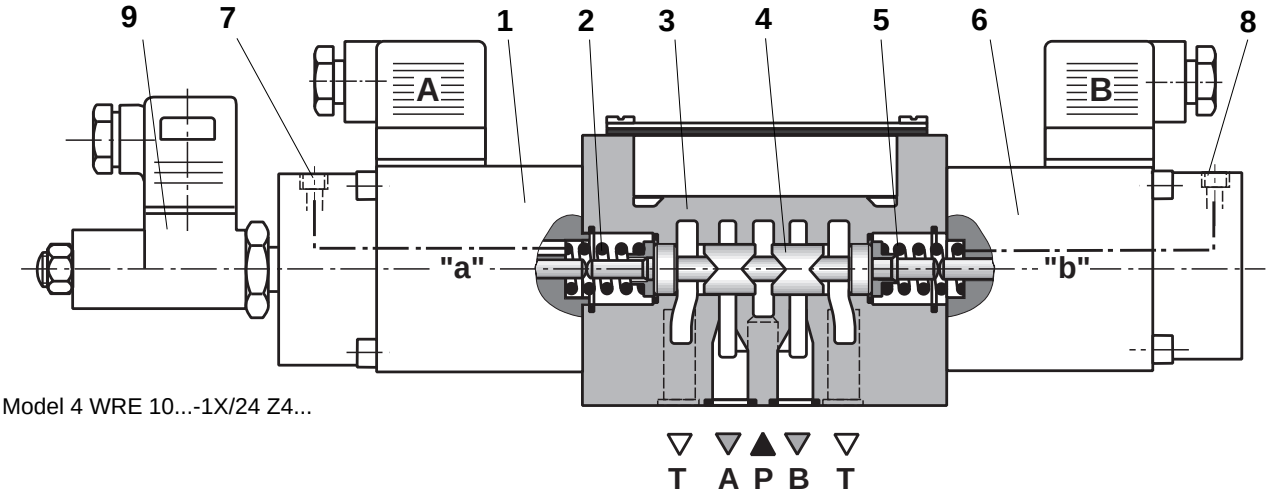
These valves basically consist of the housing (3), control spool (4), one or two centering springs (2 & 5) proportional solenoids (1, 6) with inductive positional transducer [LVDT (9)].

**Model 4 WRE...-1X/...** (3-position)

In the de-energized condition, the control spool (4) is held by the return springs (2 & 5) in the center position. When the proportional solenoid (1) is supplied with an input signal from the amplifier, the solenoid pushes directly against the control spool and shifts it to the right a proportional distance to the input signal, against the opposing spring force (5). This allows fluid to progressively flow from “P” to “B” and “A” to “T”. Likewise, when solenoid (6) is energized the control spool shifts to the left allowing progressive flow from “P” to “A” and “B” to “T”.

The LVDT (9) feedback is mechanically linked to the proportional solenoid and senses movement in either direction. Any error between the desired position and the actual spool position is fed back, compared in the electronic amplifier and then a correction signal is generated and output to the solenoid. This provides extremely high accuracy and repeatability.

**Important:** During initial start up, the air must be bled from the proportional solenoids. This may be done two ways: 1) pressurize the valve, remove the two bleed screws (7 & 8) until no more air bubbles appear, then reinstall bleed screws; or 2) remove both bleed screws (7 & 8) insert standard oil can nozzle and pump fluid in one side until it flows, without air bubbles, out the other side, then reinstall screws. In both cases the tank line must be prevented from emptying if there is no inherent back pressure in the tank port of the circuit. This may be achieved by installing a check valve in the tank line. The valve's cracking pressure should be in the range of 22 ... 45 PSI (1.5 ... 3 bar)



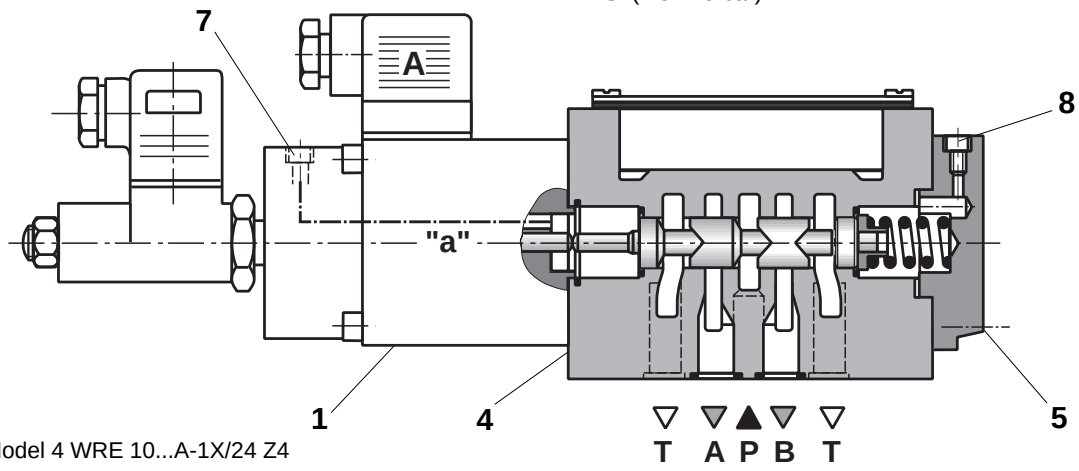

Model 4 WRE 10...-1X/24 Z4...

**Model 4 WRE...A..-1X/...** (2-position)

These are 2-position directional proportional control valves with only one proportional solenoid with inductive positional transducer [LVDT (1)]. An end cover replaces the solenoid which is removed. The function of this design is the same as that of the 3-position valve described on page 1.

**Important:**

During initial start up, the air must be bled from the proportional solenoids. This may be done two ways: 1) pressurize the valve, remove the two bleed screws (7 & 8) until no more air bubbles appear, then reinstall bleed screws; or 2) remove both bleed screws (7 & 8) insert standard oil can nozzle and pump fluid in one side until it flows, without air bubbles, out the other side, then reinstall screws. In both cases the tank line must be prevented from emptying if there is no inherent back pressure in the tank port of the circuit. This may be achieved by installing a check valve in the tank line. The valve's cracking pressure should be in the range of 22 ... 45 PSI (1.5 ... 3 bar).




Model 4 WRE 10...A-1X/24 Z4

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

| **General** | | | **Size 6** | **Size 10** |
|---|---|---|---|---|
| Weight | – Valve with 1 solenoid | lbs (kg) | 4.2 (1.9) | 12.5 (5.7) |
| | – Valve with 2 solenoids | lbs (kg) | 5.9 (2.7) | 16.9 (7.7) |
| Mounting position | | | optional (horizontal preferred, however, the end cap of the solenoid(s) should be rotated so that the bleed screw(s) is at the highest point to bleed the air on the 1st start-up) | |
| Ambient temperature range | | °F (°C) | – 4 ... 158 (– 20 ... 70) | |

**Hydraulic,** measured at $v$ = 190 SUS (41 mm²/s) and $t$ = 122 °F (50 °C)

| | | | | |
|---|---|---|---|---|
| Operating pressure[1)] | – Ports A,B,P | PSI (bar) | ... 4600 (315) | |
| | – Port T | PSI (bar) | ... 2320 (160) | |
| Max. flow | | GPM (L/min) | ... 17.2 (65) | ... 68.7 (260) |
| Hydraulic fluid | | | Petroleum oils (HM, HL, HLP); Phosphate-ester fluids (HFD-R) | |
| **Fluid cleanliness:** | | | Maximum allowable fluid cleanliness level - Class 16/13 to 18/15 according to ISO 4406. Therefore, we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$. | |
| Hydraulic fluid temperature range | | °F (°C) | – 4 ... 158 (– 20 ... 70) | |
| Viscosity range | | SUS (mm²/s) | 70 ... 1760 (15 ... 380) | |
| Hysteresis | | % | < 1 | |
| Repeatability | | % | < 1 | |
| Response sensitivity | | % | ≤ 0.5 of nominal signal | |
| Frequency response (– 3 dB, Signal ±100 %) | | Hz | 6 | 4 |

[1)] Note power limits

**Electrical** (Valve)

| | | | | | |
|---|---|---|---|---|---|
| Type of voltage | | | DC<br>12 or 24 V | 12 V | 24 V |
| Nominal output per proportional solenoid | | W | 12.5 | 22.5 | 22.5 |
| Solenoid coil resistance | Cold value at 68 °F (20 °C) | Ω | 5.4 | 3.1 | 10 |
| | max. value when hot | Ω | 8.1 | 4.4 | 14 |
| Duty cycle | | | Continuous | | |
| Coil temperature | | °F (°C) | ... 302 (... 150) | | |
| Electrical connection | | | 3 prong plug and socket connection to ISO 4400, ANSI B93.94M | | |
| Valve insulation (DIN 40 050) | | | exceeds NEMA class B (IP 65) | | |
| Associated electronic amplifier cards (to be ordered separately) | RA 30 095 – with 1 ramp time | | VT 5005 [2)] | — | VT 5006 [2)] |
| | RA 29 958 – with 1 ramp time | | VT 5024 [4)] | — | VT 5025 [4)] |
| | RA 30 095 – with 5 ramp times | | VT 5007 [2)] | — | VT 5008 [2)] |
| | RA 29 945 – with 2 ramp times | | VT 5001 [3)] | — | VT 5002 [3)] |
| | RA 29 739 – amplifier module | | VT 11 023 [2)] | — | VT 11 024 [2)] |
| | RA 29 739 – amplifier module | | VT 11 074 [4)] | — | VT 11 075 [4)] |

[2)] for 2 solenoids [3)] for 1 solenoid [4)] specially for V spool

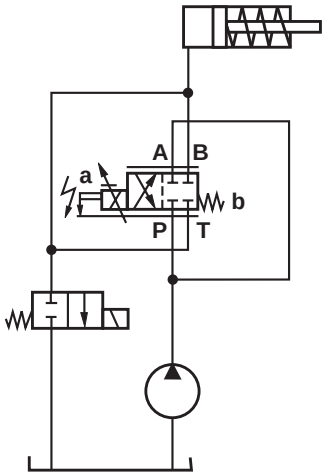
**Electrical** (inductive positional transducer)

| | | | |
|---|---|---|---|
| Electrical measuring system | | | LVDT |
| Control stroke | | in. (mm) | ± 0.11 (2.8) ± 0.157 (4) |
| Linearity tolerance | | % | 1 |
| Coil resistance at 68 °F (20 °C) (see page 4) | Coil I | Ω | 56 |
| | Coil II | Ω | 56 |
| | Coil III | Ω | 112 |
| Electrical connection | | | 3 prong plug and socket connection to ISO 4400, ANSI B93.94M |
| Insulation (DIN 40 050) | | | exceeds NEMA class B (IP 65) |
| Inductance | | mH | 6 to 8 |
| Oscillator frequency | | kHz | 2.5 |

## Power limits

| Size | Symbol/Nominal flow | | Flow in GPM (L/min) pressure drop $p_v$ in PSI (bar) 870 (60) | 1740 (120) | 2610 (180) † |
|---|---|---|---|---|---|
| 6 | E, W<br>EA, WA | 08<br>08 | 7.1 (27)<br>[12.7 (48)] | 6.6 (25)<br>[10.5 (40)] | 6.1 (23)<br>[*] |
| | E, W<br>EA, WA | 16<br>16 | 10.0 (38)<br>[17.2 (65)] | 9.0 (34)<br>[13.5 (51)] | 7.7 (29)<br>[*] |
| | E, W<br>EA, WA | 32<br>32 | 13.7 (52)<br>[17.2 (65)] | 10.8 (41)<br>[15.3 (58)] | 9.5 (36)<br>[*] |
| 10 | E, W<br>EA, WA | 16<br>16 | 12.9 (49)<br>[25.9 (98)] | 21.1 (80)<br>[30.4 (115)] | 17.2 (65)<br>[*] |
| | E, W<br>EA, WA | 32<br>32 | 34.3 (130)<br>[47.6 (180)] | 29.1 (110)<br>[39.6 (150)] | 26.4 (100)<br>[*] |
| | E, W<br>EA, WA | 64<br>64 | 47.6 (180) | 34.3 (130) | 29.1 (110) |
| | E1-, W2-<br>E2-, W2-<br>E3-, W3- | see page 1 | [68.7 (260)] | [47.6 (180)] | [*] |

**Example of double flow circuit**



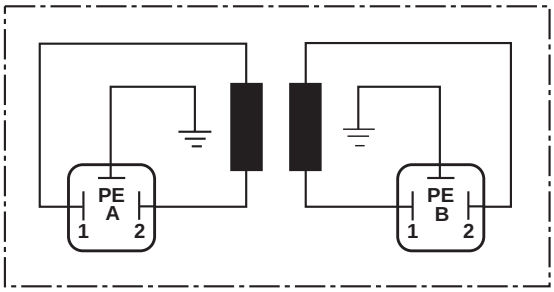

[ ] Values in brackets apply for double flow through the valve

[*] Because of the maximum tank pressure, double flow through the valve is not possible

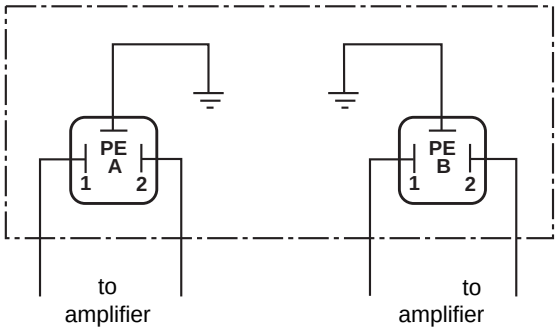
† 2600 PSI (180 bar) is the max. permissible pressure differential

## Electrical connections

Coil connection

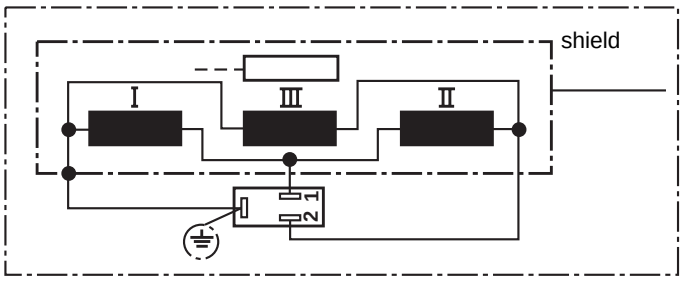



Coil to plug

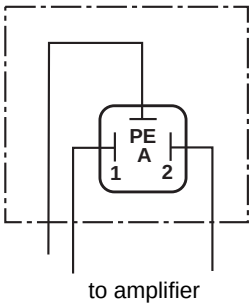



**Inductive positional transducer**

Coil connection

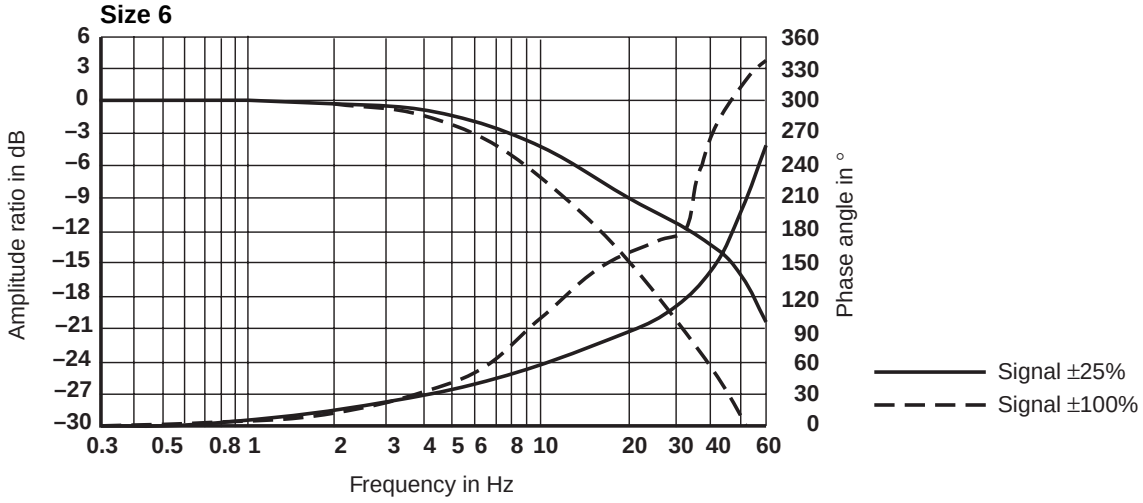



Coil to plug

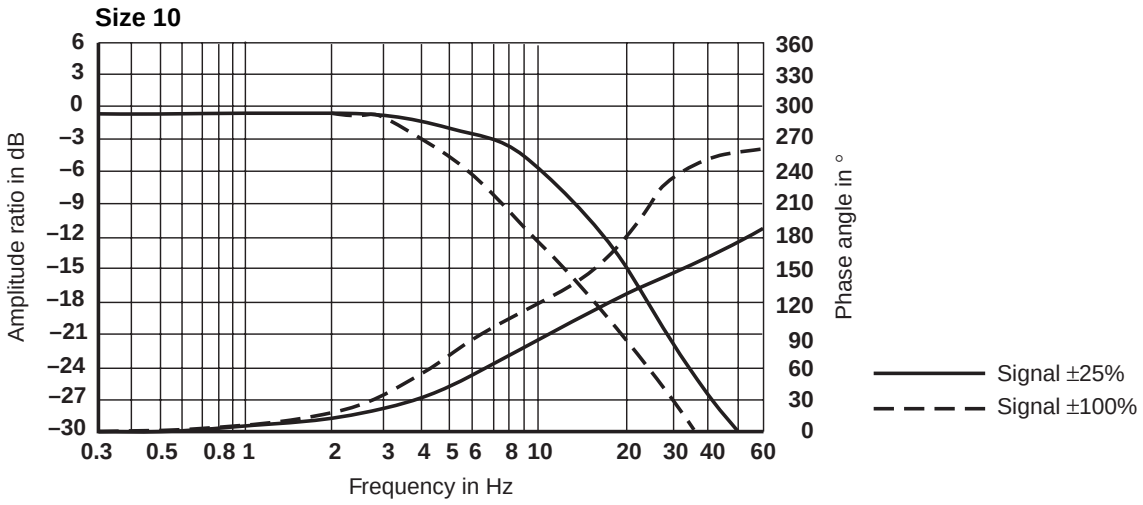


## Frequency of response: measured at $v$ = 190 SUS (41 mm²/s) and $t$ = 122 °F (50 °C)

**Size 6**

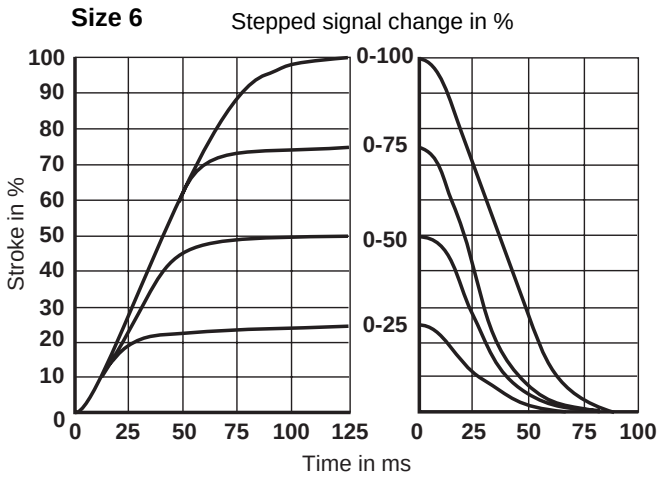



**Size 10**

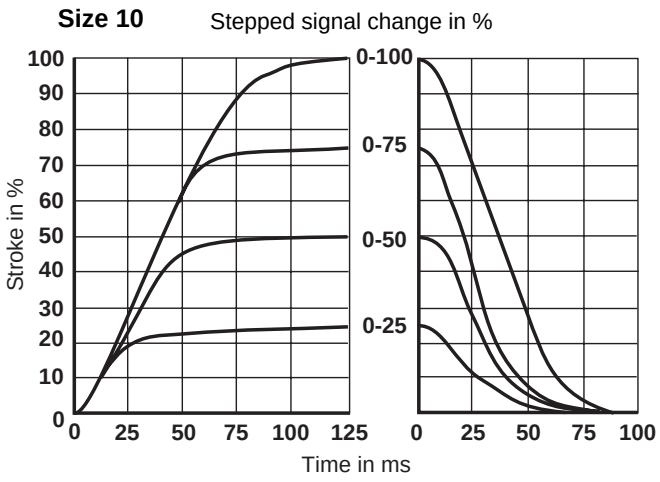



## Valve Response with stepped electrical input signals

**Size 6**

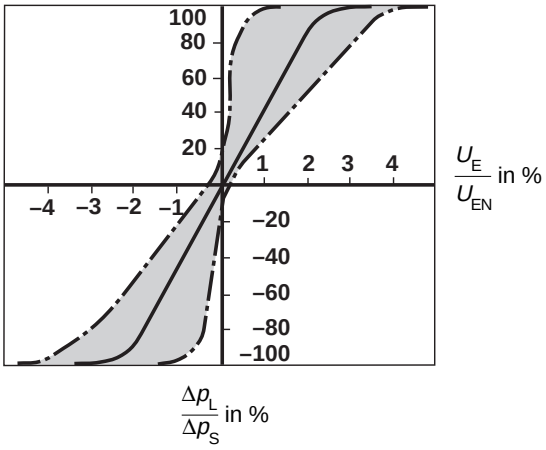



**Size 10**

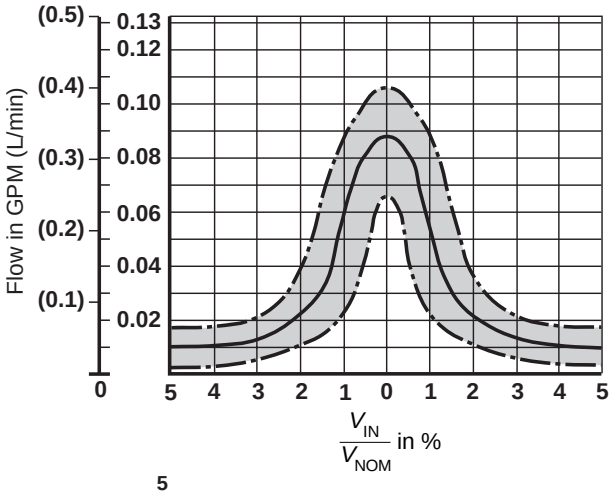


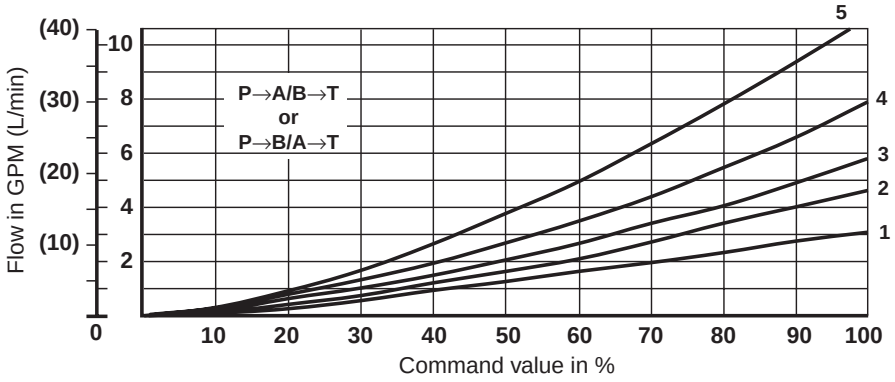
**Operating Curves, Spool Type "V":** measured at $v$ = 190 SUS (41 mm²/s) and $t$ = 122 °F (50 °C) **Model 4 WRE 6..**

Pressure gain tolerance zone
[% of system pressure available for error correction vs. % or rated current, measured at $p_0$ = 1450 PSI (100 bar)



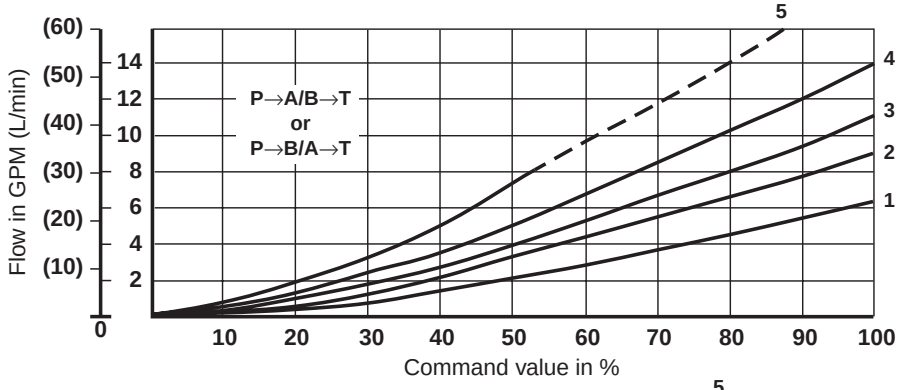

Center position flow, with "V" spool,
Tolerance zone at 1450 PSI (100 bar) pressure drop



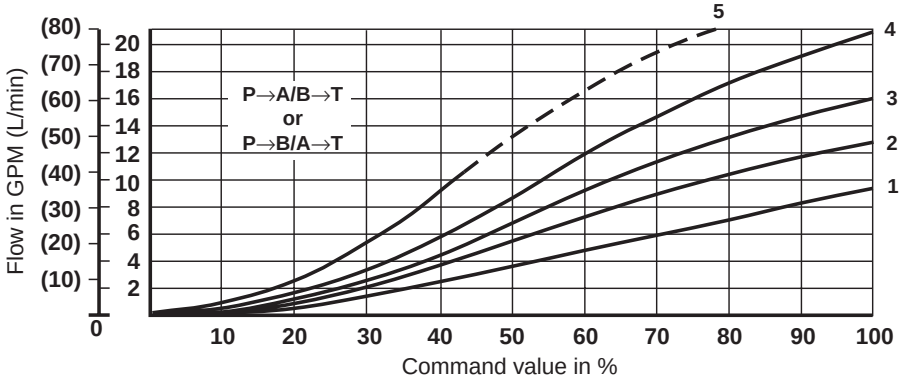

**08**
2.65 GPM (10 L/min) spool at 145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.




**16**
5.55 GPM (21 L/min) spool at 145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.



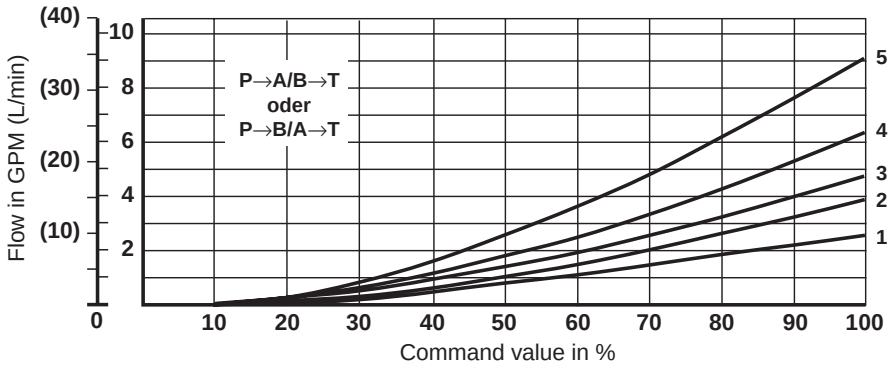

**32**
8.45 GPM (32 L/min) spool at 145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.

$p_v$ = Pressure drop across valve (total of pressure drops across inlet and outlet control lands). Should be calculated before sizing valve.

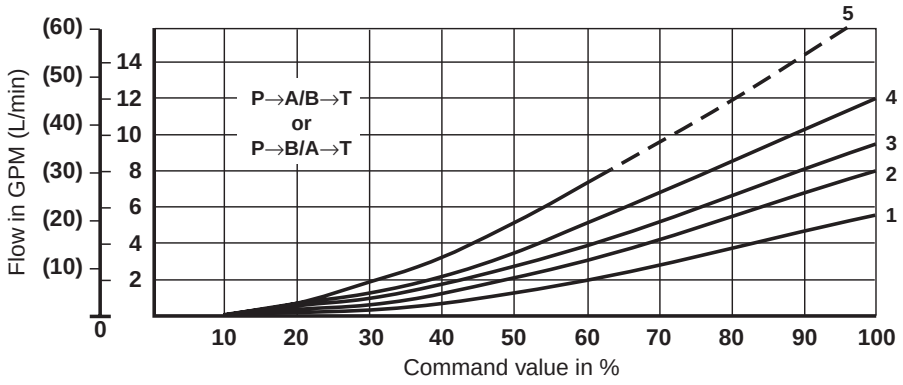
**Attention:** — — —
Please note power limits on page 4

**Operating Curves, Spool Types "E", "EA", "W", "WA":** measured at $\nu$ = 190 SUS (41 mm²/s) and $t$ = 122 °F (50 °C) **Model 4 WRE 6**



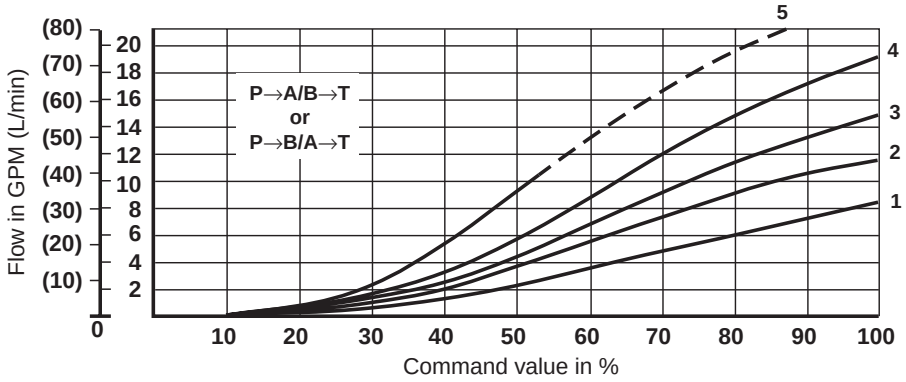

**08**
2.65 (10 L/min) spool at 145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.




**16**
5.55 GPM (21 L/min) spool at 145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.




**32**
8.45 GPM (32 L/min) spool at 145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.

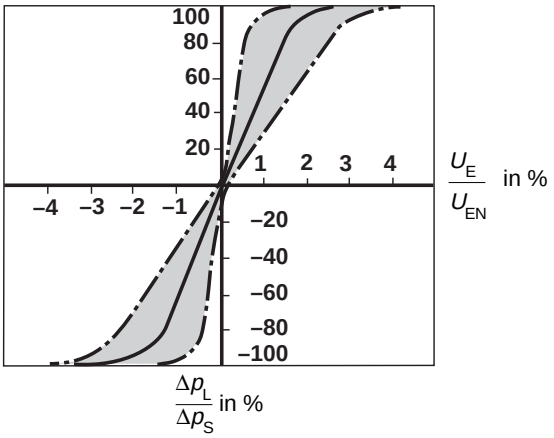
$p_v$ = Pressure drop across valve (total of pressure drops across inlet and outlet control lands). Should be calculated before sizing valve.

**Attention:** — — —
Please note power limits on page 4 and with spool types "E1-", "E2-", "E3-", "W1-", "W2-" and "W3-" notes on page 2

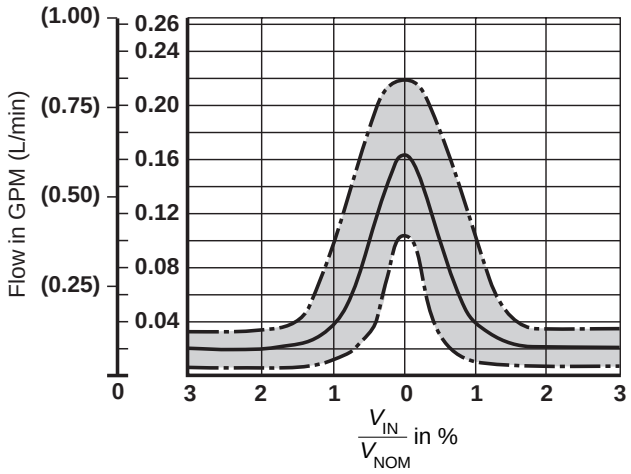
**Operating Curves, Spool Type "V":** measured at $v$ = 190 SUS (41 mm²/s) and $t$ = 122 °F (50 °C)

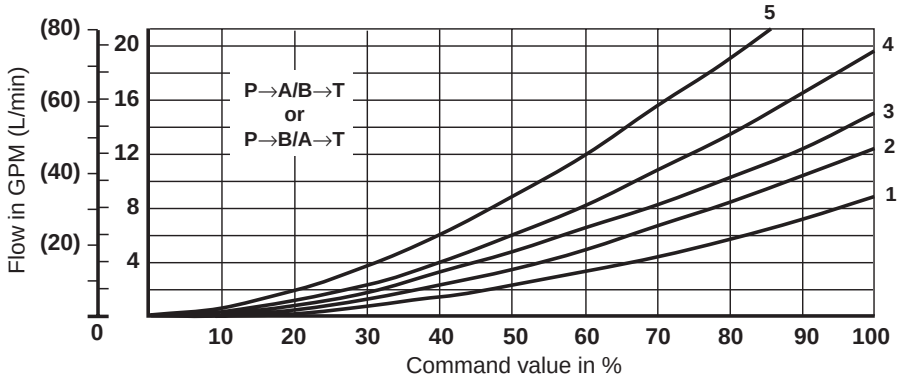
**Model 4 WRE 10...**

Pressure gain tolerance zone
[% of system pressure available for error correction vs. % or rated current, measured at $p_0$ = 1450 PSI (100 bar)



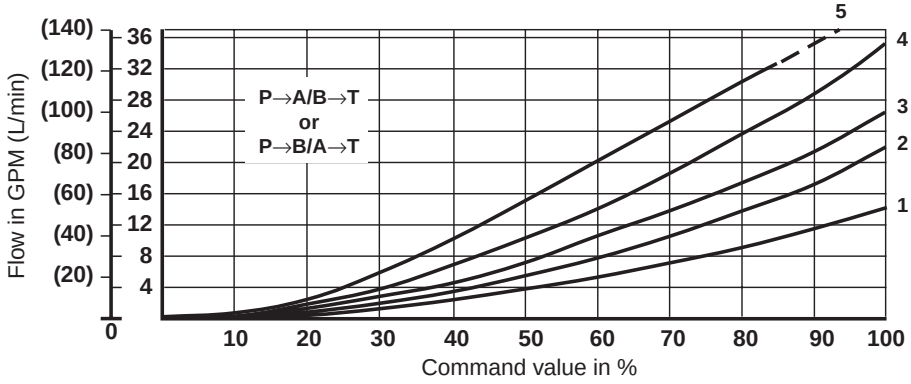

Center position flow, with "V" spool,
Tolerance zone at 1450 PSI (100 bar) pressure drop



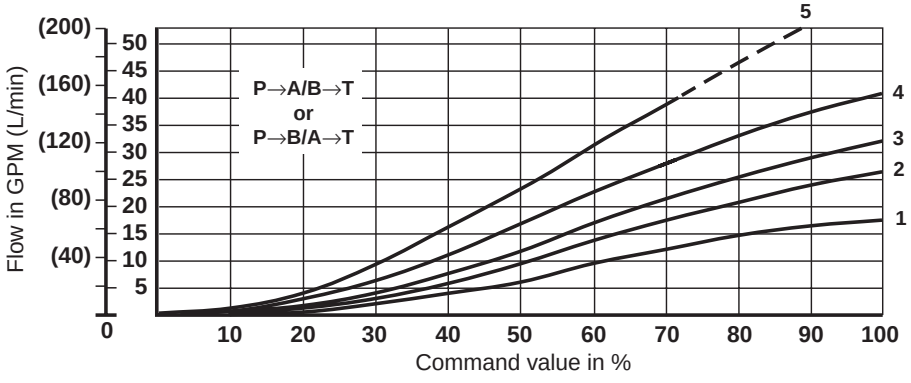

**16**
7.15 GPM (27 L/min) spool at 145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.




**32**
11.10 GPM (42 L/min) spool at 145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.



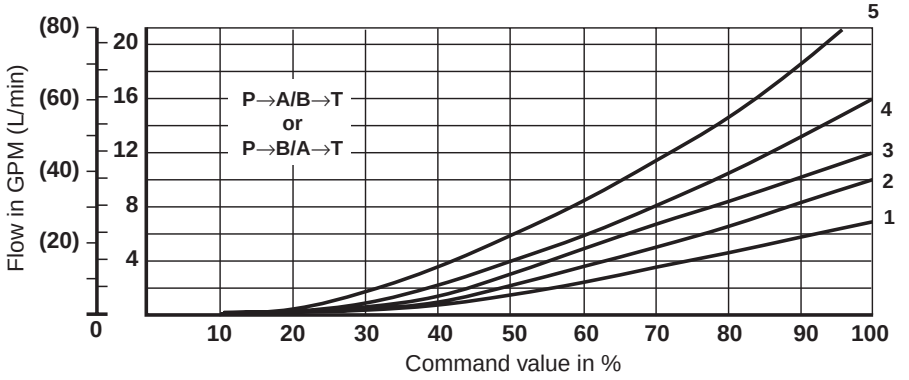

**64**
16.40 GPM (62 L/min) spool at 145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.

$p_v$ = Pressure drop across valve (total of pressure drops across inlet and outlet control lands). Should be calculated before sizing valve.

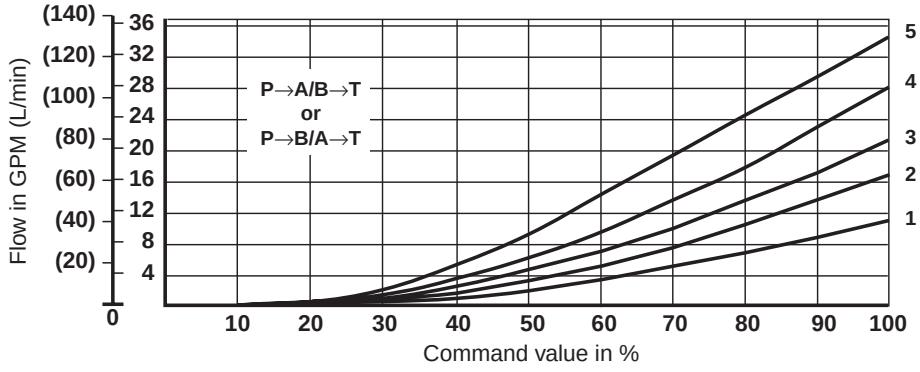
**Attention:** — — —
Please note power limits on page 4

**Operating Curves, Spool Types "E", "EA", "W", "WA":** measured at $v$ = 190 SUS (41 mm²/s) and $t$ = 122 °F (50 °C) **Model 4 WRE10**



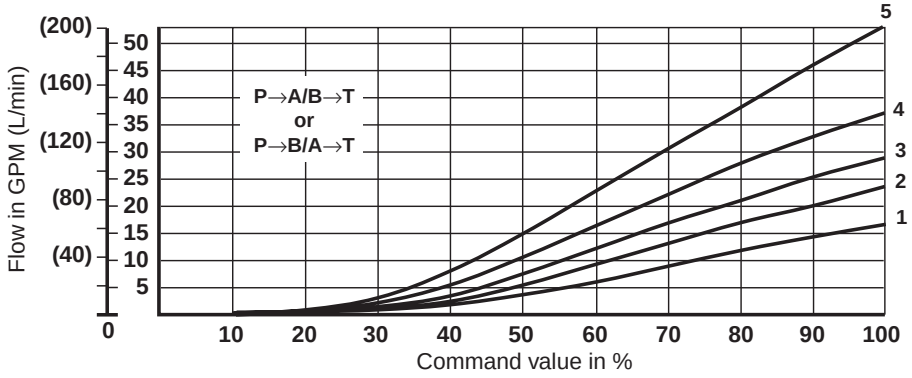

**16**
7.15 (27 L/min) spool at
145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.




**32**
11.10 GPM (42 L/min) spool at
145 PSI (10 bar) minimum pressure drop

**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.



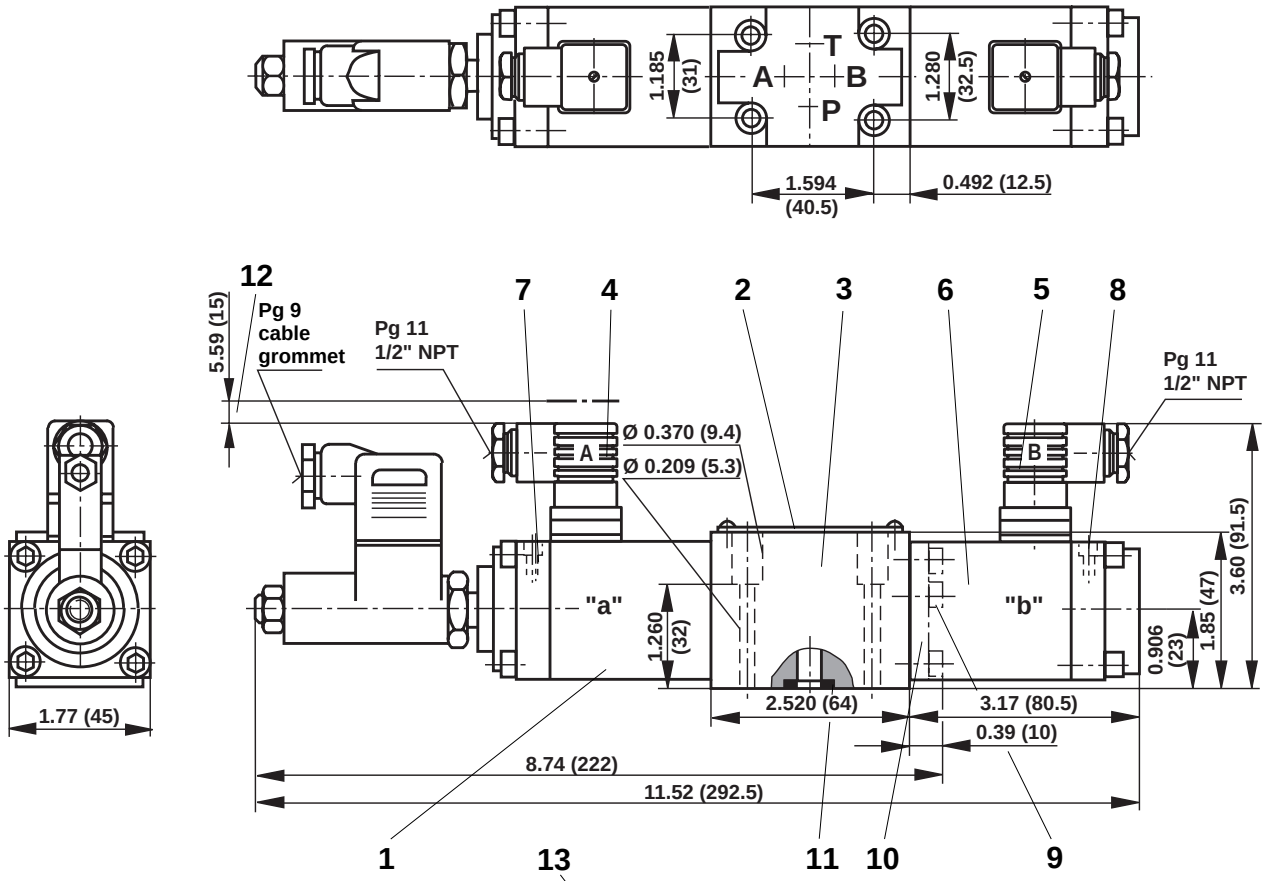

**64**
16.40 (62 L/min) spool at
145 PSI (10 bar) minimum pressure drop

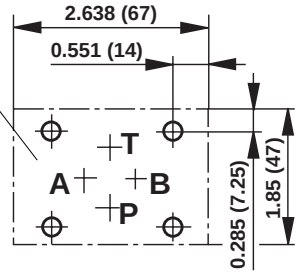
**1** $p_v$ = 145 PSI (10 bar) const.
**2** $p_v$ = 290 PSI (20 bar) const.
**3** $p_v$ = 435 PSI (30 bar) const.
**4** $p_v$ = 725 PSI (50 bar) const.
**5** $p_v$ = 1450 PSI (100 bar) const.

$p_v$ = Pressure drop across valve (total of pressure drops across inlet and outlet control lands). Should be calculated before sizing valve.

**Attention:** — — —
Please note power limits on page 4
and with spool types "E1-", "E2-", "W1-" and "W2-" notes on page 2

## **Unit dimensions, 4 WRE 6:** dimensions in inches (millimeters)



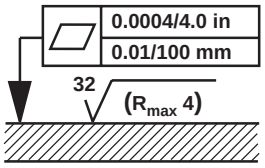




**Subplates:**

G 341/05 ( 1/4" NPT)
G 341/12 (SAE-4; 7/16-20)
G 342/05 ( 3/8" NPT)
G 342/12 (SAE-6; 9/16-18)
G 502/05 (1/2" NPT)
G 502/12 (SAE-8; 3/4-16)

**Valve mounting bolts**

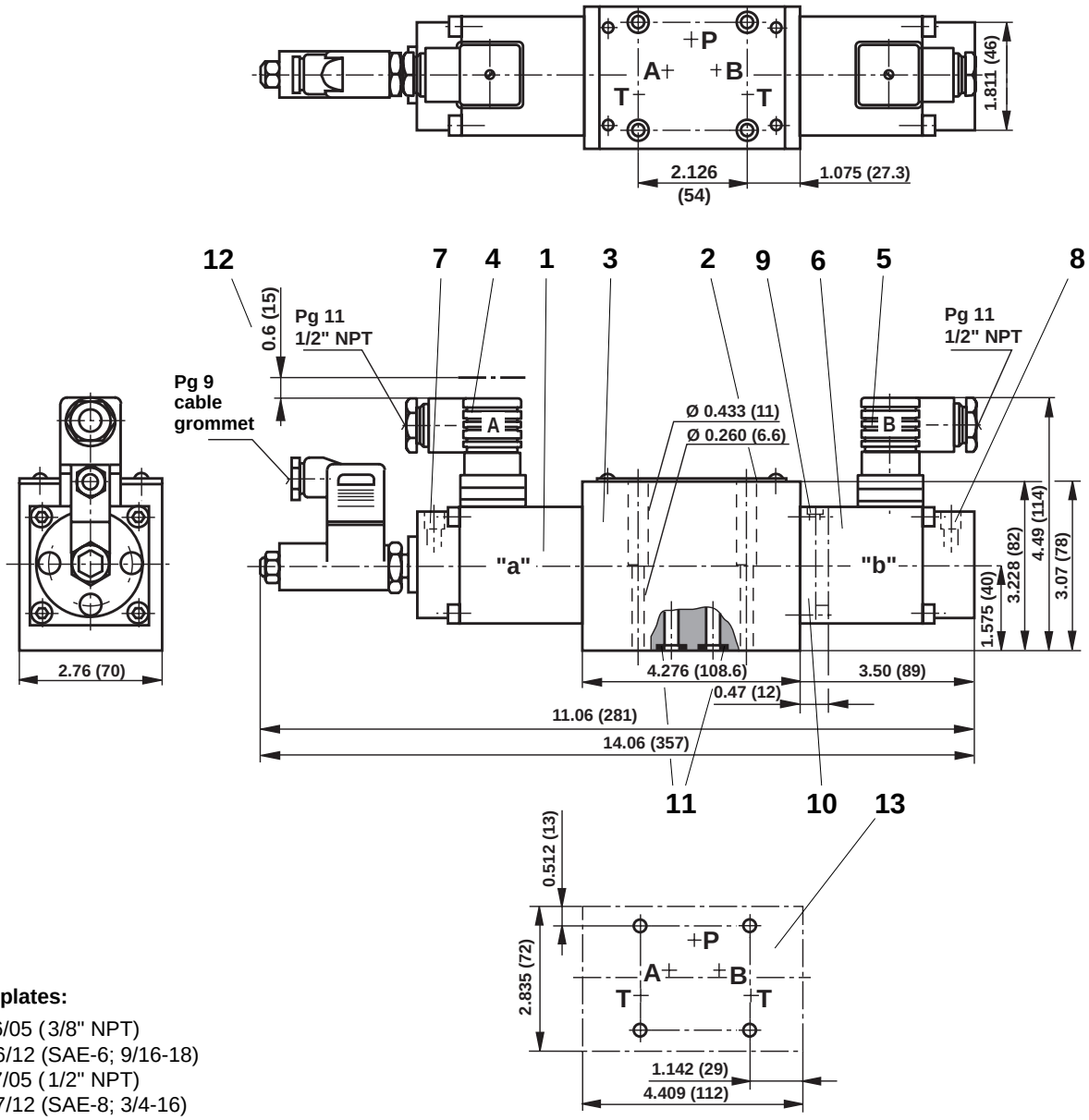
4) 10-24 UNC x 1-1/2" (M5 x 40)
Socket head cap screws (SAE grade 8 or better)
Tightening torque 6.56 ft-lb (8.9 Nm)
Subplates and valve mounting bolts must be ordered separately, see RA 45 052




Required surface finish of interface when mounting the valve without our subplate

**1** Proportional solenoid "A" with inductive position transducer (LVDT)
**2** Nameplate
**3** Valve housing
**4** Plug "A" (grey)
**5** Plug "B" (black)
**6** Proportional solenoid "B"
**7** Air bleed screw, solenoid "A"
**8** Air bleed screw, solenoid "B"
**9** Air bleed screw with Model "EA","WA"
**10** Cover for valves with 1 solenoid (2-position)
**11** O-rings 9.25 mm x 1.78 mm
R-ring 9.81 mm x 1.5 mm x 1.78 mm
(A, B, P, T)
**12** Space required to remove plug
**13** Mounting pattern to ISO 4401-3
NFPA/ANSI D 03

## **Unit dimensions, 4 WRE 10:** dimensions in inches (millimeters)

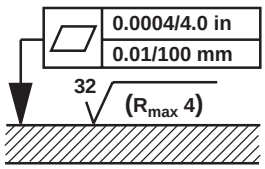



**Subplates:**

G 66/05 ( 3/8" NPT)
G 66/12 (SAE-6; 9/16-18)
G 67/05 ( 1/2" NPT)
G 67/12 (SAE-8; 3/4-16)
G 534/05 (3/4" NPT)
G 534/12 (SAE-12; 1-1/16-12)

**Valve mounting bolts**

4) 1/4-20 UNC x 2" (M6 x 50)
Socket head cap screws (SAE grade 8 or better)
Tightening torque 11.4 ft-lb (15.5 Nm)
Subplates and valve mounting bolts must be ordered separately, see RA 45 054




Required surface finish of interface when mounting the valve without our subplate

**1** Proportional solenoid "A" with inductive position transducer (LVDT)
**2** Nameplate
**3** Valve housing
**4** Plug "A" (grey)
**5** Plug "B" (black)
**6** Proportional solenoid "B"
**7** Air bleed screw, solenoid "A"
**8** Air bleed screw, solenoid "B"
**9** Air bleed screw with Model “EA”, “WA”
**10** Cover for valves with 1 solenoid (2-position)
**11** O-rings 12 mm x 2 mm (A, B, P, T)
R-ring 13.0 mm x 1.6 mm x 2.0 mm
**12** Space required to remove plug
**13** Mounting pattern to ISO 4401-5 NFPA/ANSI D 05

## Notes

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