Self-operated Pressure Regulators
Type 41-23 Universal Pressure Reducing Valve

ANSI version

Application

Pressure regulators for set points from **0.75** to **400 psi** (**0.05 to 28 bar**) · Valves in **NPS ½** to **4** (**DN 15** to **100**) · Pressure rating **Class 125** to **300** (**PN 16** to **40**) · Suitable for water, gases, and vapors up to **660 °F** (**350 °C**)

The valve **closes** when the downstream pressure rises

Special features

- Low-maintenance proportional regulators requiring no auxiliary energy
- Frictionless plug stem seal with stainless steel bellows
- Control line kit available for tapping the pressure directly at the valve body
- Wide set point range and convenient set point adjustment using a nut
- Exchangeable set point springs and actuator
- Spring-loaded, single-seated valve with upstream and downstream pressure balancing [1] by a stainless steel bellows
- Soft-seated plug for high shut-off requirements
- Standard low-noise plug · Special version with flow divider St I or St III (NPS 2½ to 4/DN 65 to 100) for further noise level reduction (see Data Sheet ▶ T 8081)
- All wetted parts free of non-ferrous metal

Fig. 1: *Type 41-23 Universal Pressure Reducing Valve*

Versions

Pressure reducing valve to regulate the downstream pressure p_2 to the adjusted set point. The valve closes when the downstream pressure rises.

Type 41-23 · Standard version

Type 2412 Valve · Valve in **NPS ½** to **4** (**DN 15** to **100**) · Plug with metal seal · Body made of either cast iron A126B, cast steel A216 WCC or cast stainless steel A351 CF8M
Type 2413 Actuator with EPDM rolling diaphragm

Version with additional features

Pressure reducing valve with increased safety · Actuator with leakage line connection and seal or two diaphragms and diaphragm rupture indicator · Valve with backup packing

Steam pressure reducing valve with compensation chamber for steam up to 660 °F (350 °C)

Pressure reducing valve for low flow rates · Valve with micro-flow trim (C_V = 0.0012 to 0.05/K_{VS} = 0.001 to 0.04) or special C_V/K_{VS} coefficients (restricted cross-sectional area of flow)

―――
[1]   With C_V ≤3/K_{VS} ≤2.5: without balancing bellows

Special versions

- Control line kit for tapping the pressure directly at the valve body (accessories)
- With internal parts made of FPM (FKM), e.g. for use with mineral oils
- Free of oil and grease for oxygen with NBR diaphragm
- EPDM diaphragm with PTFE protective facing
- Actuator for remote set point adjustment (autoclave control)
- Bellows actuator for valves NPS ½ to 4 (DN 15 to 100) Set point ranges 30 to 85 psi, 75 to 150 psi, 150 to 320 psi, 300 to 400 psi (2 to 6 bar, 5 to 10 bar, 10 to 22 bar, 20 to 28 bar)
- Valve with flow divider St I or St III (NPS 2½ to 4/DN 65 to 100) for particularly low-noise operation with gases and vapors
- Version entirely of stainless steel
- Stainless Cr steel seat and plug with PTFE soft seal (max. 440 °F/max. 220 °C) · With EPDM soft seal (max. 300 °F/max. 150 °C)
- Version for industrial gases

- Free of oil and grease for high-purity applications
- Stellite-faced seat and plug for low-wear operation
- Wetted plastic parts conforming to FDA regulations (max. 140 °F/max. 60 °C)

Principle of operation (Fig. 2)

The medium flows through the valve (1) as indicated by the arrow. The position of the plug (3) determines the flow rate across the area released between plug and valve seat (2). The plug stem (5) with the plug (3) is connected to the actuator stem (11) of the actuator (10).
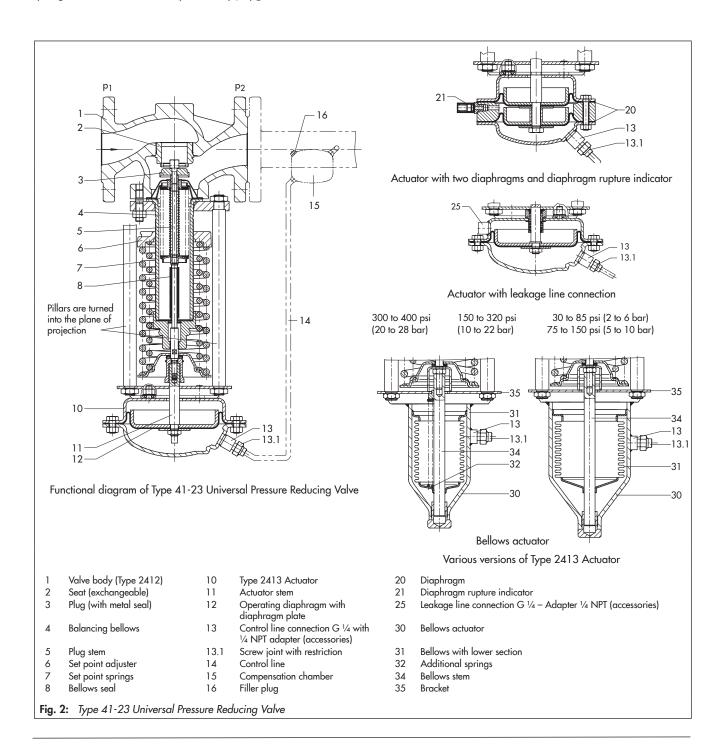
To control the pressure, the operating diaphragm (12) is tensioned by the set point springs (7) and the set point adjuster (6) so that the valve is opened by the force of the set point springs when it is relieved of pressure ($p_1 = p_2$).
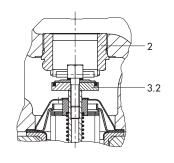
The downstream pressure p_2 to be controlled is tapped downstream of the valve and transmitted over the control line (14) to the operating diaphragm (12) where it is converted into a positioning force. This force is used to move the valve plug (3) according to the force of the set point spring (7).
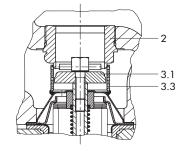
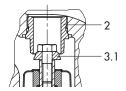The spring force is adjustable at the set point adjuster (6).

When the force resulting from the downstream pressure p_2 rises above the adjusted pressure set point, the valve opens proportionally to the change in pressure.

The fully balanced valve has a balancing bellows (4). The downstream pressure p_2 acts on the inside of the bellows, whereas the upstream pressure p_1 acts on the outside of the bellows. As a result, the forces produced by the upstream and downstream pressures acting on the plug are balanced out.

Functional diagram of Type 41-23 Universal Pressure Reducing Valve

Actuator with two diaphragms and diaphragm rupture indicator

Actuator with leakage line connection

300 to 400 psi (20 to 28 bar)   150 to 320 psi (10 to 22 bar)   30 to 85 psi (2 to 6 bar) 75 to 150 psi (5 to 10 bar)

Bellows actuator

Various versions of Type 2413 Actuator

1	Valve body (Type 2412)	10	Type 2413 Actuator
2	Seat (exchangeable)	11	Actuator stem
3	Plug (with metal seal)	12	Operating diaphragm with diaphragm plate
4	Balancing bellows	13	Control line connection G ¼ with ¼ NPT adapter (accessories)
5	Plug stem	13.1	Screw joint with restriction
6	Set point adjuster	14	Control line
7	Set point springs	15	Compensation chamber
8	Bellows seal	16	Filler plug

20	Diaphragm
21	Diaphragm rupture indicator
25	Leakage line connection G ¼ – Adapter ¼ NPT (accessories)
30	Bellows actuator
31	Bellows with lower section
32	Additional springs
34	Bellows stem
35	Bracket

Fig. 2: *Type 41-23 Universal Pressure Reducing Valve*

Fig. 3: *Additional features of seat and plug for Type 41-23 Universal Pressure Reducing Valve*

Valve for small flow rates
$C_V \leq 3$ ($K_{VS} \leq 2.5$): without balancing bellows

2	Seat
3.1	Plug with metal seal
3.2	Plug with soft seal
3.3	Flow divider

Table 1: *Technical data · All pressures (gauge)*

Valve		Type 2412		
Nominal pressure	Class	125, 150 or 300		
	PN	16, 25 or 40		
Valve size	NPS	½ to 2	2½ and 3	4
	DN	15 to 50	65 and 80	100
Max. permissible differential pressure	psi	360	290	230
	bar	25	20	16
Temperature ranges		See pressure-temperature diagram in ▶ T 2500		
	Valve plug	Metal seal: max. 660 °F (350 °C) · PTFE soft seal: max. 430 °F (220 °C) · EPDM, FPM soft seal: max. 300 °F (150 °C) · NBR soft seal: max. 175 °F (80 °C) [1]		
Leakage class according to ANSI/ FCI 70-2		Metal seal: Leakage class I ($\leq$0.05 % of C_V/K_{VS} coefficient) Soft seal: Leakage class IV ($\leq$0.01 % of C_V/K_{VS} coefficient)		
Compliance		$C\epsilon$ $E\mathbb{H}[$		
Diaphragm actuator		**Type 2413**		
Set point ranges		0.75 to 3.5 psi · 1.5 to 8.5 psi · 3 to 17 psi · 10 to 35 psi [2] 30 to 75 psi · 65 to 145 psi · 115 to 230 psi		
		0.05 to 0.25 bar · 0.1 to 0.6 bar · 0.2 to 1.2 bar 0.8 to 2.5 bar [2] · 2 to 5 bar · 4.5 to 10 bar · 8 to 16 bar		
Max. permissible temperature		Gases 660 °F (350 °C), however, max. 175 °F (80 °C) at the actuator [1] · Liquids 300 °F (150 °C), with compensation chamber max. 660 °F (350 °C) · Steam with compensation chamber max. 660 °F (350 °C)		
Bellows actuator		**Type 2413**		
Actuator area		5.1 sq. in (33 cm²)	9.6 sq. in (62 cm²)	
Set point ranges		150 to 320 psi (10 to 22 bar) 300 to 400 psi (20 to 28 bar)	30 to 85 psi (2 to 6 bar) 75 to 150 psi (5 to 10 bar)	

[1]   For oxygen max. 140 °F (60 °C)
[2]   Version with actuator with two diaphragms: 15 to 35 psi/1 to 2.5 bar

Table 2: *Max. perm. pressure at actuator*

Set point ranges · Actuator with rolling diaphragm							Set point ranges · Bellows actuator			
0.75 to 3.5 psi (0.05 to 0.25 bar)	1.5 to 8.5 psi (0.1 to 0.6 bar)	3 to 17 psi (0.2 to 1.2 bar)	10 to 35 psi (0.8 to 2.5 bar)	30 to 75 psi (2 to 5 bar)	65 to 145 psi (4.5 to 10 bar)	115 to 230 psi (8 to 16 bar)	30 to 85 psi (2 to 6 bar)	75 to 150 psi (5 to 10 bar)	150 to 320 psi (10 to 22 bar)	300 to 400 psi (20 to 28 bar)
Max. perm. pressure *above* the set point adjusted at the actuator										
9 psi (0.6 bar)	9 psi (0.6 bar)	19 psi (1.3 bar)	36 psi (2.5 bar)	73 psi (5 bar)	145 psi (10 bar)	145 psi (10 bar)	94 psi (6.5 bar)	94 psi (6.5 bar)	116 psi (8 bar)	29 psi (2 bar)

Table 3: *Materials · Material numbers according to ASTM and DIN EN*

Valve	Type 2412		
Pressure rating	Class 125 (PN 16)	Class 150 (PN 25) Class 300 (PN 40)	Class 150 (PN 25) Class 300 (PN 40)
Max. permissible temperature	570 °F (300 °C)	660 °F (350 °C)	660 °F (350 °C)
Body	Cast iron A126B	Cast steel A216 WCC	Cast stainless steel A351 CF8M
Seat	CrNi steel		CrNiMo steel
Plug	CrNi steel		CrNiMo steel
Seal for soft-seated plug	PTFE with 15 % glass fiber · EPDM · NBR · FPM		
Guide bushing	PTFE/graphite		
Balancing bellows and bellows seal	Stainless steel 1.4571		
Actuator	Type 2413		
Diaphragm cases	Sheet steel DD11 (StW22) [1]		
Diaphragm	EPDM with fabric insert [2] · FPM for mineral oils · NBR · EPDM with PTFE protective facing		

[1] In corrosion-resistant version (CrNi steel)
[2] Standard version; see Special versions for other diaphragms

Installation

Normally, the valve is installed with the actuator suspended downwards. Install pipelines horizontally with a slight downward slope on both sides of the valve for drainage of the condensate.

For further details on installation refer to Mounting and Operating Instructions ▶ EB 2512.

The direction of flow must match the arrow on the valve body.

– The control line must be adapted to match the onsite conditions and is not delivered with the valve. On customer request, a control line kit for pressure tapping directly at the valve body (see Accessories) is available.

Type 41-23 · Standard version

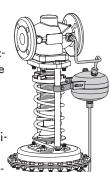## Accessories

Included in the scope of delivery:

– Screw joint with restriction for ⅜" control line.

To be ordered separately:

– Adapter G ¼ to ¼ NPT, various screw fittings.

– **Control line kit** (optionally with or without compensation chamber) for direct attachment to the valve and actuator (pressure tapped directly at the valve body, for set points ≥12 psi/0.8 bar).

– **Compensation chamber** for condensation and to protect the operating diaphragm against extreme temperatures. A compensation chamber is required for liquids above 300 °F (150 °C) as well as for steam.

For detailed information on accessories refer to Data Sheet ▶ T 2595

Type 41-23 · With control line and compensation chamber

Ordering text

Type 41-23 Universal Pressure Reducing Valve
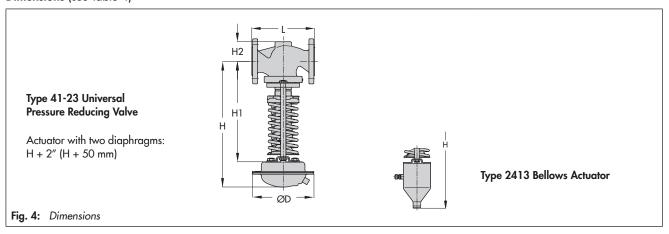
Additional features …

Valve size NPS (DN) …

Class (PN) …, body material …

C_V coefficient (K_{VS} coefficient) …

Set point range … psi (bar)

Optionally, special version …, accessories … (▶ T 2595)

Dimensions (see Table 4)

Type 41-23 Universal Pressure Reducing Valve

Actuator with two diaphragms: H + 2" (H + 50 mm)

Type 2413 Bellows Actuator

Fig. 4: *Dimensions*

Table 4: *Dimensions and weights*

Type 41-23 Universal Pressure Reducing Valve											
Valve size NPS (DN)			½ (15)	¾ (20)	1 (25)	1½ (40)	2 (50)	2½ (65)	3 (80)	4 (100)	
Length L	Class 125	Inch	–	–	7.25	8.75	10.0	10.87	11.75	13.87	
		mm	–	–	184	222	254	276	298	352	
	Class 150	Inch	7.25	7.25	7.25	8.75	10.0	10.87	11.73	13.88	
		mm	184	184	184	222	254	276	298	352	
	Class 300	Inch	7.50	7.63	7.75	9.25	10.50	11.50	12.50	14.50	
		mm	190	194	197	235	267	292	318	368	
Height H1		Inch	13.19			15.35		20.08		20.67	
		mm	335			390		510		525	
Height H2		Inch	1.7			2.83		3.93		4.72	
		mm	44			72		98		118	

Set point ranges		Dimension		Dimensions							
psi	bar										
0.75 to **3.5**	**0.05** to **0.25**	Height H		17.52" (445 mm)			19.69" (500 mm)		24.41" (620 mm)		25.0" (635)
		Actuator		ØD = 15" (380 mm), A = 100 in² (640 cm²)							
1.5 to **8.5**	**0.1** to **0.6**	Height H		17.52" (445 mm)			19.69" (500 mm)		24.41" (620 mm)		25.0" (635)
		Actuator		ØD = 15" (380 mm), A = 100 in² (640 cm²)							
3 to **17**	**0.2** to **1.2**	Height H		16.93" (430 mm)			18.90" (480 mm)		23.62" (600 mm)		24.4" (620)
		Actuator		ØD = 11.2" (285 mm), A = 50 in² (320 cm²)							
10 to **35** [2]	**0.8** to **2.5** [2]	Height H		16.93" (430 mm)			19.09" (485 mm)		23.82" (605 mm)		24.4" (620)
		Actuator		ØD = 8.86" (225 mm), A = 25 in² (160 cm²)							
30 to **75**	**2** to **5**	Height H		16.10" (410 mm)			18.31" (465 mm)		23.03" (585 mm)		23.62" (600)
		Actuator		ØD = 6.69" (170 mm), A = 12 in² (80 cm²)							
65 to **145**	**4.5** to **10**	Height H		16.10" (410 mm)			18.31" (465 mm)		23.03" (585 mm)		23.62" (600)
		Actuator		ØD = 6.69" (170 mm), A = 6 in² (40 cm²)							
115 to **230**	**8** to **16**	Height H		16.10" (410 mm)			18.31" (465 mm)		23.03" (585 mm)		23.62" (600)
		Actuator		ØD = 6.69" (170 mm), A = 6 in² (40 cm²)							
0.75 to **8.5**	**0.05** to **0.6**	Weight [1], approx.	lb	49.6	52		69.4	77.2	112.4	127.8	147.7
			kg	22.5	23.5		31.5	35	51	58	67
3 to **35**	**0.2** to **2.5**		lb	37.5	39.7		56.2	64	99.2	114.6	134.5
			kg	16	18		25.5	29	45	52	61
30 to **230**	**2** to **16**		lb	26.5	28.7		46.3	53	88.2	103.6	123.5
			kg	12	13		21	24	40	47	56

Bellows actuator											
30 to **85**	**2** to **6**	Height H		21.65" (550 mm)			23.82" (605 mm)		28.54" (725 mm)		29.13" (740)
		Actuator		A = 9.6 in² (62 cm²)							
75 to **150**	**5** to **10**	Height H		21.65" (550 mm)			23.82" (605 mm)		28.54" (725 mm)		29.13" (740)
		Actuator		A = 9.6 in² (62 cm²)							
150 to **320**	**10** to **22**	Height H		21.06" (535 mm)			23.23" (590 mm)		27.95" (710 mm)		28.54" (725)
		Actuator		A = 5.1 in² (33 cm²)							
300 to **400**	**20** to **28**	Height H		21.06" (535 mm)			23.23" (590 mm)		27.95" (710 mm)		28.54" (725)
		Actuator		A = 5.1 in² (33 cm²)							
A = 5.1 in² (33 cm²)		Weight [1], approx.	lb	36	39	40	56	64	106	123	146
			kg	16.5	17.9	18	25.5	29	48	56	66
A = 9.6 in² (62 cm²)			lb	46	47	49	65	73	119	143	165
			kg	20.9	21.5	22	29.5	33	54	65	75

[1] Based on Class 150; +10 % for Class 300
[2] Version with actuator with two diaphragms: 15 to 35 psi/1 to 2.5 bar

T 2513 EN

Table 5: C_V (K_{VS}) coefficients and x_{FZ} values · Terms for noise level calculation according to VDMA 24422, edition 1.89
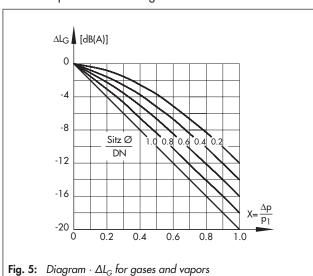
| Valve size | $C_V \cdot K_{VS}$ [1] | | | | | | $C_V\ I \cdot K_{VS}\ I$ | | $C_V\ III \cdot K_{VS}\ III$ | |
| | Standard | | x_{FZ} | Special version | | x_{FZ} | With flow divider | | | |
NPS | DN	C_V	K_{VS}		C_V	K_{VS}		C_V I	K_{VS} I	C_V III	K_{VS} III
½ | 15				0.12 · 0.5 · 1.2	0.1 · 0.4 · 1	0.7 · 0.65 · 0.6				
				3	2.5	0.55				
	5	4	0.5				3.5	3		
¾ | 20				0.12 · 0.5 · 1.2	0.1 · 0.4 · 1	0.7 · 0.65 · 0.6				
				3	2.5	0.55				
				5	4	0.5				
	7.5	6.3	0.45				6	5		
1 | 25				0.12 · 0.5 · 1.2	0.1 · 0.4 · 1	0.7 · 0.65 · 0.6				
				3	2.5	0.55				
	9.4	8	0.4	3 · 5 · 7.5	4 · 6.3	0.5 · 0.45	7.2	6		
1½ | 40				7.5 · 9.4	6.3 · 8	0.45 · 0.4	6 · 7.2	5 · 6		
	23	20	0.4	20	16	0.4	17	15		
2 | 50				9.4	8	0.4	7.2	6		
	37	32	0.4	20 · 23	16 · 20	0.45 · 0.4	30	25		
2½ | 65				23 · 37	20 · 32	0.4	17 · 30	15 · 25	12 · 23	10 · 20
	60	50	0.4				45	38	30	25
3 | 80				37	32	0.4	30	25	23	20
	94	80	0.35	60	50	0.4	70	60	46	40
4 | 100				60	50	0.4	45	38		25
	145	125	0.35				110	95	70	60

[1] With C_V 0.0012 to 0.05/K_{VS} 0.001 to 0.04: valve with micro-trim (NPS ½ to 1/DN 15 to 25 only) without balancing bellows

Valve-specific correction terms

ΔL_G · For gases and vapors:

Values as specified in the diagram

Fig. 5: Diagram · ΔL_G for gases and vapors

ΔL_F · For liquids:

$$\Delta L_F = -10 \cdot (x_F - x_{FZ}) \cdot y$$

with $x_F = \dfrac{\Delta p}{p_1 - p_v}$ and $y = \dfrac{K_V}{K_{VS}}$

Terms for control valve sizing according to IEC 60534, Parts 2-1 and 2-2:

$F_L = 0.95$, $X_T = 0.75$

x_{FZ} · Acoustical valve coefficient

C_V I (K_{VS} I), C_V III (K_{VS} III) · When a flow divider St I or St III is installed as a noise-reducing component · Flow characteristic differences between valves with and valves without flow dividers do not occur until the valve has passed through approx. 80 % of its travel range.

Specifications subject to change without notice