Self-operated Temperature Regulators

Temperature Regulator Type 9

With balanced[1] three-way valve · Flange connection

ANSI version

Application

Temperature regulator with mixing or flow-diverting valve for heating or cooling installations by means of liquids

Control thermostats for **set points** from **15 to +480 °F (–10 to +250 °C)**

Three-way valves in **sizes NPS ½ to 6 · Nominal pressure Class 150 and 300 · Temperatures up to +660 °F (350 °C)**

Note

Typetested temperature regulators (TR), temperature limiters (TL), safety temperature monitors (STM) and safety temperature limiters (STL) are available.

The regulators consist of a three-way valve and a control thermostat with a temperature sensor, a set point adjuster with an excess temperature safety device, a capillary tube and an operating element.

Special features

- Low-maintenance P regulators requiring no auxiliary energy
- Wide set point range and convenient set point adjustment
- Three-way valve with plug balancing[1] by means of a stainless steel bellows, available with plug arrangement for mixing or diverting the flow of liquids
- Flow rate across the cross-sectional area AB is independent of the valve plug position
- Valve body optionally made of carbon steel or stainless carbon steel
- Versions with a manual adjuster or a double adapter for attachment of a temperature limiter or a second thermostat are available. For details, see Data Sheet T 2036 EN.

Versions

Type 9 Temperature Regulator with Type 2119 Three-way Valve

NPS ½ to 1 not pressure balanced · NPS 1½ to 6 pressure balanced · Class 150 and 300 · Types 2231 to 2235 Thermostats

Type 2119 Three-way Valve optionally available with plug arrangement for mixing or flow-diverting service. For more details on the thermostats, refer to Information Sheet T 2010 EN.

Type 2119/2231 (Fig. 1) · With Type 2119 Valve and Type 2231 Control Thermostat · For liquids · Set points from 15 to 300 °F (–10 to +150 °C) · Set point adjustment at the sensor

Type 2119/2232 (Fig. 2) · With Type 2119 Valve and Type 2232 Control Thermostat · For liquids and steam · Set points from 15 to 480 °F (–10 to +250 °C) · Separate set point adjustment

Type 2119/2233 · With Type 2119 Valve and Type 2233 Control Thermostat · For liquids, air and other gases · Set points from 15 to 300 °F (–10 to +150 °C) · Separate set point adjustment

Type 2119/2234 · With Type 2119 Valve and Type 2234 Control Thermostat for liquids, air and other gases · Set points from 15 to 480 °F (–10 to +250 °C) · Separate set point adjustment

Type 2119/2235 · With Type 2119 Valve and Type 2235 Control Thermostat · For air-heated storage rooms, drying, climatic and heating cabinets · Set points from 15 to 480 °F (–10 to +250 °C) · Separate set point adjustment and a sensor tube which can be installed by the user

[1] NPS ½ to 1: not pressure balanced

Fig. 1 · Type 9 Temperature Regulator with Type 2231 Control Thermostat

Fig. 2 · Type 9 Temperature Regulator with Type 2232 Control Thermostat, version with separate set point adjustment

Special version

– Longer capillary tube 15 ft (5 m), 33 ft (10 m), 50 ft (15 m)
– Capillary tube made of CrNiMo steel/Cu-plastic coated
– Sensor made of CrNiMo steel
– Valve made completely of stainless steel (min. material 1.4301)

Principle of operation (Figs. 3 and 4)

The regulators operate according to the liquid expansion principle. The temperature sensor (11), capillary tube (8) and operating element (7) are filled with an expansion liquid. The temperature-dependent change in volume of this liquid causes the operating element to move and, as a result, also the plug stem (5) with the attached plug (3).

The position of the plug determines the flow rate of the heat transfer medium across the free area between the plug (3) and the seat (2). With a key (9), the temperature set point can be adjusted to a value which is indicated on the dial (10).

With pressure balanced valves (sizes NPS ½ to 6), the pressure at port B acts through a hole in the plug stem (5) onto the outer surface of the balancing bellows [1] (4.1), whereas the pressure at port A acts onto the inner bellows area which equalizes the forces acting onto the valve plugs (3).

In mixing valves (see Fig. 3 with plug arrangement I), the process media to be mixed flow through valve ports A and B. The combined flow is discharged from common port AB. The flow rate from A or B to common valve port AB depends on the free area of flow between the seats (2) and the plugs (3), i.e. on the position of the plug stem (5). When the temperature rises, port A opens and port B closes.

In flow-diverting valves, in contrast, the process medium flows through common valve port AB, and the partial flows are discharged from port A or B. The flow rate from AB to A or B depends on the position of the plug stem. Flow-diverting valves are supplied with plug arrangement II (Fig. 4). In this case, port A closes and port B opens when the temperature rises.

[1] Valve sizes NPS ½ to 1 are not pressure balanced

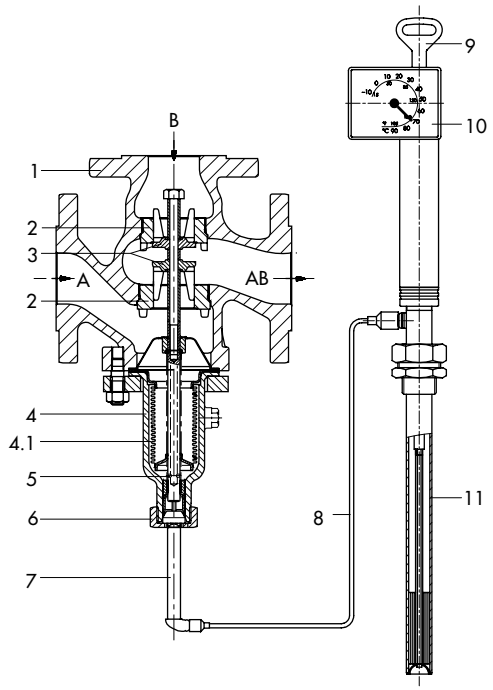

Fig. 3 · Type 9 Temperature Regulator with Type 2231 Control Thermostat, Type 2119 Three-way Valve (NPS 2) with plug arrangement I, arrows indicate mixing service

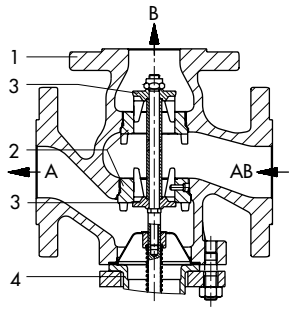

Fig. 4 · Type 2119 Three-way Valve with plug arrangement II, arrows indicate flow-diverting service

Three-way valve

1 Valve body
2 Seats (replaceable)
3 Plug
4 Lower part (bellows housing)
4.1 Balancing bellows
5 Plug stem with spring
6 Nipple with coupling nut

Control thermostat

7 Operating element
8 Capillary tube
9 Key for set point adjustment
10 Set point dial
11 Temperature sensor (bulb sensor)

Installation

– Install the regulator in horizontal pipelines with the thermostat connection vertically suspended. Match the direction of the medium flow as indicated by the arrow on the valve body.
– Install the capillary tube so as to avoid exposure to large temperature fluctuations. Prevent mechanical damage. Minimum bending radius must be 2″ (50 mm).
– The bulb sensor may be installed in any desired position, however, make sure its entire length is immersed in the medium to be controlled. Install the sensor in a location where overheating or considerable idle times do not occur.
– Be sure to only combine the same kind of materials, for example stainless-steel heat exchangers should only be fitted with thermowells made of stainless steel 1.4571.

Table 1 · **Technical data** · All pressures stated in psi and bar (gauge). The permissible pressures and differential pressures specified are limited by the data given in the pressure-temperature diagram

Type 2119 Three-way Valve										
Nominal pressure ratings		Class 150 and 300								
C_V and K_{VS} values and max. perm. differential pressures Δp										
Size	NPS	**½**	**¾**	**1**	**1½**	**2**	**2½**	**3**	**4**	**6**
Mixing valve	C_V in US gal/min	5	7.5	9.4	23	37	60	94	145	230
	K_{VS} value in m^3/h	4	6.3	8	16	32	50	80	125	200
When p in B > p in A	Δp in psi	145			230		145			120
	Δp in bar	10			16		10			8
Flow-diverting valve (from AB to A or B)	C_V in US gal/min	5	7.5	9.4	23	37	50	77	117	185
	K_{VS} value	4	6.3	8	16	32	40	64	100	160
	Δp in psi	58			50		45			29
	Δp in bar	4			3.5		3			2
Permissible valve temperature		See Fig. 6 · Pressure-temperature diagram								
Type 2231 to Type 2235 Thermostats		Size 150								
Set point range (standard version)		15 to 195, 70 to 250 or 120 to 300 °F For Types 2232, 2234, 2235 also 210 to 390, 300 to 480 °F								
		–10 to +90 °C, 20 to 120 °C or 50 to 150 °C For Types 2232, 2234, 2235 also 100 to 200 °C, 150 to 250 °C								
Perm. ambient temperature at the set point adjuster		–40 to +150 °F · –40 to +80 °C								
Perm. temperature at the sensor		100 K above the adjusted set point								
Perm. pressure at the sensor for Types 2231, 2232, 2233 and 2234		With and without thermowell: Class 300 · Version with flange or other nominal pressures available on request								
Length of capillary tube		10 ft (special version 16 ft, 33 ft or 50 ft) · 3 m (special version: 5, 10 or 15 m)								

Table 2 · **Materials** · Material number acc. to ASTM and DIN EN

Type 2119 Three-way Valve			
Size		**NPS ½ to 6**	Up to **NPS 4**
Nominal pressure		Class 150 and 300	Class 150 and 300
Body		Carbon steel A 216 WCC	Stainless carbon steel A 351 CF8M
Seat and plug		Stainless Cr steel (1.4006)	CrNiMo steel (1.4571)
Plug stem/spring		1.4301/1.4310	
Balancing bellows [1]		1.4571	
Bellows housing		1.0305 (St 35.8)	1.4571
Sealing ring		Graphite on metal core	
Extension piece/distance piece		Brass (special version: Stainless steel 1.4301)	1.4301
Type 2231, 2232, 2233, 2234 and 2235 Thermostats [2]			
		Standard version	Special version
Operating element		Brass, nickel-plated	
Sensor	Types 2231/2232	Bronze, nickel-plated	– / Stainless steel 1.4571
	Types 2233/2234	Copper, nickel-plated	
	Type 2235	Copper	
Capillary tube		Copper, nickel-plated	Copper, plastic-coated
Thermowell with threaded connection			
Immersion tube		Bronze, nickel-plated	Copper / 1.4571
Threaded nipple		Brass, nickel-plated	Copper / 1.4571
... with flange connection on request			

[1] NPS ½ to 1: without balancing bellows
[2] Type 2235 not available in stainless steel

Arrangement of temperature regulators with three-way valves - depending on the plug arrangement in the valve - schematic diagram

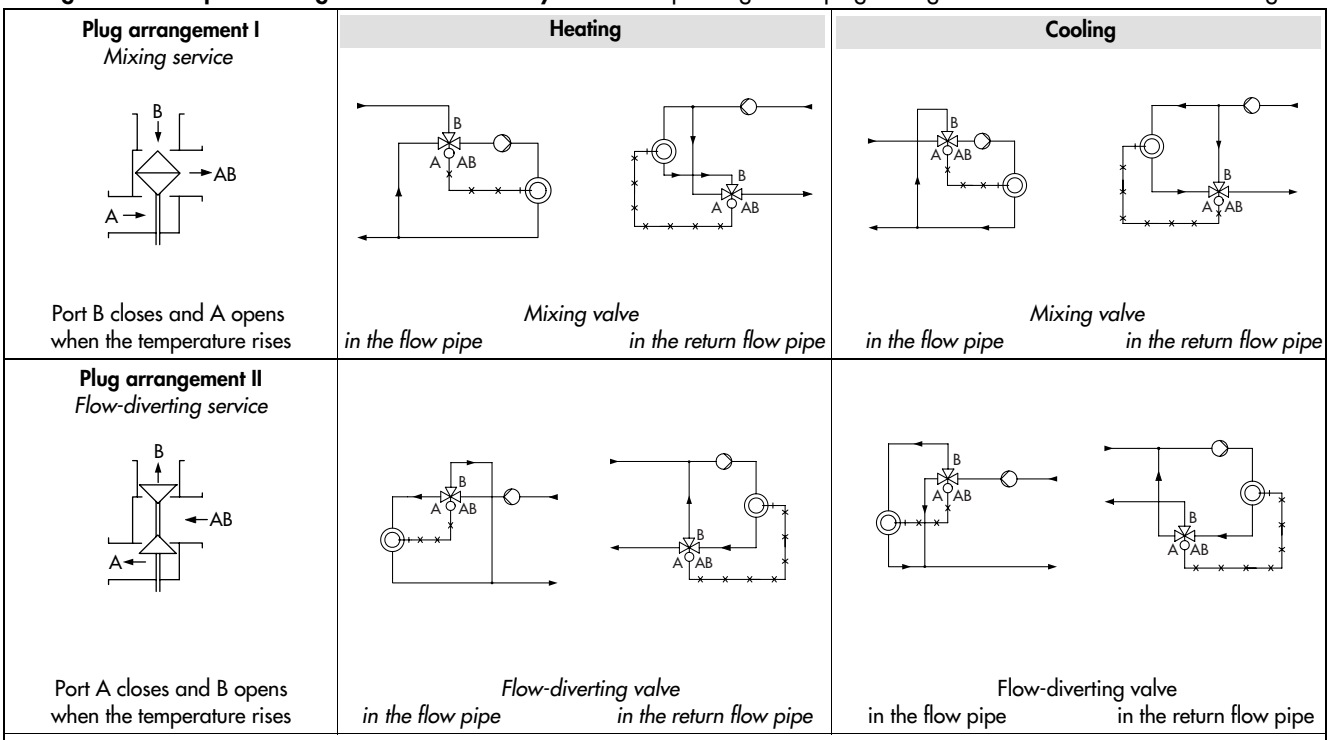

Fig. 5 · Arrangement of the temperature regulators

Pressure-temperature diagram acc. to DIN EN 12516-1

The pressures specified in the technical data section are limited by the data indicated in the pressure-temperature diagram.

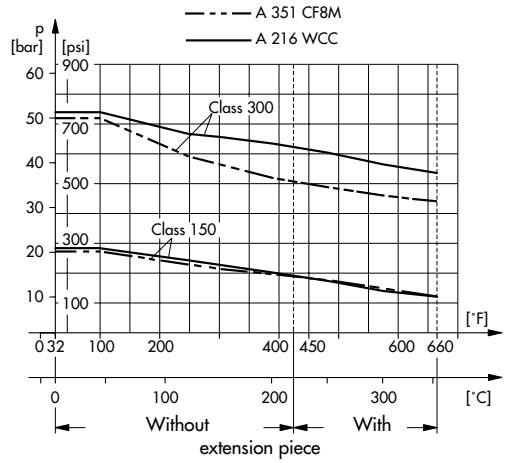

Fig. 6 · Pressure-temperature diagram

Typetested safety devices

The register numbers are available on request. Those available include:

Temperature regulators (TR) with a Type 2231, 2232, 2233, 2234 or 2235 Thermostat and a Type 2119 Three-way Valve, sizes NPS ½ to 6, for which the max. operating pressure should not exceed the max. permissible differential pressure Δp specified in the technical data section.

Sensor without thermowell: Applicable up to Class 300
With thermowell: Only use SAMSON version 1 NPT, bronze and 1.4571 up to Class 300

Temperature limiters (TL) with a thermostat and three-way valve as specified above and a double adapter Do (see Data Sheet T 2036 EN).

For further details on the selection and application of typetested devices, see Information Sheet T 2040 EN.

Safety temperature monitors (STM) and **safety temperature limiters (STL)** are also available. For details, see Data Sheets T 2043 EN and T 2046 EN.

Table 3 · Dimensions and weights

Type 2119 Three-way Valve		NPS	1/2	3/4	1	1½	2	2½	3	4	6
L	Class 150	inch	7.25	7.25	7.25	8.75	10	10.9	11.75	13.9	17.75
		mm	184	184	184	222	254	276	398	352	451
	Class 300	inch	7.50	7.6	7.75	9.25	10.5	11.5	12.5	14.5	18.6
		mm	191	194	197	235	267	292	318	368	473
H2	Class 150	inch	3.6	3.6	3.6	4.4	5	5.4	5.9	6.9	8.9
		mm	92	92	92	111	127	138	149	176	225
	Class 300	inch	3.8	3.8	3.9	4.6	5.3	5.8	6.3	7.2	9.3
		mm	95.5	97	98.5	117.5	133.5	146	159	184	236.5
H1	Up to 430 °F (without extension piece)	inch	9.25			9.5	9.7	12.2		14	19.7
	Up to 220 °C (without extension piece)	mm	235			240	245	310		355	500
	Up to 660 °F (with extension piece)	inch	14.8			15	15.5	18.1		19.5	25.2
	Up to 350 °C (with extension piece)	mm	375			380	385	460		495	640
H	Up to 430 °F (without extension piece)	inch	20.7			20.9	21.1	24		25.4	31.1
	Up to 220 °C (without extension piece)	mm	525			530	535	610		645	790
	Up to 660 °F (with extension piece)	inch	26.2			26.4	26.6	29.5		30.9	
	Up to 350 °C (with extension piece)	mm	665			670	675	750		785	
Weight, approx. [1]		lb	13	15.5	17.5	33	37.5	68	82	108	
		kg	6	7	8.5	15	17	31	37	49	

Thermostat Type	2231	2232	2233	2234	2235
Immersion depth T	11.4″ (290 mm) [2]	9.25″ (235 mm) [2]	16.9″ (430 mm)	18.1″ (460 mm)	136.2″ (3460 mm)
Weight, approx.	7 lb (3.2 kg)	8.8 lb (4.0 kg)	7.5 lb (3.4 kg)	8.1 lb (3.7 kg)	7.9 lb (3.6 kg)

[1] +10% for Class 300 [2] Larger immersion depths are available on request

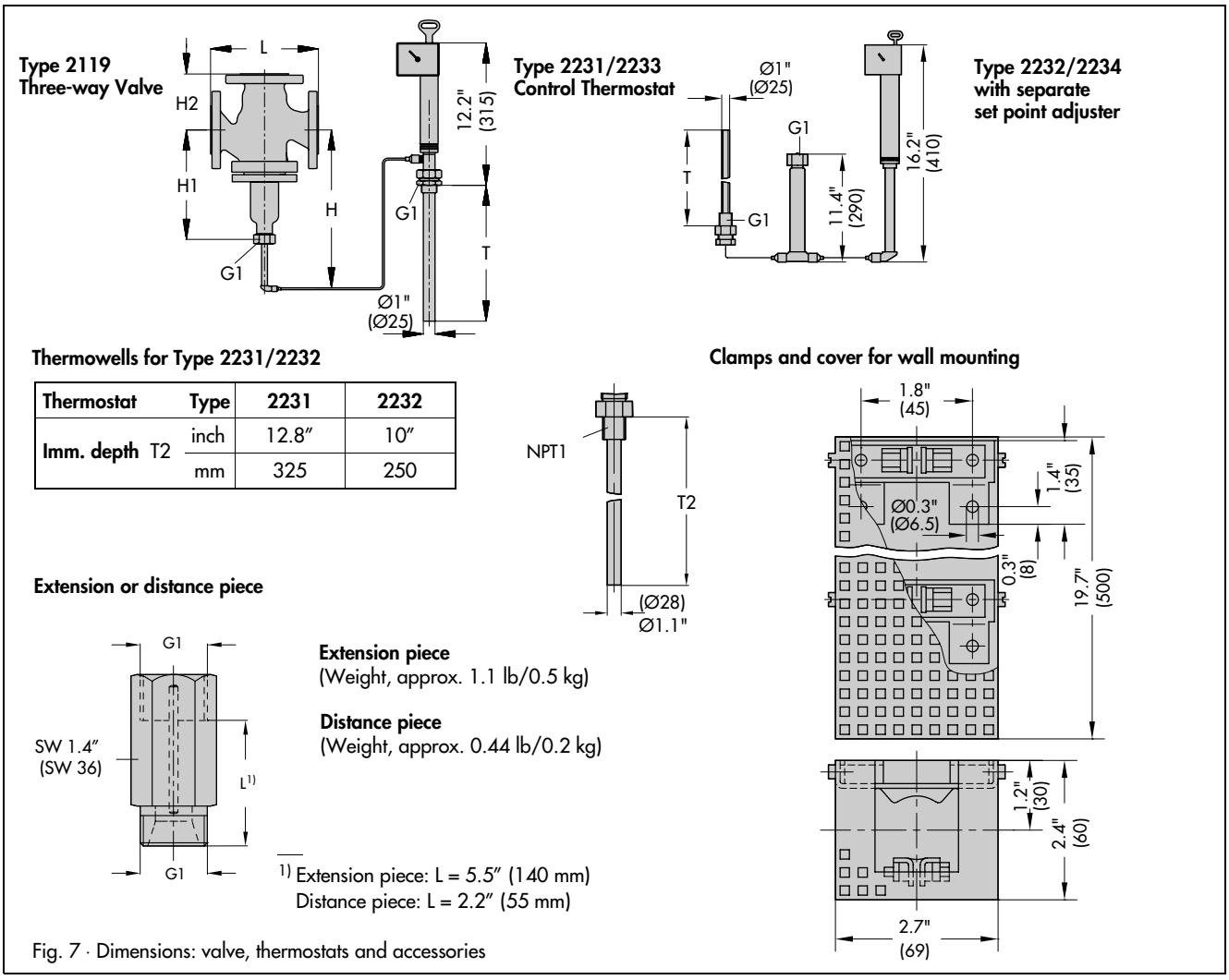

Fig. 7 · Dimensions: valve, thermostats and accessories

Accessories

Thermowells with threaded or flanged connections for Types 2231 and 2232 Bulb Sensor · 1 NPT threaded connection, Class 300, made of bronze/steel/CrNiMo steel · Flanged connection NPS 1½ , Class 300, with CrNiMo steel/steel immersion tube · Steel immersion tube with PVC/PPH coating, NPS 1½ , Class 300 · PTFE immersion tube, Class 50 (flange Class 300)

Thermowells typetested by DVGW (German Technical and Scientific Association on Gas and Water) for flammable gases, 1 NPT threaded connection, Class 600

Mounting parts for Type 2233 and Type 2234 · Clamps for wall mounting · Perforated cover for thermostat

Distance piece/extension piece made of brass (for water, steam) or CrNiMo steel (for water, oil, steam)

A distance piece is used in the stainless steel version to separate the non-ferrous metals of the operating element from the process medium flowing through the valve. In addition, it prevents the medium from leaking when the thermostat is replaced. The distance piece is installed between the valve and thermostat.

The extension piece must be used for temperatures above 430 °F (220 °C) (see pressure-temperature diagram).

Double adapter Type Do1 for connection of a second thermostat · Type DoS with electric signal transmitter

Manual adjuster Ma with travel indicator · MaS with electric signal transmitter

Ordering text

Temperature Regulator Type 9/....
NPS ..., Class ...
Mixing or flow-diverting valve
Body material ...
With Thermostat Type ...
Set point range ...°F (°C)
Capillary tube ... ft (m)
Optional special version ...,
Optional accessories ...

Dynamic behavior of the thermostats

The dynamics of the regulator are mainly determined by the response behavior of the sensor with its characteristic time constant.

Table 4 lists the time constants of SAMSON thermostats operating on different principles when tested in water.

Table 4 · Dynamic response of SAMSON thermostats

Functioning principle	**Type ... Control Thermostat**	**Time constant in seconds**	
		Without thermowell	With thermowell
Liquid expansion	2231	70	120
	2232	65	110
	2233	25	–[1]
	2234	15	–[1]
	2235	10	–[1]
	2213	70	120
Adsorption	2212	–[1]	40

[1] Not permissible

Specifications subject to change without notice.

SAMSON AG · MESS- UND REGELTECHNIK
Weismüllerstraße 3 · 60314 Frankfurt am Main · Germany
Phone: +49 69 4009-0 · Fax: +49 69 4009-1507
Internet: http://www.samson.de