

Self-operated Temperature Regulators

Series 43

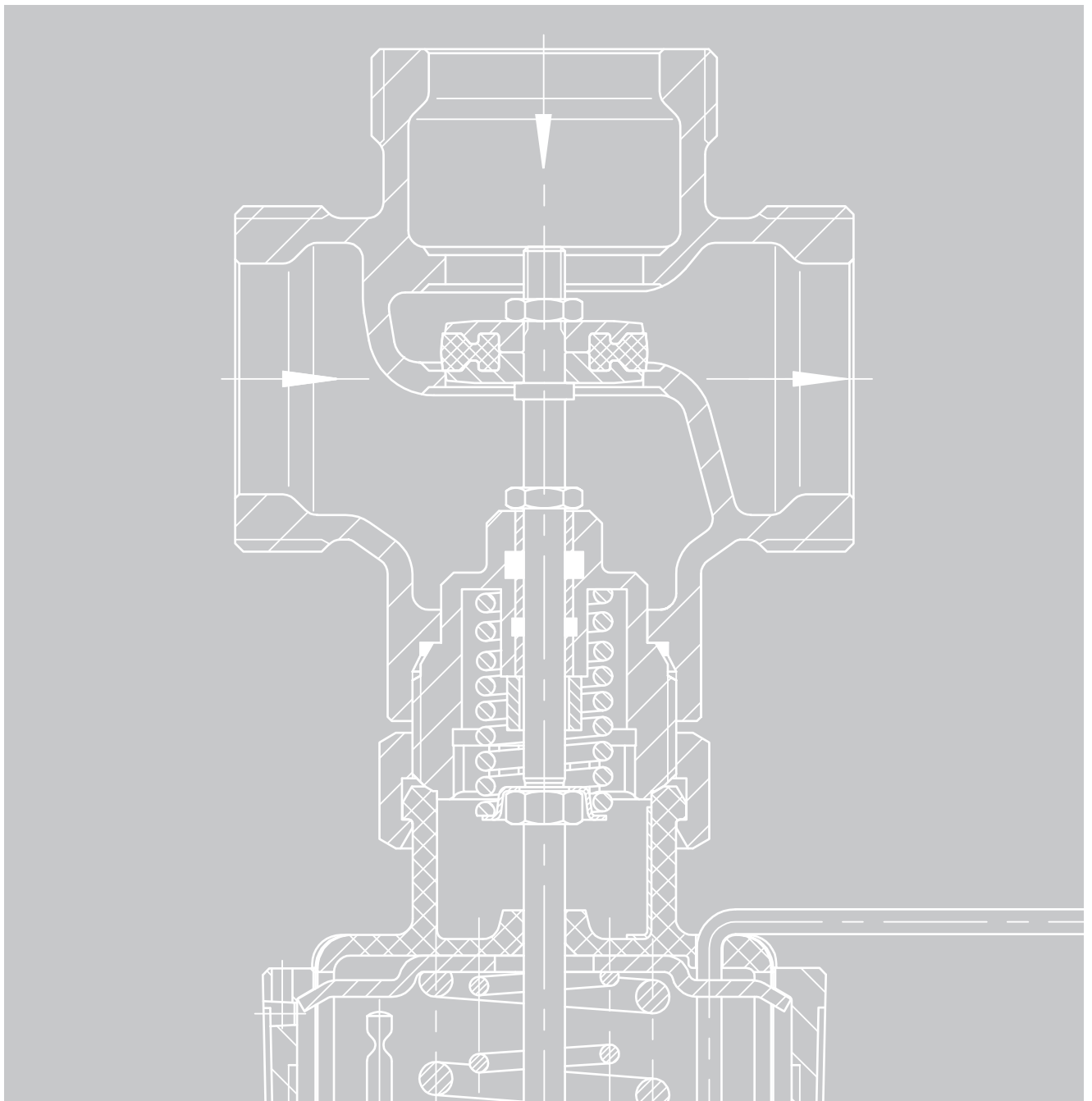


PN 25 · Class 250

DN 15 to 50 · NPS ½ to 2

G ½ to 1 · ½ to 1 NPT

Up to 200 °C · Up to 390 °F



Edition August 2012

Information Sheet

T 2170 EN

Series 43 Self-operated Temperature Regulators

Applications with	Steam				•			•			
	Water, liquids	•	•	•	•	•	•	•	•	•	
	Oil	•	•	•	•	•	•	•	•	•	
	Air, non-flammable gases	•	•	•	•	•	•	•	•	•	
	Heating	•	•	•				•	•	•	
	Cooling				•	•		•	•		
	Mixing							•	•		
	Globe valve	•	•	•	•	•	•			•	
	Three-way valve							•	•		
	Pressure-balanced	•	•	•	•	•	•				
	Not balanced							•	•	•	
	Connection	Threaded flanges		•			•		•		
		Female thread	•		•	•					
Welding ends			•			•	•		•	• ¹⁾	
Threaded ends			•			•	•		•	• ¹⁾	
Nominal size	G ½ to 1	DN 15 to 50	G ½ to 1	G ½ to 1	DN 32 to 50	DN 15 to 50	G ½ to 1	DN 15 to 50	DN 15		
Nominal pressure	PN 25									PN 16	
Perm. temperature	150 °C	150 °C	200 °C	150 °C	150 °C	200 °C	150 °C	150 °C	120 °C		
Body material	Red brass	•	•	•	•	•	•	•	•	•	
	St. steel	•	•	•	•	•	•	•	•	•	
Thermostat	With thermostat Type	2430 K									
	Set point	0 to 35 °C · 25 to 70 °C · 40 to 100 °C · 50 to 120 °C · 70 to 150 °C								0 to 100 °C	
	Double adapter/man. adjuster	•	•	•	•	•	•	•	•	•	
	Sensor material	Copper									
	Thermowell	Optionally copper or stainless steel									
Type	43-1	43-2 ³⁾	43-5	43-6	43-6 ³⁾	43-7 ³⁾	43-3	43-3 ²⁾	43-2 N		
Data Sheet	T 2171 EN		T 2172 EN				T 2173 EN		T 2186 EN		
Type 2040 Safety Temperature Monitor for cryogenic applications on request (see T 2090 EN).											

¹⁾ Connecting thread G ¾ B to attach soldering ends, welding ends or threaded ends

²⁾ In the version with male thread for welding ends, threaded ends or flanges also available as diverting valve

³⁾ DN 32 to 50: also with flanged body made of EN-JS1049 (DIN version only)

Thermostats and temperature sensors

Series 43 Temperature Regulators are fitted with Type 2430 K Thermostats. The temperature sensors can be used for operating pressures up to 40 bar (580 psi) and set points up to 150 °C (300 °F).

Refer to corresponding data sheets for details.

Combined regulators

To attach further thermostats and control equipment, a double adapter can be installed between valve and control thermostat (see Data Sheet T 2176 EN).

The regulators can be combined with flow and differential pressure regulators.

- 10 Control thermostat
- 11 Housing with spring mechanism
- 20 Double adapter (housing)
- 21 Type 2439 K Safety Thermostat (STL)
- 22 Temperature sensor with thermowell

TR Temperature regulator
STL Safety temperature limiter

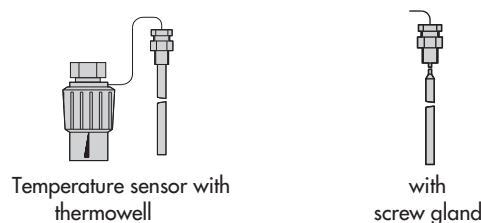


Fig. 1 · Thermostat with various sensor versions

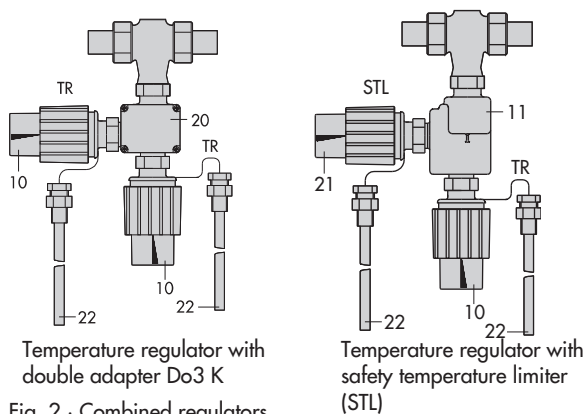

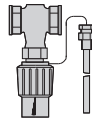
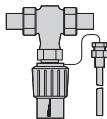
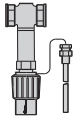
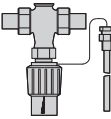
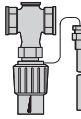
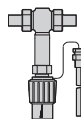
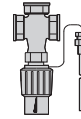
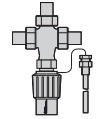


Fig. 2 · Combined regulators

ANSI version

•		•		•	•	•	•	•	
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DN 15	½ to 1 NPT	NPS ½ to 2	½ to 1 NPT	NPS 1¼ to 2	½ to 1 NPT	NPS ½ to 2	½ to 1 NPT	NPS ½ to 2	
PN 25/16	Class 250								
150 °C/120 °C ¹⁾	300 °F	300 °F	390 °F	300 °F	300 °F	390 °F	300 °F	300 °F	
•	•	•	•	•	•	•	•	•	
2430 K									
45 to 65 °C	30 to 95 °F · 75 to 160 °F · 105 to 210 °F · 125 to 250 °F · 160 to 300 °F								
•	•	•							
CrNiMo	Copper								
Without	Optionally copper or stainless steel								
43-8	43-1	43-2	43-5	43-6	43-6	43-7	43-3	43-3	
T 2178	T 2175 EN		T 2174 EN				T 2177 EN		
									

¹⁾ Max. permissible valve temperature

Safety thermostats

The **Type 2403 K Safety Thermostat** for safety temperature monitors (STM) consists of a temperature sensor without thermowell, limit adjuster, capillary tube and connecting element.

The **Type 2439 K Safety Thermostat** for safety temperature limiters (STL) consists of a housing with spring mechanism and thermostat with capillary tube, bulb sensor as well as a thermowell.

They can also be supplied with an **electric signal transmitter** for the remote transmission of a fault.

Dynamic behavior of thermostats

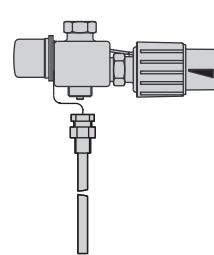
The regulator's dynamics basically depends on the response behavior of the sensor with its characteristic time constant.

Table 1 shows the time constants of SAMSON thermostats working according to different operating principles measured in water.

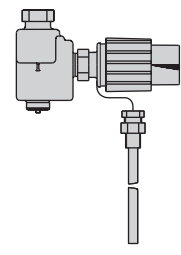
Table 1 · Time constants of SAMSON thermostats

Operating principle	Type	Without thermowell		With thermowell	
		15 s ¹⁾	30 s ²⁾	40 s ¹⁾	80 s ²⁾
Adsorption	2430 K	15 s ¹⁾	30 s ²⁾	40 s ¹⁾	80 s ²⁾
	2439 K	– ³⁾		40 s	
Vapor pressure	2403 K	3 s		– ³⁾	

¹⁾ DN 15 to 25 · ²⁾ DN 32 to 50 · ³⁾ Not permissible



Type 2403 K



Type 2439 K

Fig. 3 · Safety thermostats

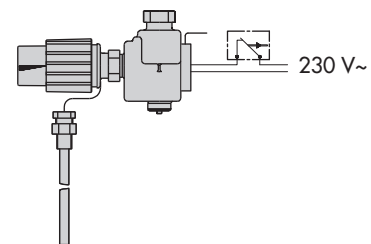
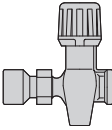
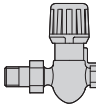
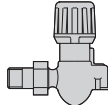


Fig. 4 · Type 2439 K Safety Thermostat with electric signal transmitter

Return temperature limiters

Applications with	Steam			
	Water	•	•	•
	Oil			
	Air and non-flammable gases			
	Heating			
	Cooling			
	Mixing			
	Globe valve	•	•	Angle valve
	Three-way valve			
	Pressure-balanced			
	Not balanced	•	•	•
	Threaded flanges			
	Female thread	•	Outlet	Outlet
	Welding ends	•	•	
Threaded ends		•	Inlet	
Valves	Connection			
	Nominal size	G ½ to G 1	G ¾ to G ½	G ¾ to G ½
	Nominal pressure	PN 25	PN 16	PN 16
	Perm. temperature		120 °C	
	Body material		Brass	
	With thermostat	Type	Installed	
	Set point	20 to 70 °C	10 to 60 °C	
	Double adapter/manual adjuster	•	•	•
	Sensor material		Brass	
	Type	3 D	4 D	4 E
Data Sheet	T 2080 EN			
				

Conversion factors

The conversion factors commonly used for sizing, calculating and selecting valves are given below.

K_{VS} and C_V coefficients

The valve flow coefficients can be determined accurately using IEC 60534, Part 2-1 and Part 2-2. In addition, the equations specified in the ISA-S75.01-1-1985 standard and the VDI/VDE Guideline 2173 can be used for this purpose. Calculating the K_V coefficient according to the methods provided by the VDI/VDE guideline is sufficiently accurate in most cases.

The equations can be found in SAMSON's AB 04 EN Calculation Sheet.

$$K_{VS} = 0.86 \times C_V \quad K_{VS} \quad [m^3/h]$$

$$C_V = 1.17 \times K_{VS} \quad C_V \quad [U.S. \text{ gallons}/\text{min}]$$

Pressure

$$1 \text{ pound}/\text{square inch} [lbs/in^2 = \text{psi}] = 0.06895 \text{ bar}$$

$$1 \text{ bar} = 14.5 \text{ psi}$$

Area

$$1 \text{ square inch} [sq.in; in^2] = 6.452 \text{ cm}^2$$

$$1 \text{ cm}^2 = 0.155 \text{ in}^2$$

Mass

$$1 \text{ pound} [lb] = 0.4536 \text{ kg}$$

$$1 \text{ kg} = 2.2046 \text{ lb}$$

Mass flow

$$1 \text{ pound per second} [lb/s] = 0.4536 \text{ kg/s}$$

$$1 \text{ kg/s} = 2.2046 \text{ lb/s}$$

Flow rate

$$1 \text{ U.S. gallon per min} [US \text{ gal}/\text{min}] = 0.227 \text{ m}^3/\text{h}$$

$$1 \text{ m}^3/\text{h} = 4.4 \text{ US gal}/\text{min}$$

Temperature

$$^{\circ}\text{F} = \frac{9}{5} ^{\circ}\text{C} + 32$$

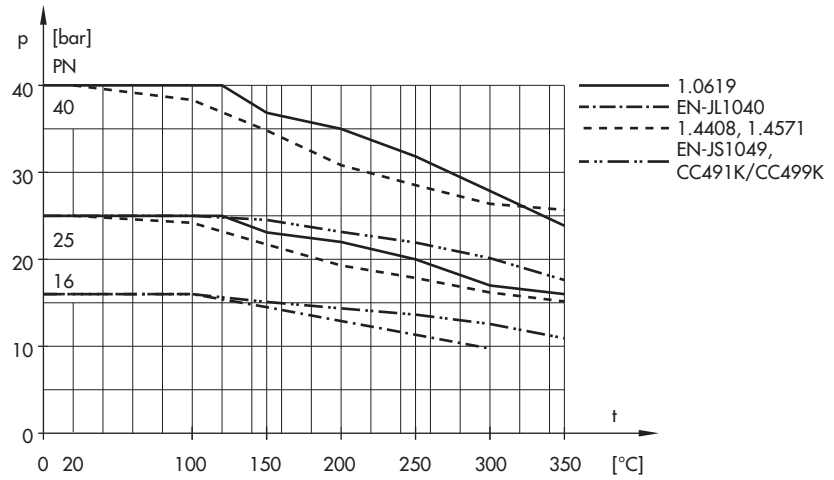
$$^{\circ}\text{C} = \frac{5}{9} (^{\circ}\text{F} - 32)$$

Pressure-temperature diagrams

The pressures specified in the data sheets are the maximum pressure specifications. They are limited by the specifications of the associated pressure-temperature diagrams.

The diagrams for DIN materials were created based on DIN EN 12516-1 and for ANSI materials according to ASME B16.1 and ASME B16.34.

Pressure-temperature diagram according to DIN



Pressure-temperature diagram according to ANSI

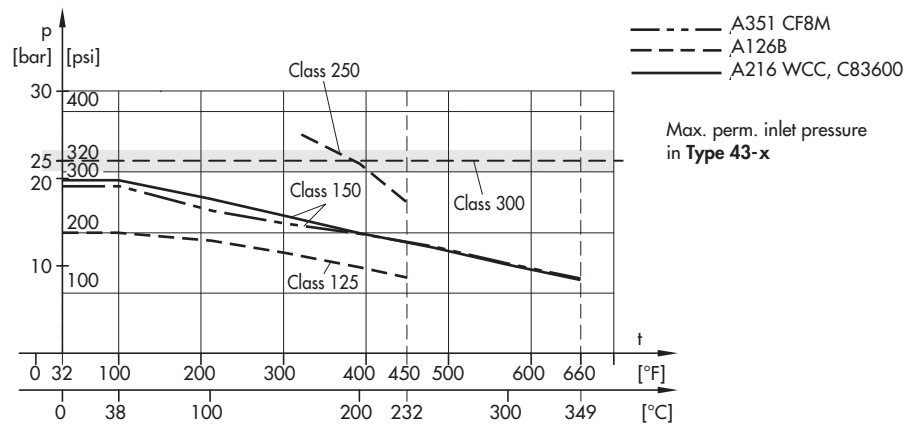


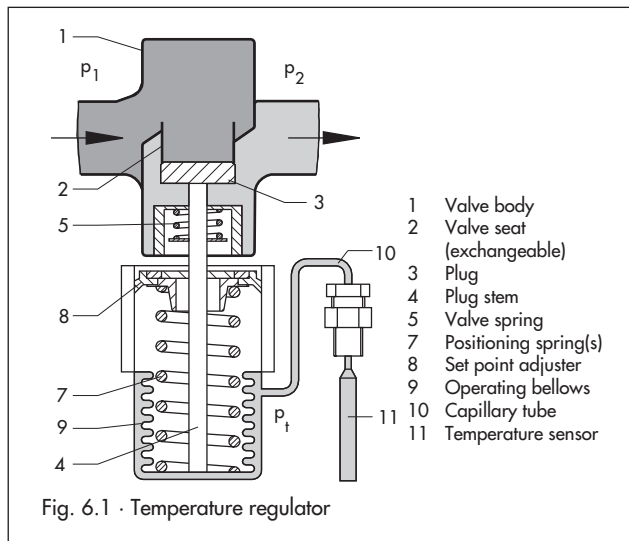
Fig. 5 · Pressure-temperature diagrams according to DIN/ANSI

Principle of operation of Series 43 Temperature Regulators

The measuring unit of self-operated temperature regulators withdraws the energy it requires from the process medium and releases enough force to move the valve stem.

The regulators illustrated in the figures consist of a valve (1) and a control thermostat with set point adjuster (8), capillary tube (10) and a temperature sensor (11) which operates according to the adsorption principle¹⁾.

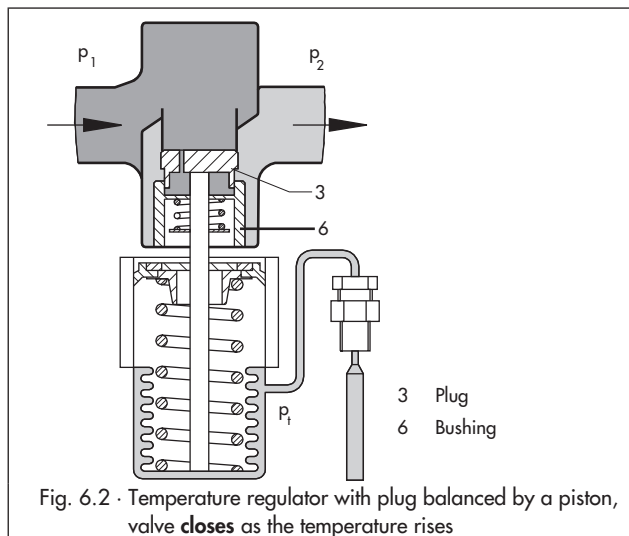
The medium temperature generates a pressure p_t in the sensor (11) corresponding to the actual value. This pressure is transmitted to the bellows (9) through the capillary tube (10). The force $F_t = p_t \times A$ is created at the effective area A of the metal bellows. This force corresponds to the controlled variable x . At the bottom of the metal bellows, it is compared to the spring force F_s (= set point w), which depends on the set point adjustment. When the temperature changes, the plug (3) is moved until $F_t = F_s$.



Pressure-balanced plug

Control accuracy and stability depend on the disturbances that occur (e.g. changes in upstream pressure and flow). However, the regulators are designed to keep this impact low.

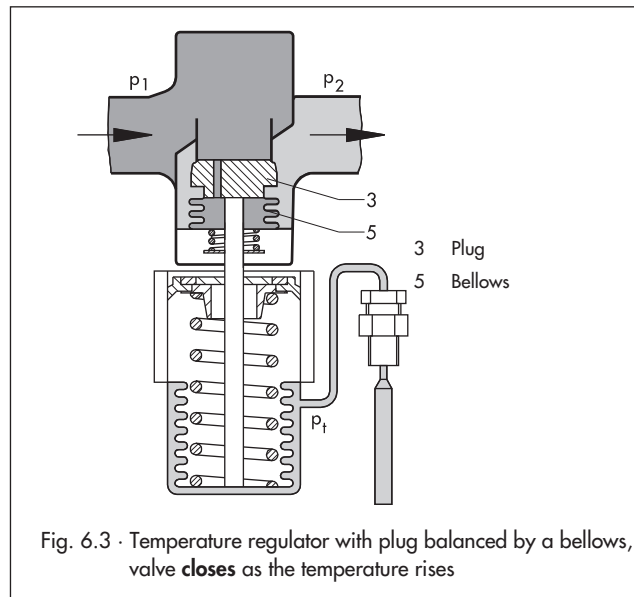
The force exerted by the upstream pressure on the valve plug, for example, may be eliminated by using a pressure-balanced plug. The balanced plug has a bore so that both the front and



the back of the plug are pressurized. The downstream pressure is separated from the plug either by the bushing of a piston plug (Fig. 6.2) or by a metal bellows (Fig. 6.3).

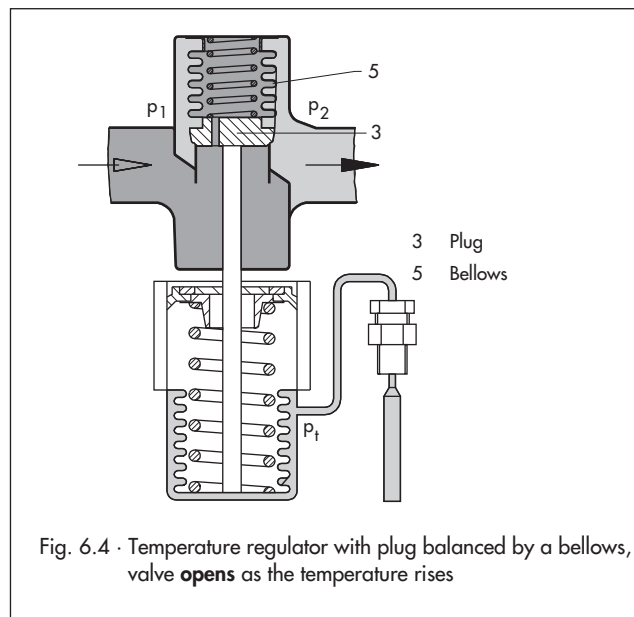
Regulators for heating installations

Regulators illustrated in Figs. 6.2 and 6.3 are suitable for heating installations. The valve **closes** as the temperature at the sensor rises.



Regulators for cooling installations

Regulators illustrated in Fig. 6.4 are suitable for cooling installations. The valve **opens** as the temperature at the sensor rises.



¹⁾ Special versions with small time constant, which operate according to the vapor pressure principle, are available.

Series 43 Temperature Regulators

- Low-maintenance P regulators requiring no auxiliary energy
- Temperature sensor suitable for installation in any position and for operation at high permissible ambient temperatures
- Suitable for liquids, gases and vapors at operating pressures up to 40 bar
- Especially suitable for use in district heating supply systems

Versions with globe valves

Type 43-1 and Type 43-2 Temperature Regulators

Regulators for heating installations · With a plug balanced by a piston¹⁾ · The valve closes as the temperature rises

Technical data	Data Sheets T 2171 EN · T 2175 EN
Set point ranges	0 to 150 °C · 30 to 300 °F
Nominal size	DN 15 to 50 · NPS ½ to 2 G ½ to G 1 · ½ to 1 NPT
Nominal pressure	PN 25 · Class 250 · Class 300
Temperatures	
Liquids	Up to 150 °C · Up to 300 °F
Non-flammable gases	Up to 80 °C · Up to 175 °F

Series 43- ... N

- Low-maintenance P-regulators requiring no auxiliary energy
- Temperature sensor can be mounted in any position
- For treated water up to 120 °C at operating pressures up to 16 bar
- Especially suitable for local heat supply and large heating networks

Type 43-2 N Temperature Regulator

Temperature regulators for heating installations · Valve closes as the temperature rises

Technical data	Data Sheet T 2186 EN
Set point ranges	0 to 100 °C
Nominal size	DN 15
Nominal pressure	PN 16
Temperature	
Treated water	Up to 120 °C

Type 43-5 and Type 43-7 Temperature Regulators

Regulators for heating installations · With a plug balanced by a piston¹⁾ · The valve closes as the temperature rises

Technical data	Data Sheets T 2172 EN · T 2174 EN
Set point ranges	0 to 150 °C · 30 to 300 °F
Nominal size	DN 15 to 50 · NPS ½ to 2 G ½ to G 1 · ½ to 1 NPT
Nominal pressure	PN 25 · Class 250 · Class 300
Temperatures	
Liquids and steam	Up to 200 °C · Up to 390 °F
Non-flammable gases	Up to 80 °C · Up to 175 °F

Type 43-6 Temperature Regulator

Regulators for cooling installations · With a plug balanced by a piston¹⁾ · The valve opens as the temperature rises

Technical data	Data Sheets T 2172 EN · T 2174 EN
Set point ranges	0 to 150 °C · 30 to 300 °F
Nominal size	DN 15 to 50 · G ½ to G 1 ½" to 2" · ½ to 1 NPT
Nominal pressure	PN 25 · Class 250 · Class 300
Temperatures	
Liquids	Up to 15 °C · Up to 300 °F
Gases	Up to 80 °C · Up to 175 °F

Versions with three-way valves

Type 43-3 Temperature Regulator

Temperature regulators for mixing and flow-diverting service in heating or cooling installations

Technical data	Data Sheets T 2173 EN · T 2177 EN
Set point ranges	0 to 150 °C · 30 to 300 °F
Nominal size	DN 15 to 50 · G ½ to G 1 ½" to 2" · ½ to 1 NPT
Nominal pressure	PN 25 · Class 250
Temperatures	
Water and oil	Up to 150 °C · Up to 300 °F

¹⁾ Pressure balancing is not necessary in versions with reduced K_{VS} coefficients and small seat bores

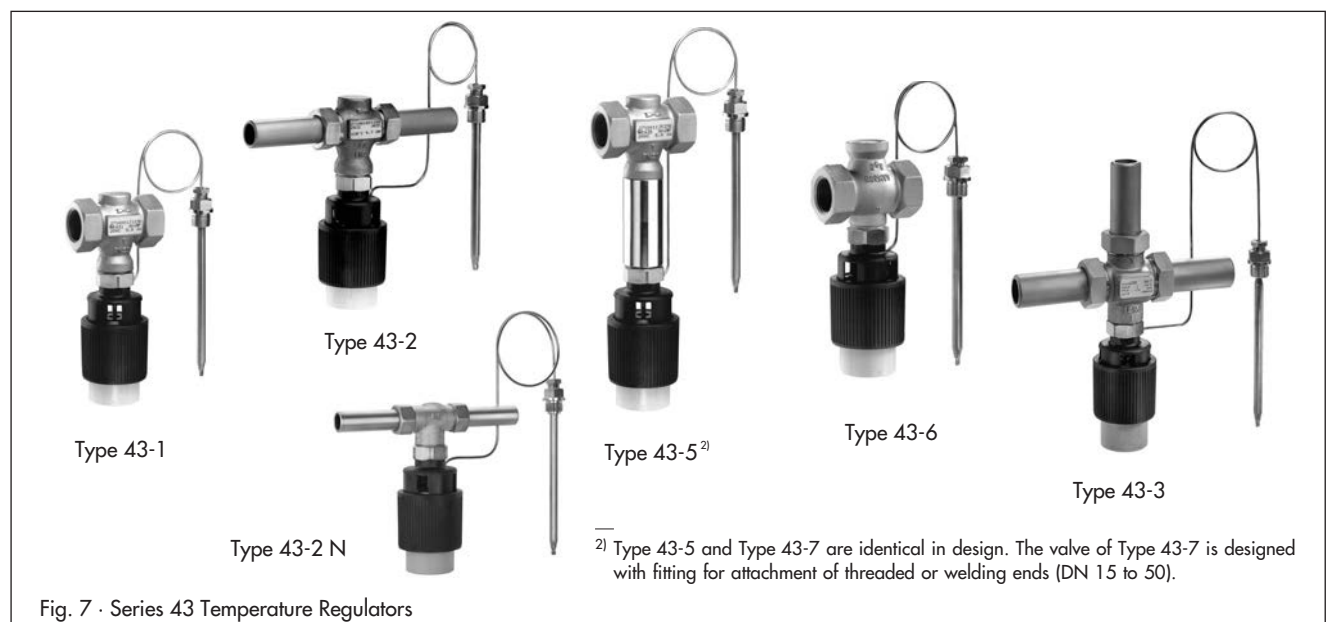


Fig. 7 · Series 43 Temperature Regulators

²⁾ Type 43-5 and Type 43-7 are identical in design. The valve of Type 43-7 is designed with fitting for attachment of threaded or welding ends (DN 15 to 50).

Type 43-8 and Type 43-8 N Temperature Regulators with Hydraulic Controller

Temperature regulation of instantaneous water heaters in small district heating units, particularly in single- and two-family dwellings

- Regulation of small instantaneous water heaters
- Compact design, simple installation and operation
- Stable regulation already at tapped quantity of 2 l/min
- Idle temperature regulation
- Fast-responding vapor pressure thermostats

Technical data	Data Sheet T 2178 EN
Valve	Type 2432 K
Nominal pressure	PN 25/PN 16 ¹⁾
Nominal size	DN 15
Kvs coefficient	2.5
Max. perm. temperature	130 °C/120 °C ¹⁾
Control thermostat	Type 2430 K
Set point range	45 to 65 °C
Perm. pressure at sensor	PN 40
Perm. temp. at set point adjuster	35 °C
Hydraulic controller	Type 2438 K
Nominal pressure	PN 16
Perm. ambient temperature	80 °C

¹⁾Type 43-8 N

Type 3 D, Type 4 D and Type 4 E Return Flow Temperature Limiters

Limiters for the return flow temperature in district heating systems and other heating installations. The valve closes as the temperature rises

Technical data	Data Sheet T 2080 EN
Set point range	+10 to +70 °C
Nominal size	G ½ to G 1 or G ¾ bis G ½
Nominal pressure	PN 25/PN 16
Max. perm. temperature	120 °C

Type 2040 Temperature Regulator for special applications

The Type 2040 Safety Temperature Monitor is used for protection of consumer plants, especially in cryogenics.

The regulator with integrated temperature sensor and set point adjuster closes whenever the medium temperature falls below

the adjusted set point or when the sensor fails (safety function).

Suitable for cryogenic gases and liquids as well as other liquids, gases and vapors

Technical data	Data Sheet T 2090 EN ¹⁾
Set point range	-30 to 70 °C
Connection	Conical joint G 1¼ A
Operating pressure	Max. 40 bar
Temperature range	-60 to +60 °C

¹⁾ See Volume 1 of Self-operated Regulators Catalog

Temperature regulators with double adapter or manual adjuster

Double adapter Do3 K

The double adapter can be installed between valve and control thermostat for the attachment of further thermostats to apply additional controlled variables. The adapter is suited to attach max. two control thermostats or control units. One of the connections may be used to attach a manual adjuster.

Manual adjuster

For the manual operation of the valve. The manual adjuster can either be attached directly to the valve instead of a control thermostat or to the Do3 K at connection b.

Technical data	Data sheet T 2176 EN
Connection to	Series 43 Globe and Three-way Valves
Nominal size	G ½ to G 1 · DN 15 to 50
Nominal pressure	PN 25

Typetested temperature regulators

Typetested temperature regulators (TR), safety temperature monitors (STM), safety temperature limiters (STL) and pressure limiters (PL) as well as combined regulators (e.g. TR/PL) with limit values up to 170 °C are part of the safety equipment used in heat generating installations.

 These versions are DIN-tested and approved. Register no. and test mark are available on request.

For details refer to the corresponding data sheets and Information Sheet T 2181 EN.

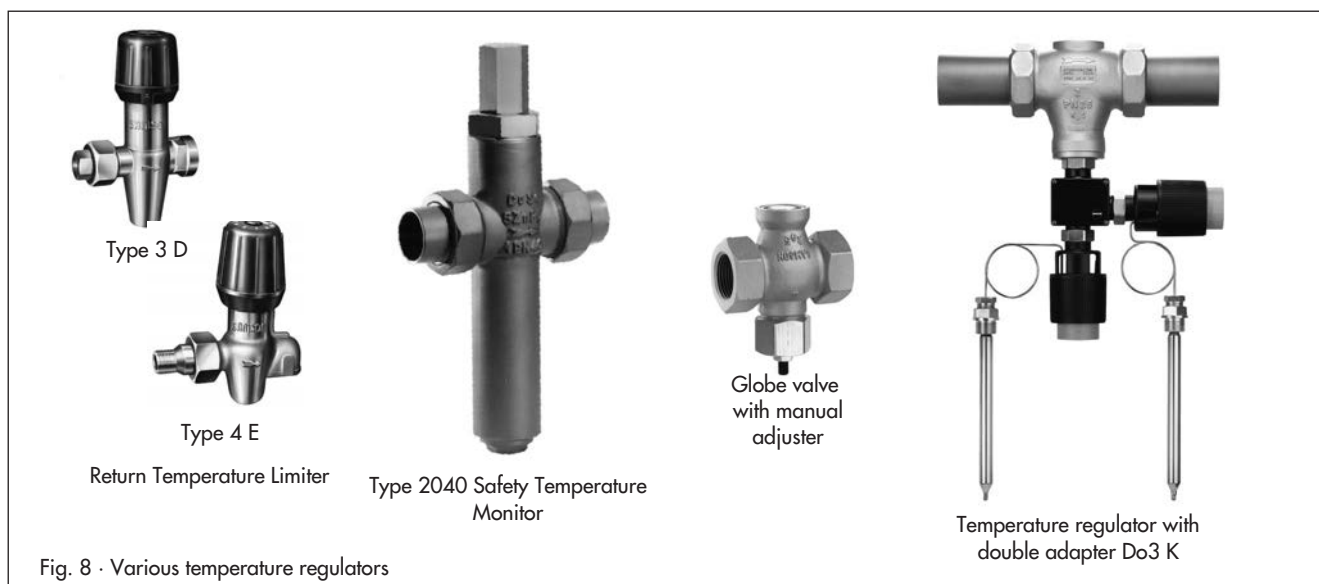
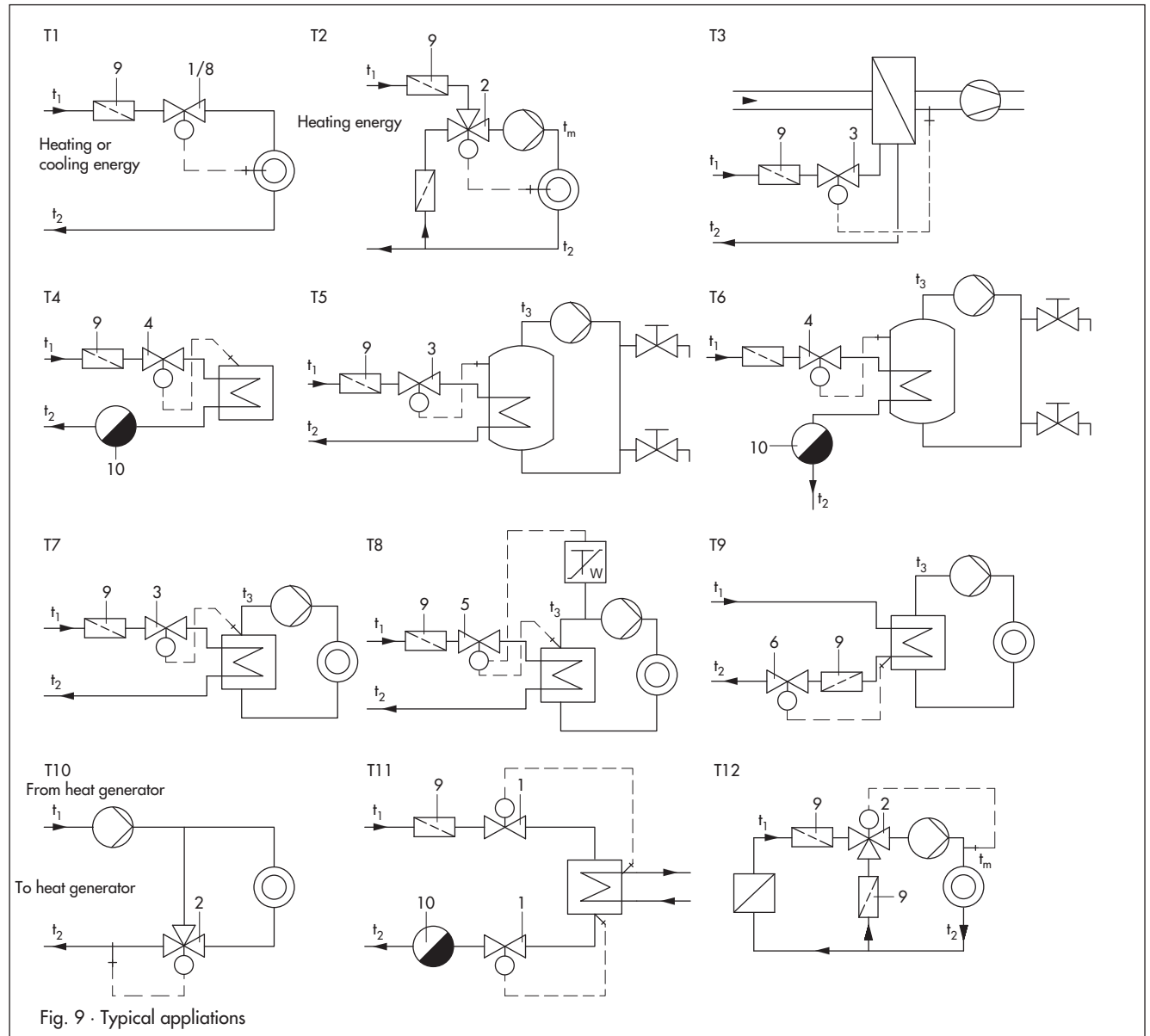


Fig. 8 · Various temperature regulators

Typical applications



Temperature regulation for different consumers

- T1 Heating or cooling with globe valve
- T2 Heating with three-way valve (mixing valve)
- T3 Regulation of a water-heated air duct
- T4 Regulation of a steam-heated drying cabinet, drying chamber or storeroom

Temperature regulation of boilers, heat generators and heat exchangers

- T5 Regulation of water-heated boilers
- T6 Regulation of steam-heated boilers
- T7 Regulation of a heat generator or water-heated heat exchanger
- T8 Temperature regulation safeguarded by safety temperature monitor on a heat exchanger or water-heated heat exchanger

Temperature regulation in district heating systems and cooling installations

- T9 Return flow temperature limitation
- T10 Return flow temperature increase in a boiler system
- T11 Temperature regulation of a condenser
- T12 Regulation of the cooling water circuit of engines or compressors

Legend of the typical applications:

- 1 For heating: Type 43-1, 43-2, 43-5, 43-7, 43-2 N,
For cooling: Type 43-6
- 2 Type 43-3
- 3 Type 43-1, 43-2, 43-2 N
- 4 Type 43-5, 43-7
- 5 Type 43-1, 43-2, 43-5, 43-7, 43-2 N with typetested
safety equipment (TR/STL)
- 6 Type 43-1, 43-2, 43-5, 43-7, 43-2 N
- 8 Type 43-6
- 9 SAMSON strainer
- 10 SAMSON steam trap

For further application examples of typetested regulators, refer to Information Sheet T 2181 EN.

Specifications subject to change without notice



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T 2170 EN

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