INFORMATION SHEET

T 2170 EN

Series 43 Self-operated Temperature Regulators

PN 16/25 · Class 150/300
DN 15 to 50 · NPS ½ and 1
G ½ to 1 · ½ to 1 NPT
Up to 200 °C · Up to 390 °F

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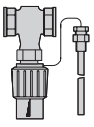
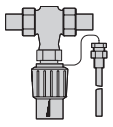
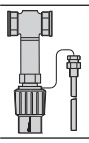
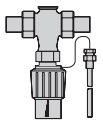
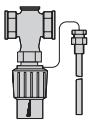
Series 43 Self-operated Temperature Regulators | DIN versions

Valve	Can be used for	Steam				•	
		Water, liquids	•	•	•	•	•
		Oil	•	•		•	•
		Gases, non-flammable gases [4]	•	•	•	•	•
		Heating	•	•	•		
		Cooling				•	•
		Mixing/diverting					
	Globe valve		•	•	•	•	•
	Three-way valve						
		Balanced	•	•	•	•	•
		Unbalanced					
	Connection	Female thread	•		•	•	
		Welding ends		•			•
		Threaded ends		•			•
		Flanges		•			•
	Valve size	DN		15 to 50			15 to 50
	Connection size	G	½ to 1		½ to 1	½ to 1	
	Pressure rating	PN	25				
	Max. permissible temperature	°C	150		200	150	
	Body material	Hot-pressed brass					
		Red brass	•	• [3]	•	•	• [3]
		Spheroidal graphite iron		• [1]			• [1]
		Stainless steel	•	• [2]		•	• [2]
Thermostat	Type ... Control Thermostat		2430				
	Set point	°C	0 to 35 · 25 to 70 · 40 to 100 · 50 to 120 · 70 to 150				
	Sensor material		Copper				
	Thermowell		Optionally copper or stainless steel				
Type			**43-1**	**43-2**	**43-5**	**43-6**	**43-6**
Data Sheet T ...			▶ **T 2171**		▶ **T 2172**		
Type 2040 Safety Temperature Monitor for cryogenic service on request (▶ **T 2090**)							

[1] Flange DN 32 to 50 [2] Flange DN 15 and 25 [3] Male thread DN 15 to 50 [4] Max. permissible temperature 80 °C

Control thermostats

Control thermostats and temperature sensors

The Series 43 Temperature Regulators are fitted with Type 2430 Control 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).

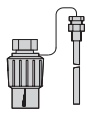
Details can be found in the corresponding data sheets.

Combined regulators

A double adapter can be attached between the valve and control thermostat to mount further control thermostats and control equipment (▶ **T 2176**).

Combinations with flow and differential pressure regulators are possible.

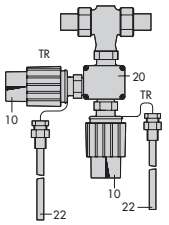
10	Control thermostat
11	Housing with spring mechanism
20	Double adapter Do3 (housing)
21	Type 2439 Safety Temperature Limiter (STL)
22	Temperature sensor with thermowell
TR	Temperature regulator
STL	Safety temperature limiter (STL)



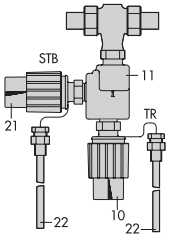
Control thermostat with temperature sensor and thermowell

Temperature sensor with screw gland

Fig. 1: *Control thermostat with various sensor versions*



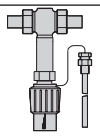
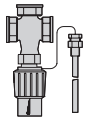
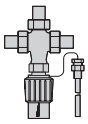
Temperature regulator with double adapter Do3



Temperature regulator with safety temperature limiter (STL)

Fig. 2: *Combined regulators*

Series 43 Self-operated Temperature Regulators

Valve	Can be used for	Steam		•				
		Water, liquids		•	•	•	•	•
		Oil			•	•		
		Gases, non-flammable gases [4]		•				
		Heating		•	•	•	•	•
		Cooling			•	•		
		Mixing/diverting			•	•		
	Globe valve			•			•	•
	Three-way valve				•	•		
		Balanced		•				•
		Unbalanced			•	•	•	
	Connection	Female thread						
		Welding ends		•		•	• [1]	
		Threaded ends		•		•	• [1]	
		Flanges		•		•		
	Valve size		DN	15 to 50		15 to 50	15	
	Connection size		G		½ to 1			
	Pressure rating		PN	25			16	16/25
	Max. permissible temperature		°C	200	150		120	120 [3] · 130
	Body material	Hot-pressed brass					•	
		Red brass		•	•	•		•
		Spheroidal graphite iron		•				
		Stainless steel						
Thermostat	Type ... Control Thermostat			2430				
	Set point		°C	0 to 35 · 25 to 70 · 40 to 100 · 50 to 120 · 70 to 150			0 to 100	45 to 65
	Sensor material			Copper				CrNiMo steel
	Thermowell			Optionally copper or stainless steel				Without
Type				**43-7**	**43-3**	**43-3** [2]	**43-2 N**	**43-8**
Data Sheet T ...				**▶ T 2172**	**▶ T 2173**		**▶ T 2186**	**▶ T 2178**
								

1) Connecting thread G ¾ B to mount welding ends and threaded ends
2) Version with male thread to mount welding ends, threaded ends or flanges also available as diverting valve
3) Max. permissible valve temperature
4) Max. permissible temperature 80 °C

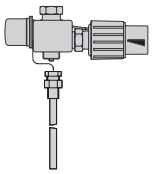
Safety thermostats

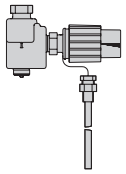
The **Type 2403 Safety Thermostat** for safety temperature monitor consists of a temperature sensor without thermowell, limit adjuster, capillary tube and connecting element.

The **Type 2439 Safety Thermostat** for safety temperature limiters (STL) consists of a housing with a spring mechanism and thermostat with capillary tube, bulb sensor and thermowell. The device can also be delivered with an **electric signal transmitter** for remote transmission of a malfunction.

Dynamic behavior of control thermostats

The dynamics of the regulator are mainly determined by the response of the sensor with its characteristic time constant. Table 1 lists the response times of SAMSON control thermostats for Series 43 Regulators operating according to different principles measured in water.





Type 2403 (STM) Type 2439 (STL)

Fig. 3: *Safety thermostats*

Table 1: *Dynamic behavior of some SAMSON control thermostats*

Type of operation	Type	Without Thermowell		With Thermowell	
Adsorption	2430	15 s [1]	30 s [2]	40 s [1]	80 s [2]
	2439	– [3]		40 s	
Vapor pressure	2403	3 s		– [3]	

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

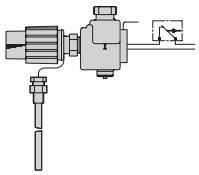
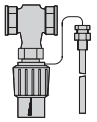
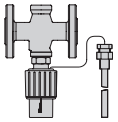
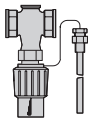
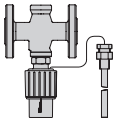


Fig. 4: *Type 2439 Safety Thermostat with electric signal transmitter*

Series 43 Self-operated Temperature Regulators			ANSI versions			
Valve	Can be used for	Steam				
		Water, liquids	•	•	•	•
		Oil	•	•	•	•
		Gases, non-flammable gases [1]	•	•	•	•
		Heating	•	•		
		Cooling			•	•
		Mixing/diverting				
	Globe valve		•	•	•	•
	Three-way valve					
	Balanced		•	•	•	•
	Unbalanced					
	Connection	Female thread	•		•	
		Welding ends		•		•
		Threaded ends		•		•
		Flanges		•		•
	Valve size	NPS		½ · 1		½ · 1
	Connection size	NPT	½ to 1		½ to 1	
	Pressure rating	Class	300	150	300	150
	Max. permissible temperature	°F	300			
	Body material	Stainless steel A351 CF8M	•	•	•	•
Thermostat	Type ... Control Thermostat		2430			
	Set point	°F	30 to 95 · 75 to 160 · 105 to 210 · 125 to 250 · 160 to 300			
	Sensor material		Copper			
	Thermowell		Optionally copper or stainless steel			
Type			**43-1**	**43-2**	**43-6**	**43-6**
Data Sheet T ...			▶ **T 2175**		▶ **T 2174**	
						

[1] Max. permissible temperature 176 °F

Conversion factors

K_{VS} and C_V coefficient

The exact calculation is performed according to IEC 60534, parts 2-1 and 2-2. The ISA-S75.01-1-1985 standard and VDI/VDE directive 2173 are also used. The calculation of the K_V coefficient according to this directive is sufficiently accurate in most cases. The equations are also listed in the Application Notes AB 04.

K_{VS}	=	0.86 x C_V	K_{VS}	[m³/h]
C_V	=	1.17 x K_{VS}	C_V	[US gallon/min]

Pressure

1 pound/square inch [lbs/in² = psi] = 0.06895 bar

1 bar = 14.5 psi

Area

1 square inch [sq.in; in²] = 6.452 cm²

1 cm² = 0.155 in²

Mass

1 pound [lb] = 0.4536 kg

1 kg = 2.2046 lb

Mass flow

1 pound per second [lb/s] = 0.4536 kg/s

1 kg/s = 2.2046 lb/s

Flow rate

1 US gallon per min [US gallon/min] = 0.227 m³/h

1 m³/h = 4.4 US gallon/min

Temperature

°F = 9/5 °C + 32

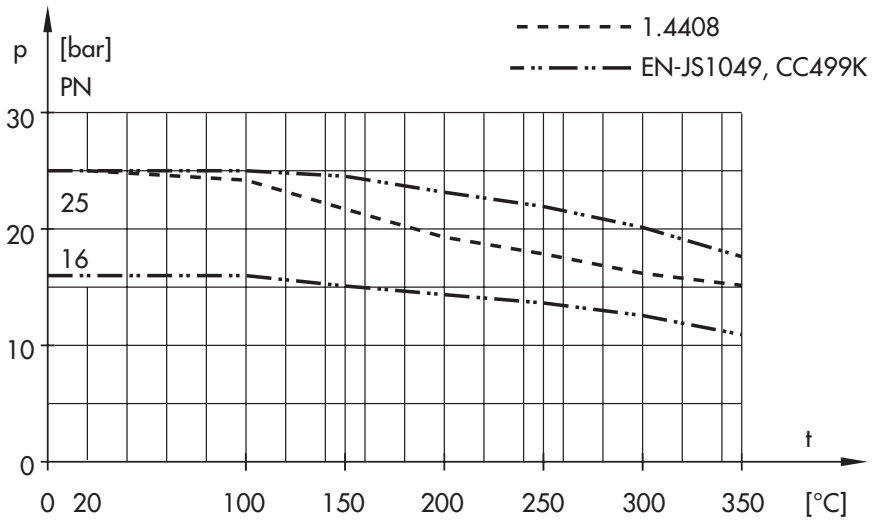
°C = 5/9 (°F - 32)

Pressure-temperature diagrams

The pressures specified in the corresponding data sheets are maximum values which are limited by the pressure-temperature diagram.

For DIN materials, the diagrams were created based on DIN EN 12516-1. For materials in accordance with US standards, these were created in compliance with ASME B16.1 and ASME B16.34.

Pressure-temperature diagram (DIN)



Pressure-temperature diagram (ANSI)

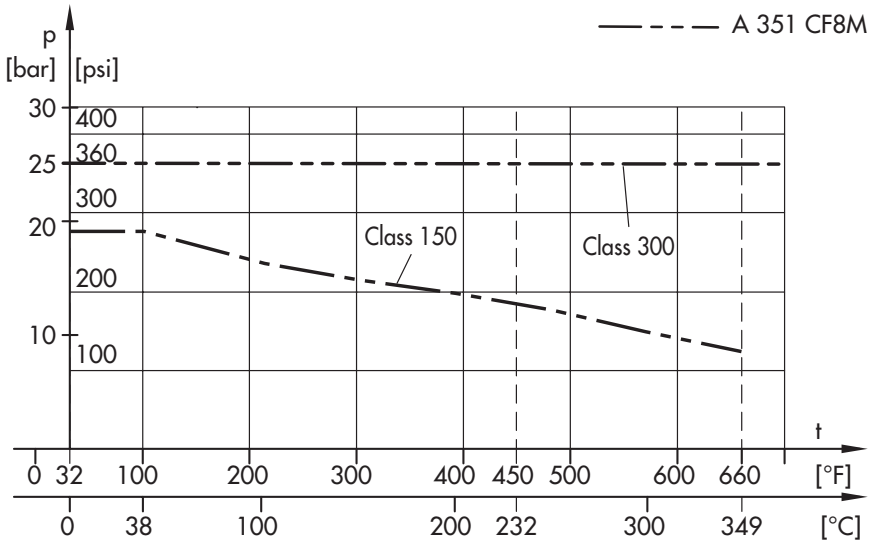
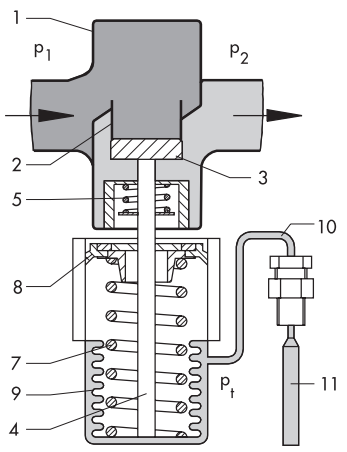


Fig. 5: *Pressure-temperature diagrams (DIN/ANSI)*

Principle of operation (see Fig. 6)



1 Valve body
2 Valve seat (exchangeable)
3 Plug
4 Plug stem
5 Valve spring
7 Set point spring(s)
8 Set point adjuster
9 Positioning bellows
10 Capillary tube
11 Temperature sensor

Fig. 6: *Temperature regulator*

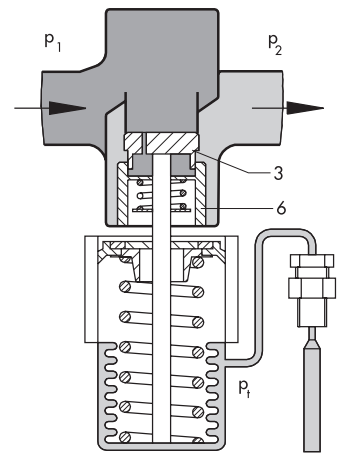
Self-operated temperature regulators are control devices whose measuring units draw their energy from the process medium which creates sufficient force to move the final control element (plug with plug stem).

The regulators illustrated consist of a valve (1) and a control thermostat with set point adjuster (8), capillary tube (10) and temperature sensor (11) operating according to the adsorption principle [1].

The medium temperature creates the pressure p_t in the sensor (11) that corresponds to the actual value. This pressure is transferred over the capillary tube (10) to the positioning bellows (9) where the force $F_t = p_t \times A$ is created at the effective bellows area A. This force that corresponds to the controlled variable x is compared at the bottom of the bellows with the spring force F_s (= set point w) dependent on the set point adjustment.

When the temperature changes, the plug (3) moves until $F_t = F_s$.

Pressure balancing



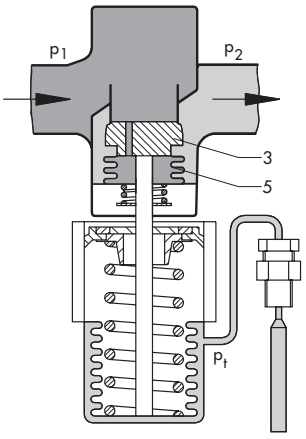
3 Plug balanced by a piston
6 Bushing

Fig. 7: *Temperature regulator with plug balanced by a piston. The valve **closes** as the temperature rises.*

The control accuracy and stability of the control process depend on the disturbances occurring in the loop (for example, changes in upstream pressure and flow rate). The regulators are designed in such a way that the effect of these disturbances is relatively small. The force acting on the valve plug depending on, for example the upstream pressure, can be eliminated by balancing the plug correspondingly.

The valve plug has a hole through it to allow the upstream pressure to be applied to the front and back of the plug. The downstream pressure is separated from the plug either by the bushing of a piston plug (Fig. 7) or a metal bellows (Fig. 8).

Regulators for plants to be heated



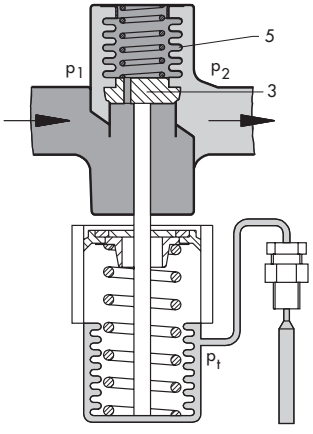
3 Plug balanced by bellows
5 Metal bellows

Fig. 8: *Temperature regulator with plug balanced by a bellows. The valve **closes** as the temperature rises.*

The regulators (Fig. 7 and Fig. 8) are suitable for plants to be heated.

The valve **closes** as soon as the temperature at the sensor rises.

Regulators for plants to be cooled



3 Plug balanced by bellows
5 Metal bellows

Fig. 9: *Temperature regulator with plug balanced by a bellows. The valve **opens** as the temperature rises.*

The regulators (Fig. 9) are suited for plants to be cooled.

The valve **opens** as soon as the temperature at the sensor rises.

[1] Special fast-responding versions available operating according to the vapor pressure principle.

Series 43 Temperature Regulators

Self-operated regulators for general applications

- Low-maintenance, medium-controlled proportional regulators requiring no auxiliary energy
- Temperature sensors suitable for all mounting positions and high permissible ambient temperatures
- Suitable for liquids, gases and vapors at operating pressures up to 40 bar
- Particularly suitable for district heating supply networks
- Body with screwed ends and flanged body

Versions with globe valve

Type 43-1 and Type 43-2 Temperature Regulators

Designed for plants to be heated. Plug balanced by a piston [1]. The valve closes as the temperature rises.

Technical data

Type 43–1 and Type 43–2	Data Sheets ▶ T 2171 · ▶ T 2175
Set point ranges	0 to 150 °C · 30 to 300 °F
Valve size	DN 15 to 50 · NPS ½ and 1 G ½ to 1 · ½ to 1 NPT
Pressure rating	PN 25 · Class 150 · Class 300
Temperature ranges	
Liquids	Up to 150 °C · Up to 300 °F
Non-flammable gases	Up to 80 °C · Up to 175 °F

Type 43-5 and Type 43-7 Temperature Regulators

Designed for plants to be heated. Version with plug balanced by a bellows [1]. The valve closes as the temperature rises.

Technical data

Type 43–5 · Type 43-7	Data Sheets ▶ T 2172 · ▶ T 2174
Set point ranges	0 to 150 °C · 30 to 300 °F
Valve size	DN 15 to 50 · NPS ½ and 1 G ½ to 1 · ½ to 1 NPT
Pressure rating	PN 25 · Class 150 · Class 300
Temperature ranges	
Liquids and steam	Up to 200 °C · Up to 390 °F
Non-flammable gases	Up to 80 °C · Up to 175 °F

[1] Pressure balancing is not required in the versions with reduced K_{VS} coefficients and small seat bores.

Type 43-6 Temperature Regulator

Designed for plants to be cooled. Version with plug balanced by a bellows [1]. The valve opens as the temperature rises.

Technical data

Type 43-6	Data Sheets ▶ T 2172 · ▶ T 2174
Set point ranges	0 to 150 °C · 30 to 300 °F
Valve size	DN 15 to 50 · NPS ½ and 1 G ½ to 1 · ½ to 1 NPT
Pressure rating	PN 25 · Class 150 · Class 300
Temperature ranges	
Liquids	Up to 150 °C · Up to 300 °F
Non-flammable gases	Up to 80 °C · Up to 175 °F

Series 43– … N

Type 43-2 N Temperature Regulator

- Temperature sensors suitable for all mounting positions
- Treated water up to 120 °C at operating pressures up to 16 bar
- Particularly suitable for local heat supply and large heating networks

Designed for plants to be heated. The valve closes as the temperature rises.

Technical data

Type 43-2 N	Data Sheet ▶ T 2186
Set point ranges	0 to 100 °C
Valve size	DN 15
Pressure rating	PN 16
Temperature ranges	
Treated water	Up to 120 °C

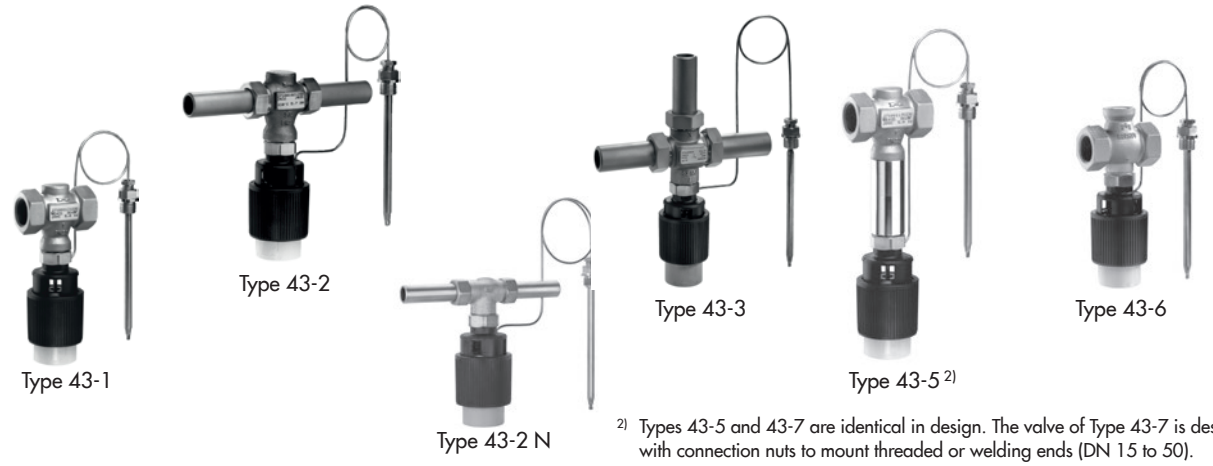
Versions with three-way valve

Type 43-3 Temperature Regulator

Designed for mixing or diverting service in heating or cooling installations

Technical data

Type 43–3	Data Sheet ▶ T 2173
Set point ranges	0 to 150 °C
Valve size	DN 15 to 50 · G ½ to G 1
Pressure rating	PN 10 · PN 25
Temperature ranges	
Water, oil	Up to 150 °C



[2] Types 43-5 and 43-7 are identical in design. The valve of Type 43-7 is designed with connection nuts to mount threaded or welding ends (DN 15 to 50).

Fig. 10: *Series 43 Temperature Regulators*

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

Temperature regulation of instantaneous water heaters in small district heating units

- Regulation of small instantaneous water heaters
- Compact design, easy to operate and install
- Stable control already at tapped quantity of 2 l/minute
- Idle temperature regulation
- Fast-responding vapor pressure thermostats

Technical data

Type 43–8 · Type 43-8 N	Data Sheet ▶ T 2178
Valve	**Type 2432**
Valve size	DN 15
Pressure rating	PN 16 [1] · PN 25
K_{VS} coefficient	2.5
Max. permissible temperature	120 °C [1]/130 °C
Control thermostat	**Type 2430**
Set point ranges	45 to 65 °C
Perm. pressure at sensor	PN 40
Perm. temperature at the set point adjuster	35 °C
Hydraulic controller	**Type 2438**
Pressure rating	PN 16
Max. permissible ambient temperature	80 °C

[1] Type 43-8 N

Type 2040 Temperature Regulator for special applications

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

Type 2040	Data Sheet ▶ T 2090
Set point range	–30 to +70 °C
Connection	G 1¼ A conical joint
Operating pressure	Max. 40 bar
Temperature range	–60 to +60 °C

Temperature regulators with double adapter or manual adjuster

Double adapter Do3

A double adapter Do3 can be attached between the valve and control thermostat to mount further control thermostats for the use of additional controlled variables. The adapter is suited to attach a maximum of 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 at connection b.

Technical data

Accessories	Data Sheet ▶ T 2176
Connection to …	Globe and three-way valves (Series 43)
Valve size	DN 15 to 50 · NPS ½ and 1 G ½ to 1 · ½ to 1 NPT
Pressure rating	PN 16 · PN 25 Class 150 · Class 300

Typetested temperature regulators

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

These versions are DIN-tested and approved. The register number and test mark are available on request.

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

Type 43-8 Temperature Regulator with Hydraulic Controller

Type 2040 Safety Temperature Monitor

Globe valve with manual adjuster

Temperature regulator with double adapter Do3

Fig. 11: *Various temperature regulators*

Sample applications

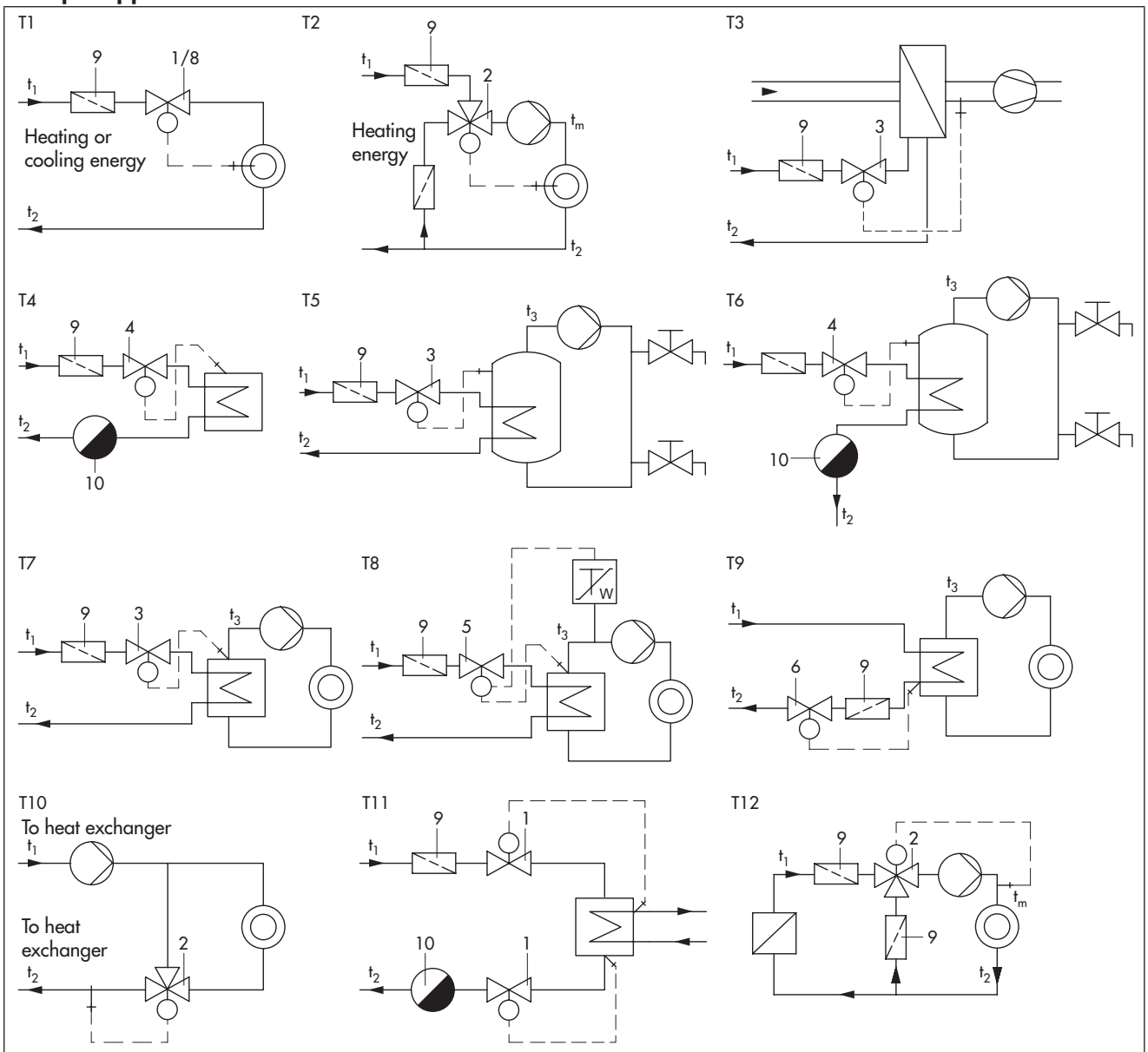


Fig. 12: *Sample applications (schematics)*

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

For further application examples of typetested regulators, refer to Information Sheet ▶ T 2081.

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 for typical applications

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