

# Self-operated Temperature Regulators

## Temperature Regulator Type 9

with balanced<sup>1)</sup> three-way valve · Flanges



### Application

Temperature regulator with either mixing or diverting valve for heating or cooling installations, with control thermostats for **set points** from  $-10\text{ °C}$  to  $+250\text{ °C}$  · **Three-way valves** in **nominal sizes** DN 15 to DN 150 · **Nominal pressures** PN 16 to PN 40 · **Temperatures** up to  $350\text{ °C}$

### Conversion of valve sizing coefficients:

$$C_v \text{ (in U.S. gallons/min)} = 1.17 \cdot K_{vs} \text{ (in m}^3\text{/h)}$$

$$K_{vs} \text{ (in m}^3\text{/h)} = 0.86 \cdot C_v \text{ (in U.S. gallons/min)}$$

### Note

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



The regulators consist of a balanced three-way valve and a control thermostat comprising 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<sup>1)</sup> by means of a stainless steel bellows, optionally available with a plug arrangement to mix or divert liquids
- Flow rate across the cross-sectional area AB is almost independent of the valve plug position
- Valve body optionally made of cast iron, cast steel or stainless cast steel
- Versions with double adapter and manual adjuster are available for attachment of a temperature limiter or a second thermostat. Refer to Data Sheet T 2036 EN for details.

### Versions

#### Type 9 Temperature Regulator

Type 2119 Three-way Valve · Sizes DN 15 to DN 25 not pressure balanced · Sizes DN 32 to DN 150 pressure balanced · PN 16 to PN 40 · Types 2231 to 2235 Control Thermostats Three-way valve optionally available with plug arrangement for mixing or diverting service. For more details on the application of 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  $-10$  to  $+150\text{ °C}$  · 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  $-10$  to  $+250\text{ °C}$  · 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  $-10$  to  $+150\text{ °C}$  · Set point adjustment at the sensor

**Type 2119/2234** · With Type 2119 Valve and Type 2234 Control Thermostat for liquids, air and other gases · Set points from  $-10$  to  $+250\text{ °C}$  · Separate set point adjustment

**Type 2119/2235** · With Type 2119 Valve and Type 2235 Control Thermostat for air-heated storerooms, drying, climatic and heating cabinets · Set points from  $-10$  to  $+250\text{ °C}$  · Separate set point adjustment and a sensor tube which can be installed by the user

<sup>1)</sup> DN 15 to DN 25: not pressure balanced

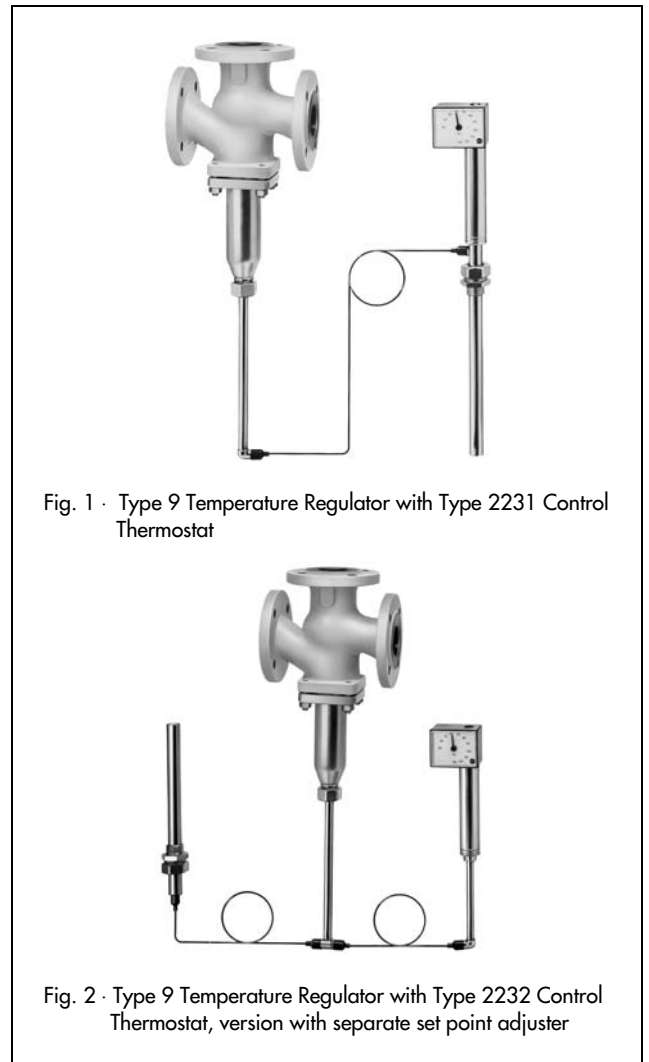


Fig. 1 · Type 9 Temperature Regulator with Type 2231 Control Thermostat

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

### Special version

- Capillary tube of either 5 m, 10 m or 15 m
- Capillary tube made of CrNiMo steel/Cu, plastic-coated
- Sensor made of CrNiMo steel
- Valve made completely of stainless steel (minimum material grade 1.4301)
- Version according to ANSI on request (see T 2134 EN)

### 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 moves 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 area released between the plug (3) and seat (2). The temperature set point is adjustable with a key (9) to a value which can be read off from the dial (10).

With pressure balanced valves in nominal sizes DN 32 to DN 150, the pressure at port B acts through a hole in the plug stem (5) onto the outer surface of the balancing bellows<sup>1)</sup> (4.1), whereas the pressure at port A acts onto the inner bellows area. This equalizes the forces acting onto the valve plugs (3).

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

In diverting valves, however, the process medium enters through port AB and the diverted flows leave the valve at ports A or B. The flow rate from AB to A or B depends on the position of the plug stem. Diverting valves are supplied with plug arrangement II (Fig. 4). In this case, port A closes and port B opens when the temperature rises.

<sup>1)</sup> Valve sizes DN 15 to DN 25 are not pressure balanced.

#### Three-way valve

- 1 Valve body
- 2 Seat (replaceable)
- 3 Plug
- 4 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)

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

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

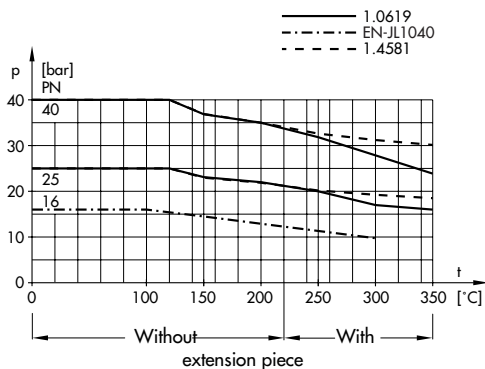


Fig. 5 · Pressure-temperature diagram

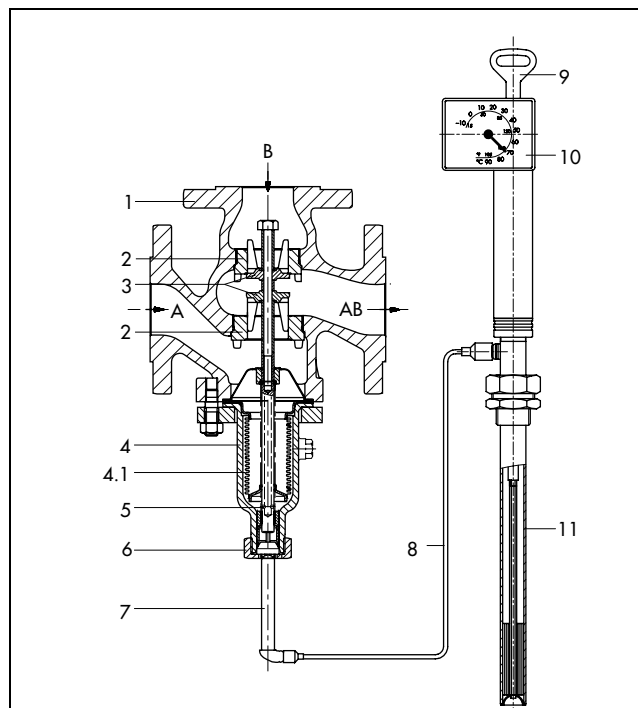


Fig. 3 · Temperature regulator with Type 2119 Three-way Valve (DN 50) and Type 2231 Control Thermostat, three-way valve with plug arrangement I, the arrows indicate mixing service

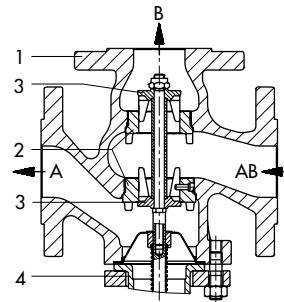


Fig. 4 · Type 2119 Three-way Valve with plug arrangement II, the arrows indicate diverting service

### Installation

- Install the regulators with the operating element suspended downwards. The medium must flow through the valve in the direction indicated by the arrow on the body.
- The capillary tube must be installed in such a way that it is not exposed to large temperature fluctuations and cannot be damaged. The smallest permissible bending radius is 50 mm.
- The temperature sensor may be installed in any desired position. Make sure its entire length is immersed in the medium to be controlled. Choose a place of installation where neither overheating nor considerable idle times occur.
- Only use the same kind of materials together, for example thermowells made of stainless steel 1.4571 can be installed in stainless steel heat exchangers.

**Table 1 · Technical data** · All pressures in bar (gauge). The permissible pressures and differential pressures specified below are limited by the values specified in the pressure-temperature diagram and the nominal pressure ratings.

<b>Type 2119 Three-way Valve</b>												
Nominal pressure		PN 16 to PN 40										
Kvs values and max. permissible differential pressures $\Delta p^{1)}$ in bar												
Connection	DN	15	20	25	32	40	50	65	80	100	125	150
Mixing valve	Kvs value	4	6.3	8	16	20	32	50	80	125	160	200
For p in B > p in A	$\Delta p$	10			16			10			8	
For p in A > p in B	$\Delta p$	5			3.5			3			2	
Diverting valve (when flow AB to A or B)	Kvs	4	6.3	8	16	20	32	40	64	100	125	160
	$\Delta p$	4			3.5			3			2	
Permissible valve temperature		See Fig. 5 · Pressure-temperature diagram										
<b>Types 2231 to 2235 Thermostats</b>		Size 150										
Set point range (each set point span 100 K)		-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 +80 °C										
Perm. temperature at the sensor		100 K above the adjusted set point										
Perm. pressure at the sensor	Types 2231/2232	Without thermowell: PN 40 · With thermowell: PN 40 or PN 100 (version of copper: PN 16) With thermowell with flange: PN 40/DN 32 or PN 100/DN 40										
	Types 2233/2234	Without thermowell: PN 40 · With thermowell: PN 6 (external $\varnothing$ 140) or PN 40/DN 32										
Length of capillary tube		3 m (special version: 5 m, 10 m or 15 m)										

<sup>1)</sup> The differential pressure corresponds to the pump pressure for liquids

**Table 2 · Materials** · Material numbers according to DIN EN

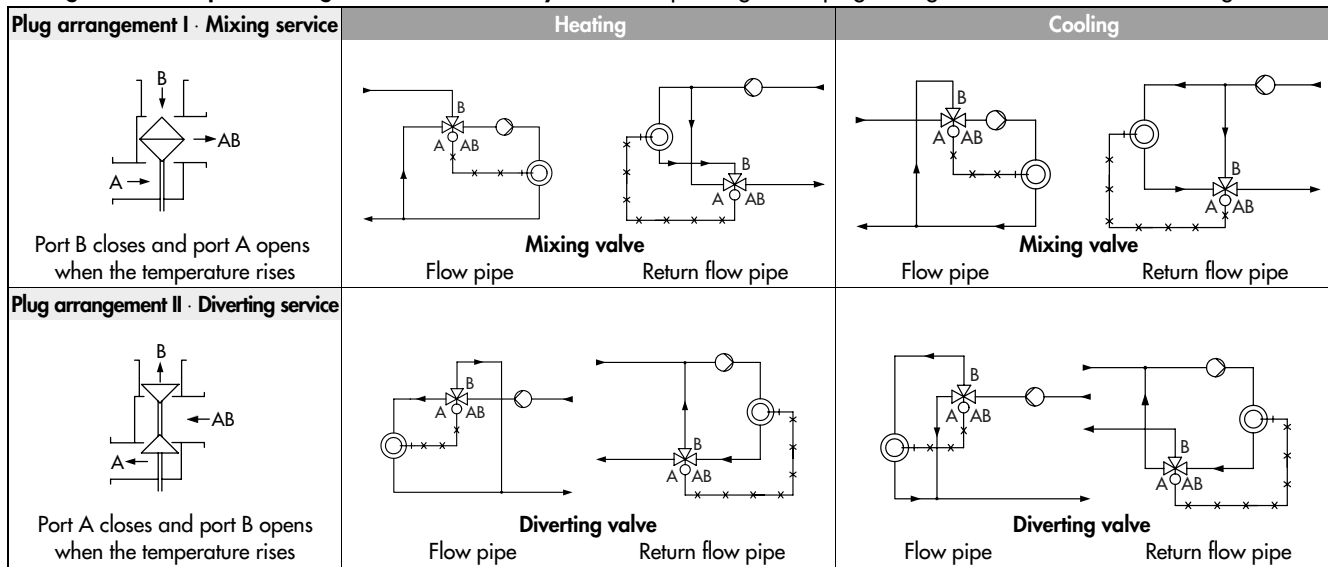
<b>Type 2119 Three-way Valve</b>			
Connection	DN 15 to DN 150		DN 15 to DN 100
Nominal pressure	PN 16		PN 25/40
Body	Cast iron EN-JL1040 (GG-25)	Cast steel 1.0619 (GS-C 25)	Stainless cast steel 1.4581
Seat and plug	Steel 1.4006 (1.4301 for DN 125 and 150)		1.4571
Plug stem/spring	1.4301/1.4310		
Balancing bellows <sup>1)</sup>	1.4571		
Bellows housing	1.0425 (St 35.8)		1.4571
Sealing ring	Graphite on metal core		
Extension piece/distance piece	Brass (special version: stainless steel 1.4301)		1.4301
<b>Types 2231, 2232, 2233, 2234 and 2235 Thermostats <sup>2)</sup></b>			
	Standard version		Special version
Operating element	Brass, nickel-plated		
Types 2231/2232	Bronze, nickel-plated		Stainless steel 1.4571
Sensor Types 2233/2234	Copper, nickel-plated		
Type 2235	Copper		
Capillary tube	Copper, nickel-plated	Copper, plastic-coated	
<b>Thermowell with threaded connection</b>			
Immersion tube	Bronze, nickel-plated	Copper	1.4571
Threaded nipple	Brass, nickel-plated	Copper	1.4571
<b>... with flange</b>			
Immersion tube	Steel	Plastic-coated or PTFE <sup>3)</sup>	1.4571
Flange	Steel		1.4571

<sup>1)</sup> DN 15 to 25: without balancing bellows

<sup>2)</sup> Type 2235 not available in stainless steel version

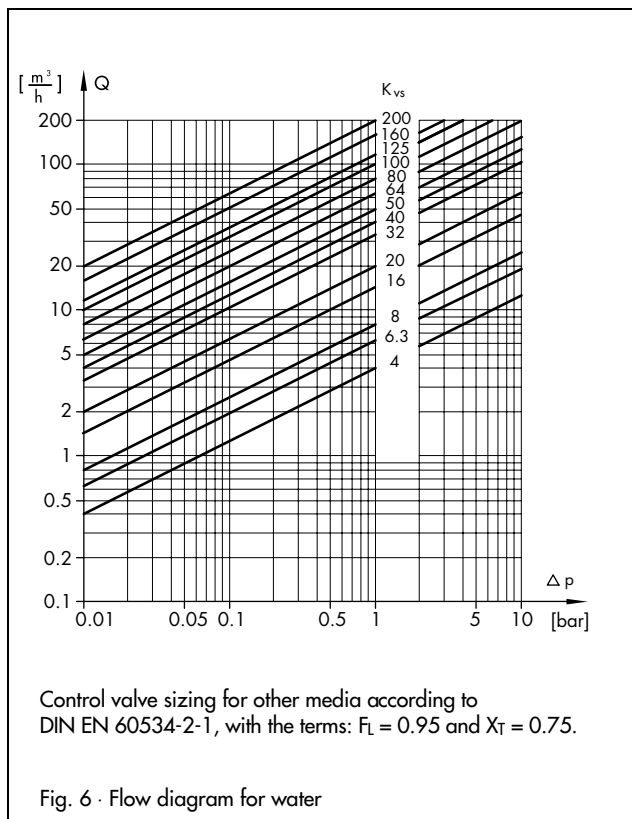
<sup>3)</sup> Plastic coating - for temperatures up to 80 °C · PVC or PPH coating. PTFE version · Immersion tube: PTFE · Flange: steel with PTFE bushing.

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



### Flow diagram for water

The values shown apply for a fully opened valve.



### Typetested safety equipment

The register number is available on request. Available are:

**Temperature regulators (TR)** with a Type 2231, 2232, 2233, 2234 or 2235 Thermostat and a Type 2119 Three-way Valve in sizes DN 15 to DN 150. The max. operating pressure must not exceed the max. permissible differential pressure  $\Delta p$  specified in the technical data section.

Sensor without thermowell: applicable up to 40 bar

Sensor with thermowell: only applicable up to 40 bar when using SAMSON version G1, of bronze and 1.4571, version of copper applicable up to 16 bar

Thermowell for flammable gases typetested by DVGW (German Technical and Scientific Association on Gas and Water), threaded connection G1, PN 100

**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 equipment, see Information Sheet T 2040 EN.

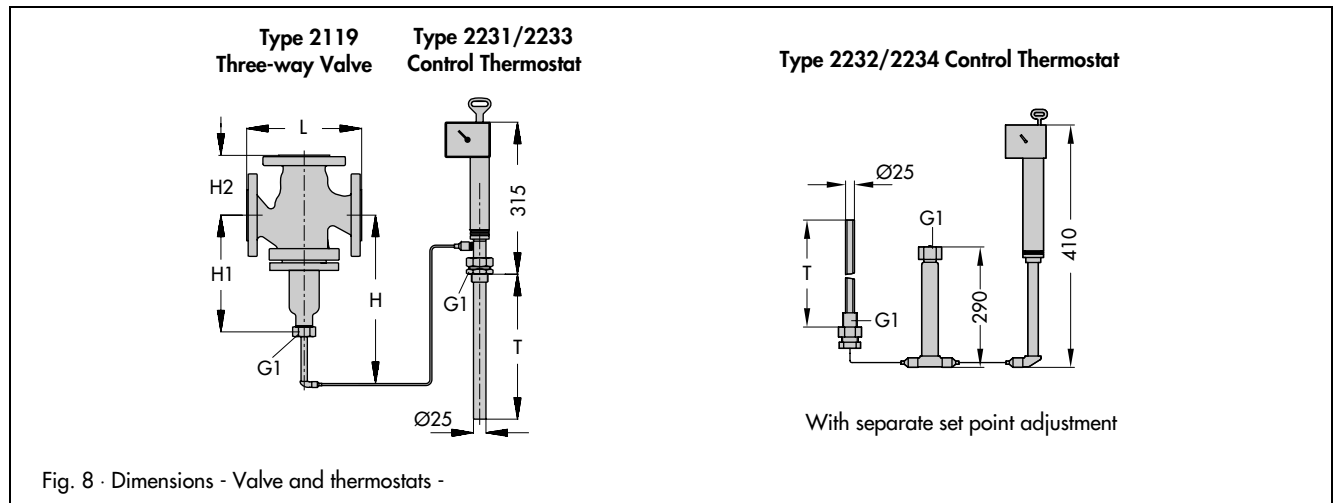
**Safety temperature monitors (STM)** and **safety temperature limiters (STL)** are also available. Refer to Data Sheets T 2043 EN and T 2046 EN.

**Table 3 · Dimensions in mm and weights**

Type 2119 Three-way Valve		DN	15	20	25	32	40	50	65	80	100	125	150
Length L			130	150	160	180	200	230	290	310	350	400	480
H2			70	80	85	100	105	120	130	140	150	200	210
H1	Up to 220 °C (without extension piece)		235			240		245	320		355	395	500
	Up to 350 °C (with extension piece)		375			380		385	460		495	535	640
H	Up to 220 °C (without extension piece)		525			530		535	610		645	685	790
	Up to 350 °C (with extension piece)		665			670		675	750		785	825	930
Weight (body PN 16) <sup>1)</sup>		Approx. kg	6	7	8.5	15	17	19	32	50	71	On request	
<b>Thermostat</b>		Type	<b>2231</b>			<b>2232</b>		<b>2233</b>		<b>2234</b>		<b>2235</b>	
Immersion depth T			290 <sup>2)</sup>			235 <sup>2)</sup>		430		460		3460	
Weight		Approx. kg	3.2			4.0		3.4		3.7		3.6	

<sup>1)</sup> +15 % for PN 25/40

<sup>2)</sup> Larger immersion depths are available on request.



**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 (right) lists the response times 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	- <sup>1)</sup>
	2234	15	- <sup>1)</sup>
	2235	10	- <sup>1)</sup>
Adsorption	2213	70	120
	2212	- <sup>1)</sup>	40

<sup>1)</sup> Not permissible

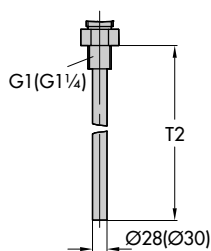
**Ordering text**

- Temperature Regulator Type 9/...
- Nominal size DN ..., nominal pressure PN ...
- Mixing or diverting valve, body material ...
- with Type ... Thermostat
- Set point range ...°C, capillary tube ... m
- Optional: special version ...
- Optional: accessories ...

## Accessories

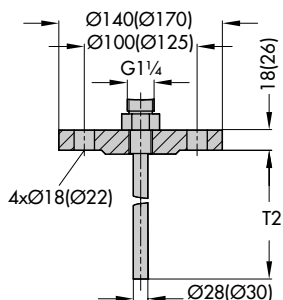
### Thermowells for Types 2231/2232

Thermostat	Type 2231	Type 2232
T2 in mm	325	250



#### Threaded connection

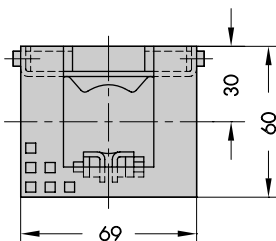
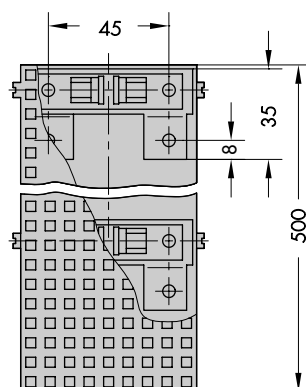
G 1 for PN 40/PN 100  
(version of copper PN 16)  
Dimensions for PN 100  
in parentheses ( )



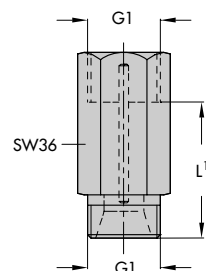
#### Flanges

DN 32 for PN 40  
DN 40 for PN 100  
Dimensions in parentheses ( )

### Clamps and perforated cover for wall mounting



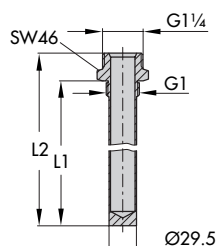
**Distance piece**  
(weight approx. 0.2 kg)  
**Extension piece**  
(weight approx. 0.5 kg)



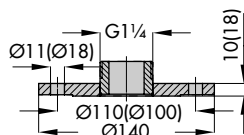
<sup>1)</sup> Distance piece:  
L = 55 mm  
Extension piece:  
L = 140 mm

### Thermowells for flammable gases (G 1/PN 100)

Control Thermostat	Type 2231	Type 2232
Length L1 in mm	315	255
Length L2 in mm	340	280



### Flange for Types 2233 and 2234



Flange PN 6; 140 external Ø

Flange PN 40/DN 32  
Dimensions in parentheses ( )

Fig. 9 · Dimensions - Accessories -

## Accessories

**Thermowells** with threaded or flanged connections for Types 2231 and 2232 Bulb Sensors · G 1 threaded connection, PN 40, made of bronze/steel/CrNiMo steel · Flanged connection DN 32, PN 40, with CrNiMo steel/steel immersion tube · Steel immersion tube with PVC/PPH coating, DN 32, PN 40 · PTFE immersion tube, PN 6 (flange PN 40)

**Thermowells typetested** by DVGW (German Technical and Scientific Association on Gas and Water) for flammable gases, G 1 threaded connection, PN 100

**Mounting parts** for Type 2233 and Type 2232 · 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 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

Specifications subject to change without notice.



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