Technical brochure

Temperature controls, differential temperature controls, Type RT

An RT temperature control is fitted with a single-pole changeover switch.

The position of the contacts depends on the bulb temperature and the set scale value.

The RT series includes temperature controls for general applications within industrial and marine refrigeration.

The RT series also includes differential temperature controls, temperature controls for neutral zone regulation, and special temperature controls with gold-plated contact surface for PLC applications.

Features

- Waterproof versions, enclosure IP 66
- Wide regulating range
- Wide range of units for industrial and marine applications
- Suitable for alternating and direct current
- Interchangeable contact system
- Special versions for PLC applications

Approvals

RT 2	RT 3	RT 4	RT 7	RT 8	RT 8L	RT 9	RT 10	RT 11	RT 12	RT 13	RT 14	RT 14L	RT 15	RT 16L	RT 17	RT 23	RT 24	RT 34	RT 101	RT 102	RT 107	RT 140	RT 140L	RT 270	
																					•				Lloyd's Reg. of Shipping, LR
	•		•	•	•	•	•		•	•	•	•	•						•		•				Germanischer Lloyd, GL
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•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	Russian Maritime Register of Shipping, RMRS
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																					•				Korean Register of Shipping, KRS
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	Conformity with EN 60730-2-1 to 9
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	CE mark according to EN 60947-4, -5
•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	China Compulsory Certificate, CCC

Technical data

Cable connection
Pg 13.5. Cable diameter 6 → 14 mm.

Enclosure
IP 66 to EN 60529 / IEC 60529, except for versions with ext. reset which are to IP 54.

Properties according to EN 60947:
Wire dimensions

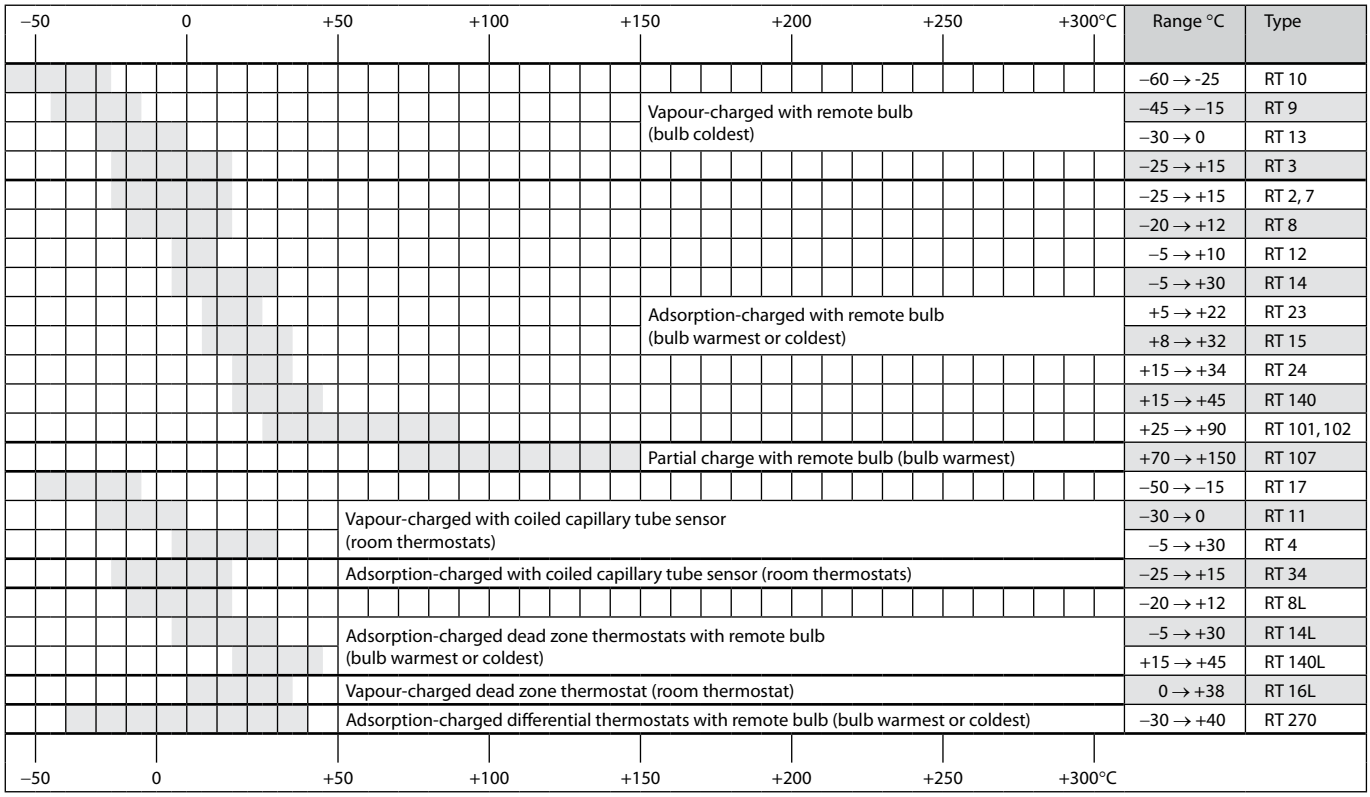
solid/stranded	0.2 - 2.5 mm²
flexible, w/out ferrules	0.2 - 2.5 mm²
flexible, with ferrules	0.2 - 1.5 mm²

Tightening torque	max. 1.5 Nm
Rated impulse voltage	4 kV
Pollution degree	3
Short circuit protection, fuse	10 Amp
Insulation	400 V
IP	54/66

Permissible ambient temperature
−50 → +70°C for thermostat housing.

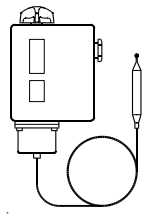
Switches
See "Ordering switches".

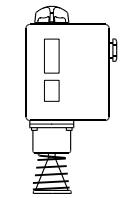
Overview



Range °C	Type
−60 → -25	RT 10
−45 → −15	RT 9
−30 → 0	RT 13
−25 → +15	RT 3
−25 → +15	RT 2, 7
−20 → +12	RT 8
−5 → +10	RT 12
−5 → +30	RT 14
+5 → +22	RT 23
+8 → +32	RT 15
+15 → +34	RT 24
+15 → +45	RT 140
+25 → +90	RT 101, 102
+70 → +150	RT 107
−50 → −15	RT 17
−30 → 0	RT 11
−5 → +30	RT 4
−25 → +15	RT 34
−20 → +12	RT 8L
−5 → +30	RT 14L
+15 → +45	RT 140L
0 → +38	RT 16L
−30 → +40	RT 270

Ordering

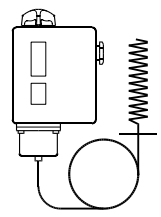




Thermostats

Charge	Type	Bulb type	Regulation range °C	Differential Δ t Lowest temp. setting K	Differential Δ t Highest temp. setting K	Reset	Max. bulb temp. °C	Capillary tube length m	Code no.
Vapour [1]	RT 10	A	−60 → −25	1.7→ 7.0	1.0→ 3.0	aut.	150	2	**017-507766**
	RT 9	A	−45 → −15	2.2→10.0	1.0→ 4.5	aut.	150	2	**017-506666**
	RT 3	A	−25 → +15	2.8→10.0	1.0→ 4.0	aut.	150	2	**017-501466**
	RT 17	B	−50 → −1w	2.2→ 7.0	1.5→ 5.0	aut.	100		**017-511766**
	RT 11	B	−30 → 0	1.5→ 6.0	1.0→ 3.0	aut.	66		**017-508366**
	RT 4	B	−5 → +30	1.5→ 7.0	1.2→ 4.0	aut.	75		**017-5036 66 017-503766**[4]
Adsorption [2]	RT 13	A	−30 → 0	1.5→ 6.0	1.0→ 3.0	aut.	150	2	**017-509766**
	RT 2	A	−25 → +15	5.0→18.0	6.0→20.0	aut.	150	2	**017-500866**
	RT 8	A	−20 → +12	1.5→ 7.0	1.5→ 7.0	aut.	145	2	**017-506366**
	RT 12	A	−5 → +10	1.0→ 3.5	1.0→ 3.0	aut.	65	2	**017-508966**
	RT 23	A	+5 → +22	1.1→ 3.5	1.0→ 3.0	aut.	85	2	**017-527866**
	RT 15	A	+8 → +32	1.6→ 8.0	1.6→ 8.0	aut.	150	2	**017-511566**
	RT 24	A	+15 → +34	1.4→ 4.0	1.4→ 3.5	aut.	105	2	**017-528566**
	RT 140	C	+15 → +45	1.8→ 8.0	2.5→11.0	aut.	240	2	**017-523666**
	RT 102	D	+25 → +90	2.4→10.0	3.5→20.0	aut.	300	2	**017-514766**
	RT 34	B	−25 → +15	2.0→10.0	2.0→12.0	aut.	100		**017-511866**
	RT 7	A	−25 → +15	2.0→10.0	2.5→14.0	aut.	150	2	**017-505366**
	RT 14	A	−5 → +30	2.0→ 8.0	2.0→10.0	aut.	150	2	**017-509966**
	RT 101	A	+25 → +90	2.4→10.0	3.5→20.0	aut.	300	2	**017-500366**
Partial [3]	RT 107	A	+70 → +150	6.0→25.0	1.8→ 8.0	aut.	215	2	**017-513566**

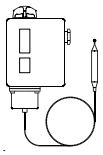
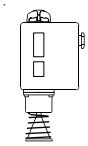
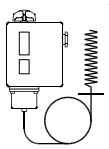
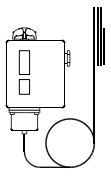
[1] The sensor must be located colder than thermostat housing and capillary tube.
[2] The sensor can be located warmer or colder than thermostat housing.
[3] The sensor must be located warmer than thermostat housing and capillary tube.
[4] With built-in heating coil – reduces the thermal differential.



Thermostats with adjustable dead zone

Charge	Type	Bulb type	Regulation range °C	Differential K	Dead zone NZ Lowest temp. setting K	Dead zone NZ Highest temp. setting K	Max. bulb temp. °C	Capillary tube length m	Code no.
Vapour	RT 16L	B	0 → +38	1.5 / 0.7	1.5 → 5.0	0.7 → 1.9	100		**017L002466**
Adsorption	RT 8L	A	−20 → +12	1.5	1.5 → 4.4	1.5 → 4.9	145	2	**017L003066**
	RT 14L	A	−5 → +30	1.5	1.5 → 5.0	1.5 → 5.0	150	2	**017L003466**
	RT 140L	C	+15 → +45	1.8 / 2.0	1.8 → 4.5	2.0 → 5.0	240	2	**017L003166**
	RT 101L	A	+25 → +90	2.5 / 3.5	2.5 → 7.0	3.5 → 12.5	300	2	**017L006266**

Type of bulb / sensor

A	B	C	D
			
Cylindrical remote sensor	*Room sensor*	*Duct sensor*	*Capillary tube sensor*

Special versions
RT can be supplied with special switches.
See next page.

When ordering, please state
1. Type
2. Code no. of standard unit
3. Code no. of special switch

Ordering
(continued)

Switches

Version	Symbol	Description	Contact rating	Reset	Code no.
Standard	 SPDT	Single-pole changeover switch with terminal board proof against leakage current. **Fitted in all standard versions of type RT.** Snap action changeover contacts.	Alternating current *Ohmic:* AC1 = 10 A, 400 V *Inductive:* AC3 = 4 A, 400 V AC15 = 3 A, 400 V *Dir. current:* DC13 = 12 W, 220 V	Aut.	**017-403066**
Man. reset	 SPDT	For manual reset of unit after contact changeover on rising temperature. **For units with reset facility.**		Max.	**017-404266**
Man. reset	 SPDT	For manual reset of unit after contact changeover on falling temperature. **For units with reset facility.**		Min.	**017-404166**
Dead zone	 SPDT	Single-pole changeover switch with dead zone and terminal board proof against leakage current.			Available only as a component part of RT controls with adjustable dead zone
Standard	 SPDT	Single-pole changeover switch with gold plated (oxide-free) contact surfaces. Increases cut-in reliability on alarm and monitoring systems, etc. Snap action changeover contacts. Terminal board proof against leakage current.	Alternating current *Ohmic:* AC1 = 10 A, 400 V *Inductive:* AC3 = 2 A, 400 V AC15 = 1 A, 400 V *Dir. current:* DC13 = 12 W, 220 V	Aut.	**017-424066**
Man. reset	 SPDT	Single-pole changeover switch with gold plated (oxide-free) contact surfaces. Increases cut-in reliability on alarm and monitoring systems, etc. Snap action changeover contacts. Terminal board proof against leakage current.		Max.	**017-404866**
Dead zone	 SPDT	Single-pole changeover switch with dead zone and gold plated (oxide-free) contact surfaces. Increase cut-in reliability on alarm and monitoring systems, etc. Snap action changeover contacts. Terminal board proof against leakage current.			Available only as a component part of RT controls with adjustable dead zone
Man. reset	 SPDT	Single-pole changeover switch with gold plated (oxide-free) contact surfaces. Increases cut-in reliability on alarm and monitoring systems, etc. Snap action changeover contacts. Terminal board proof against leakage current.		Min.	**017-404766**
Cuts in two circuits simultaneously	 SPST	Single-pole changeover switch that cuts in two circuits simultaneously on rising temperature. Snap action changeover contacts. Terminal board proof against leakage current.	Alternating current *Ohmic:* AC1 = 10 A, 400 V *Inductive:* AC3 = 3 A, 400 V AC15 = 2 A, 400 V *Dir. current*: DC13 = 12 W, 220 V [1]	Max.	**017-403466**
Cuts out two circuits simultaneously	 SPST	Single-pole changeover switch that cuts out two circuits simultaneously on rising temperature. Snap action changeover contacts. Terminal board proof against leakage current.		Min.	**017-403666**
With non-snap action change-over contacts	 SPDT	Single-pole changeover switch with non-snap action changeover contacts.	*Alternating or direct current* 25 VA, 24 V		**017-018166**

[1] If current is led through contacts 2 and 4, i.e. terminals 2 and 4 connected but not 1, max. permissible load is increased to 90 W, 220 V.

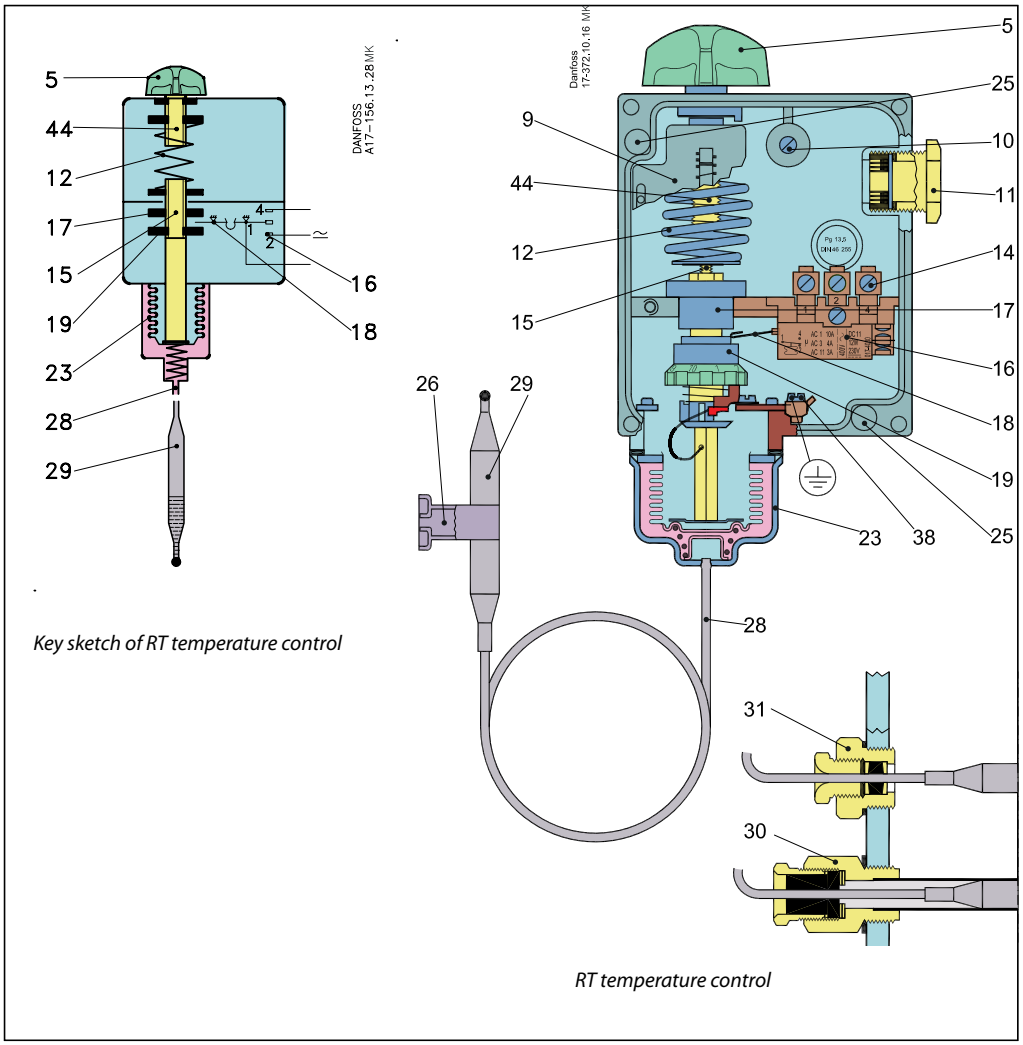
The switches are shown in the position they assume on falling temperature, i.e. after downward movement of the RT main spindle. The setting pointer of the control shows the scale value at which contact changeover occurs on falling temperature.

An exception is RT with switch, code no. **017-404266,** with max. reset where the setting pointer shows the scale value at which contact changeover occurs on rising temperature.

Spare parts and accessories,
see spare parts catalogue RX.5E.A2.02.

Design
Function

Temperature control type RT



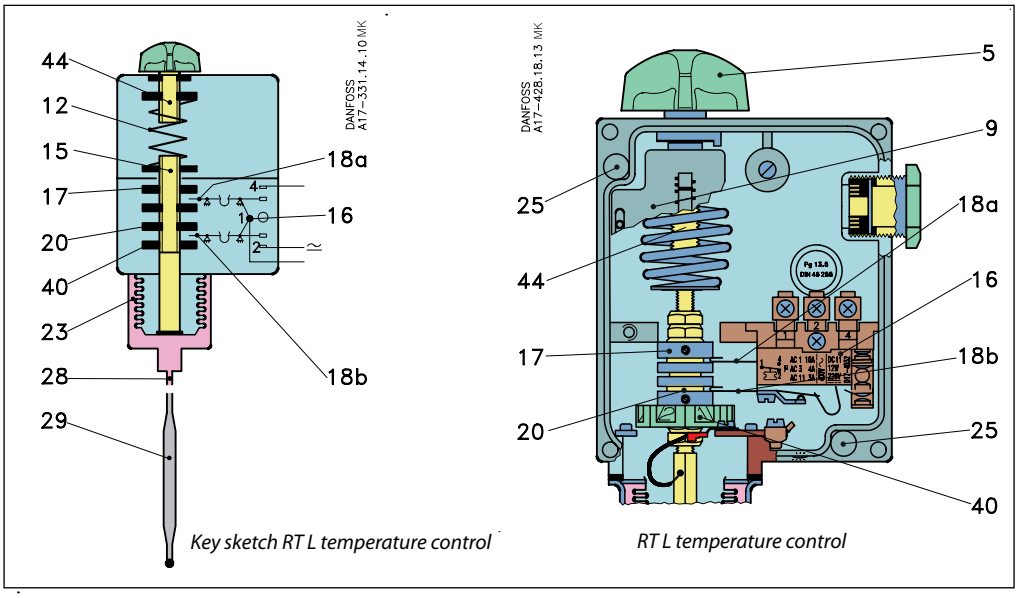
5. Setting knob
9. Regulation range scale
10. Loop terminal
11. Pg 13.5 screwed cable entry
12. Main spring
14. Terminals
15. Main spindle
16. Switch
17. Upper guide bush
18. Contact arm
19. Differential temperature setting nut
23. Bellows element
25. Fixing hole
26. Sensor (bulb) clip
28. Capillary tube
29. Sensor (bulb)
30. Sensor (bulb) pocket
31. Capillary tube gland
38. Earth terminal
44. Temperature setting spindle

The thermostatic element consists of a sensor (29) capillary tube (28) and bellows element (23). The element contains a charge that reacts to temperature variations at the sensor so that the pressure on the moving bellows rises when temperature rises.
By turning the setting knob (5) the main spring (12) can be set to balance the pressure in the element.

A rise in temperature at the sensor compresses the bellows and moves the main spindle (15) upwards until spring force and element pressure are in equilibrium.
The main spindle (15) is fitted with a guide bush (17) and a differential setting nut (19) that together transfer the main spindle movement to the switch (16).

Design
Function
(continued)

Thermostats with neutral zone, type RT L

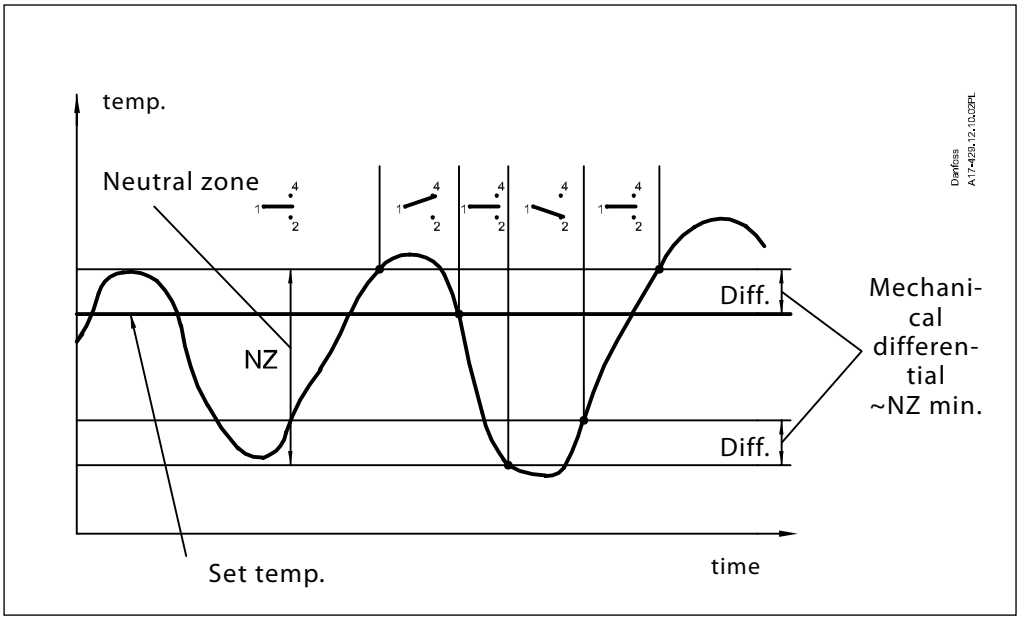


Key sketch RT L temperature control

RT L temperature control

5. Setting knob
9. Regulation range scale
12. Main spring
15. Main spindle
16. Switch
17. Upper guide bush
18a and 18b. Contact arm
20. Lower guide bush
23. Bellows element
25. Fixing hole
28. Capillary tube
29. Sensor (bulb)
40. Neutral zone setting nut
44. Temperature setting spindle

RT L temperature controls are fitted with a switch (17-4032) with an adjustable neutral zone. This enables the units to be used for floating control. The neutral zone switch contact arms (18a) and (18b) are operated by the spindle guide bushes (17) and (20). The upper guide bush (17) is fixed while the lower guide bush (20) can be moved up or down by the setting nut (40). In this way the neutral zone can be varied between a minimum value (equal to the mechanical differential of the unit) and a maximum value (depending on the type of RT unit).



Terminology

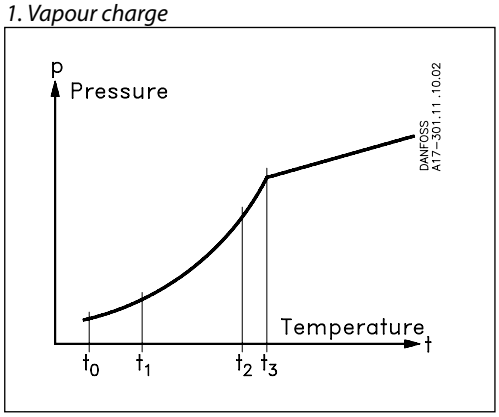
Floating control
A form of delayed control where the correcting element (e.g. valve, damper, or similar) moves towards one extreme position at a rate independent of the magnitude of the error when the error exceeds a definite positive value, and towards the opposite extreme position when the error exceeds a definite negative value.

Hunting
Periodic variations of the controlled variable from the fixed reference.

Neutral zone
The interval between the make points of the two contacts.

Charges

1. Vapour charge

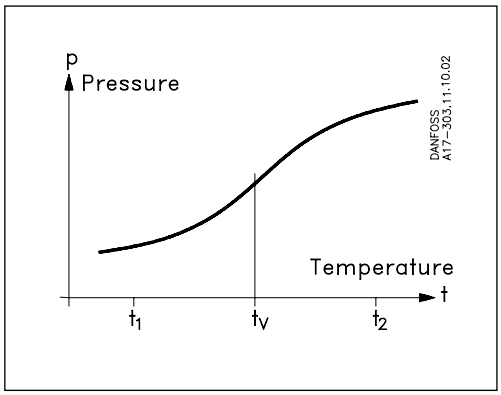


Here the interdependence between the pressure and temperature of saturated vapour is utilized, i.e. the element is charged with saturated vapour plus a small amount of liquid.
The charge is pressure-limited; a further increase in pressure after evaporation of all the liquid in the bulb, will only result in a small pressure increase in the element.

This principle can be utilized in thermostats for low temperature, etc., where evaporation must be able to take place from the free liquid surface in the bulb (within the operation range of the thermostat), and where at the same time, the bellows must be protected against deformation when kept at normal ambient temperatures.
Since the pressure in the element depends on the temperature at the free liquid surface, the thermostat must always be placed so that the bulb is colder than the rest of the thermostatic element.
The evaporated liquid will recondense at the coldest point, i.e. the bulb. Thus, as intended, the bulb becomes the temperature-controlling element in the system.

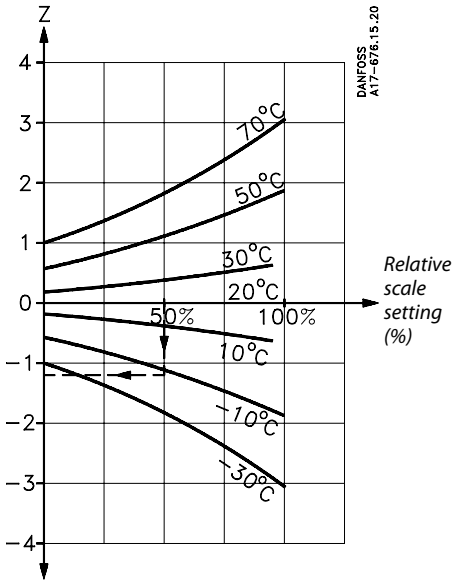
Note:
When the bulb is coldest, the ambient temperature has no effect on regulating accuracy.

2. Adsorption charge



In this case the charge consists partly of a superheated gas and partly of a solid having a large adsorption surface.
The solid is concentrated in the bulb and it is therefore always the bulb that is the temperature-controlling part of the thermostatic element.
The bulb can thus be placed warmer or colder than the rest of the thermostatic element.
Such a charge is however to some extent sensitive to changes in the temperature of the bellows element and capillary tube.
Under normal conditions this is not important, but if the thermostat is used in extreme conditions, scale deviation will occur.
The scale can be corrected by using the graph and the table.
Scale correction = Z × a.
Z can be found in the graph and "a" in the table.

Scale deviation factor



Curves for different ambient temperatures.
0% ~ lowest scale setting temperature,
100% ~ highest scale setting temperature.

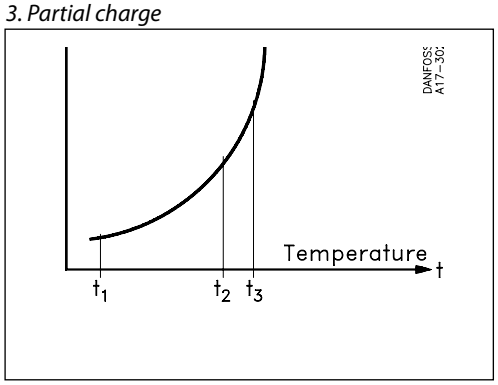
Type	Regulating range °C	Correction factor a
RT 2	−25 → +15°C	2.3
RT 7	−25 → +15°C	2.9
RT 8, RT 8L	−20 → +12°C	1.7
RT 12	−5 → +10°C	1.2
RT 14, RT 14L	−5 → +30°C	2.4
RT 15	+8 → +32°C	1.2
RT 23	+5 → +22°C	0.6
RT 24	+15 → +34°C	0.8
RT 101, RT 102	+25 → +90°C	5.0
RT 140, RT 140L	+15 → +45°C	3.1

Charges
(continued)

Example
Scale correction on an RT 14 (range –5 to +30°C) at activating temperature +12°C and ambient temperature –10°C.
The scale temperature, +12°C, lies approximately in the middle of the scale range, i.e. relative scale setting of 50%.
The factor Z can be found in the graph from 50% and the curve for –10°C, i.e. approx. –1.2.

The correction factor "a" can be found in the table for an RT 14, i.e. 2.4.
The scale correction = Z × a = –1.2 × 2.4 = –2.88.
If activation at +12°C for the same conditions is required, the thermostat must be set at +12 × 2.88 = 9.12 ≈ 9.1.

3. Partial charge



Partial charge is used in RT units having a range lying higher than ambient temperature.
As with the vapour charge, the partial charge utilizes the interdependence between the pressure and temperature of saturated vapour. The partial charge is of such a volume that the bellows housing, capillary tube and a small part of the bulb are filled when the thermostat is in operation. The bulb is thus the warmest part of the system.
The liquid will condense in the remaining, coldest, part of the system but because of the volume of the charge the free liquid surface will always be in the bulb. In this way, the bulb becomes the temperature-controlling part of the system.

Note:
When the bulb is placed warmest, the ambient temperature has no effect on regulating accuracy.

Terminology

Regulation range
The temperature differential between LT and HT sensors within which the unit can be set to operate. Indicated on the thermostat scale.

Scale indication
The difference between the temperature on LT and HT sensors at the moment when the switch contacts change over as a result of the downward movement of the spindle.

Operating range
The temperature range of the LT sensor, within which the differential thermostat can operate.

Contact differential
The temperature rise on the HT sensor over the set temperature differential which causes the switch contacts to make or break.

Reference sensor
The sensor that is placed in the medium whose temperature is not affected by the function of the thermostat (HT- or LT sensor).

Control sensor
The sensor that is placed in the medium whose temperature must be controlled (LT- or HT sensor).

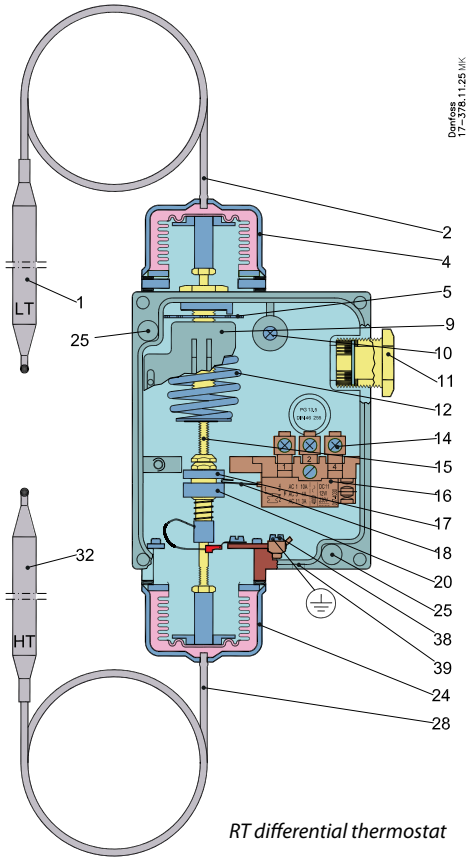
Setting of differential

The knob can be used to make a setting on the range scale for the lowest temperature at which the contact system must be activated (cut-out or cut-in).

The differential roller 19 must then be used to set the differential. The highest activating temperature at the sensor is equal to the activating temperature + the set differential.

Design
Function

RT differential thermostat



RT differential thermostat

1. LT sensor (bulb)
2. Capillary tube
4. LT bellows element
5. Setting disc
9. Regulation range scale
10. Loop terminal
11. Pg 13.5 screwed cable entry
12. Main spring
14. Terminals
15. Main spindle
16. Switch
17. Upper guide bush
18. Contact arm
20. Lower guide bush
24. HT bellows element
25. Fixing hole
28. Capillary tube
32. HT sensor (bulb)
38. Earth terminal
39. Blow-out disc

An RT differential temperature control contains a single-pole changeover switch that makes or breaks depending on the temperature difference between the two sensors of the unit.
The RT 270 is for use in process plant, ventilation plant, and refrigeration and heating plant where there is need to maintain a certain temperature differential, 0 - 15°C, between two media. One sensor is used as a reference and the other as a control sensor. The temperature differential is the direct controlled variable.

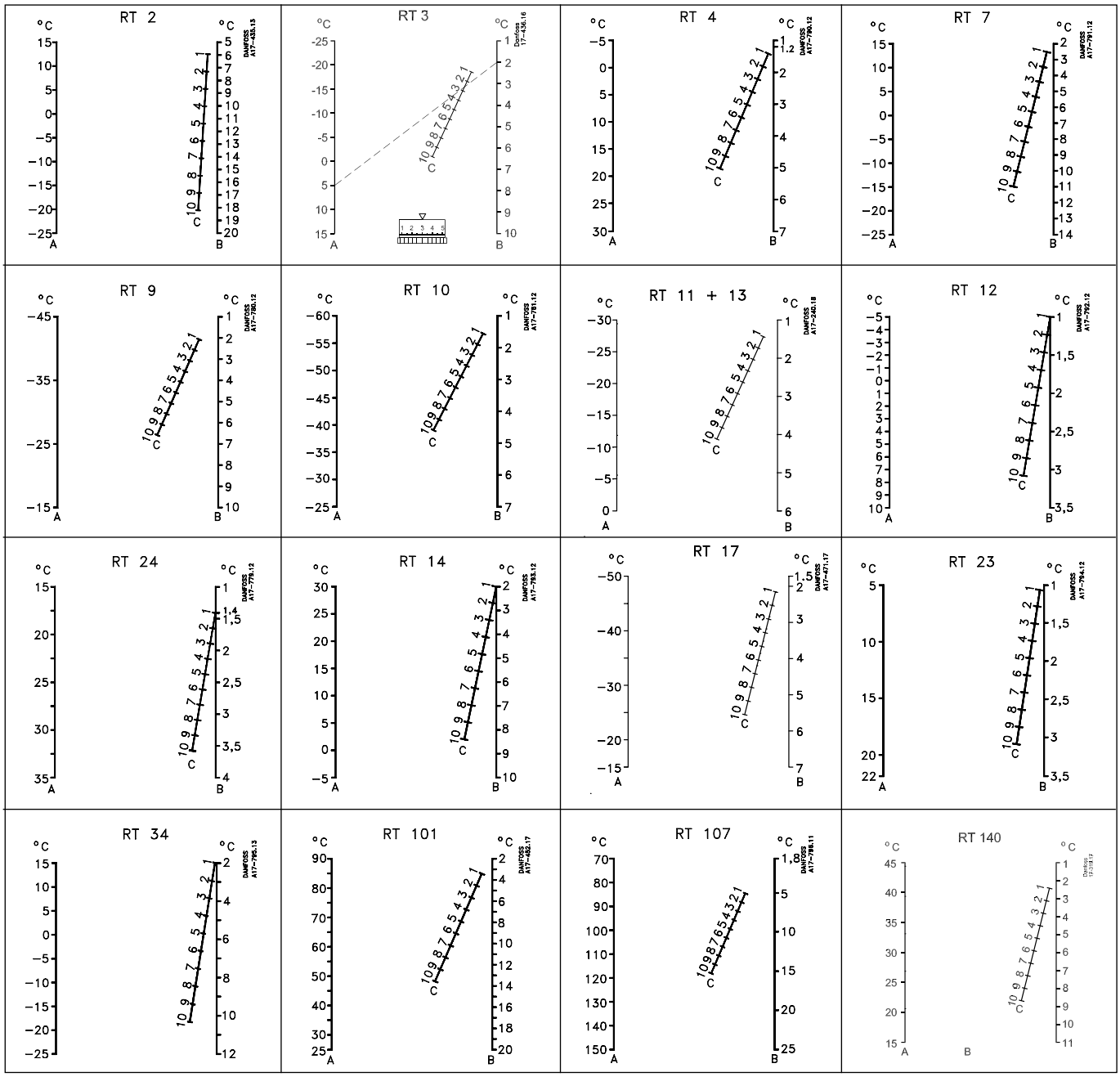
The figure shows a cross-section of the RT 270.

The differential temperature control contains two bellows elements: the LT element whose sensor must be placed in the medium having the lowest wwtemperature, and the HT element whose sensor must be placed in the medium having the highest temperature.
The main spring has a rectilinear characteristic. Within the operating range the RT 270 can be set for different temperature differentials by the setting disc (5).
When the differential between LT and HT sensor temperature falls, the main spindle (15) moves downwards.
The contact arm (18) is moved downwards by the guide (17) so that contacts (1-4) break and contacts (1-2) make when the set temperature differential is reached.
The contacts changeover again when the temperature differential rises to the set value plus the fixed contact differential of approx. 2°C.

Example
Set differential = 4°C.
Switch breaks at 4°C differential and remakes at 4 + 2 = 6°C.

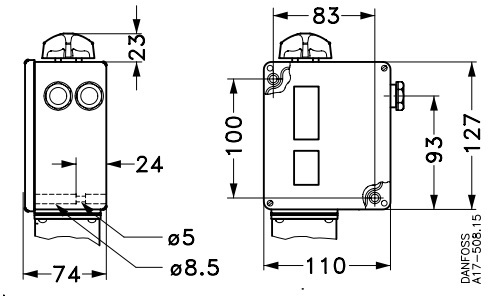
Nomograms for obtained differentials

A = Range setting
B = Obtained differential
C = Differential setting

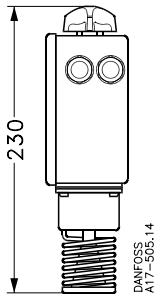


Dimensions and weight

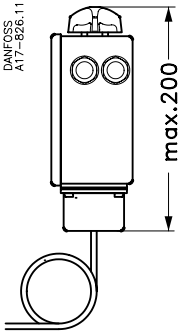
Weight approx. 1 kg



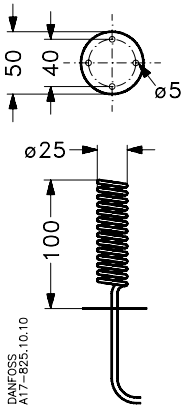
RT thermostat housing



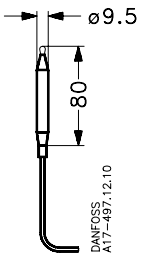
RT 4, 11, 16L, 17, 34



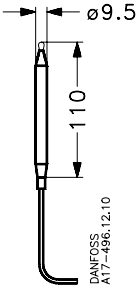
RT thermostat housing



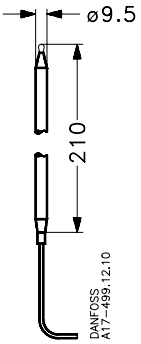
RT 140, 140L



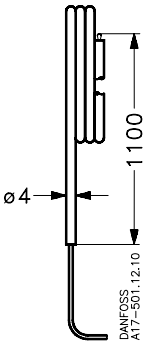
RT 2, 3, 7, 9, 10, 13, 101



RT 8, 8L, 14, 14L, 15, 107, 270



RT 12, 23, 24



RT 102