Data sheet

EN 215-1
HD 1215-2

Radiator Thermostats type RA 2000
Valve bodies type RA-FN and RA-G

Application

RA 2910 built-in sensor

RA 2920 tamperproof sensor

RA 5062 remote temperature adjuster

RA-FN straight valve body

RA-FN vertical angle valve body

RA-FN horizontal angle valve body

RA-G straight valve body

RA-G vertical angle valve body

Robustly built and designed to meet the rigours of the commercial and industrial sectors, a comprehensive range of RA2000 radiator thermostats is available for practically all systems and installation conditions. Sensors and valve bodies are packed separately so that they can be mixed and matched for any duty.

Valve bodies are of nickel-plated brass. The different types are shown below:

RA-FN For steel pipe. Straight, Vertical angled from 3/8" to 1" BSP and horizontal angled from 3/8" to ¾" BSP.
RA-G Straight and Vertical Angled for one-pipe pumped or gravity systems, ½", ¾" and 1" BSP.
RA-N Valves with integral presetting facility. See separate Data Sheet.

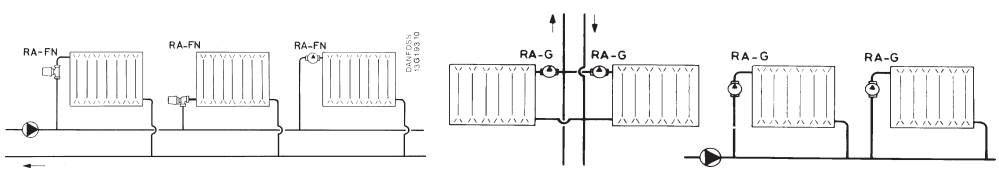
In all valves, the pressure pin of the gland seal is made of chromium steel and this works in a lifetime-lubricated O Ring seal. The complete gland assembly can be replaced without draining down the system.

The protective cap supplied with each new valve may be used for manual control during installation only. It should not be used as isolation device. A manual shut off device is available as a spare part.

Sensors are available as both standard and tamperproof, built-in and remote sensing models, as well as remote adjusting. All have range limiting and locking. They are for use with Danfoss valve bodies types RA-FN and RA-G.
RA 2000 sensors are not suitable for use with RA-FR valves.

RA2000 Features
- **Robust Construction**
- **Accurate Temperature Control**
- **Full Range**
- **Range Limiting and Locking**
- **Tamper Resistant Models**
- **Remote Sensors**
- **Remote Wall Adjuster**
- **Low Temperature Models**
- **Presetting Valves**

System



Approved to EN 215

All Danfoss RA2000 radiator thermostats are manufactured to highest standards, and are approved to the European standard EN 215 and dimension standard HD 1215-2, which supersedes BS 6284.

Selection and specification

Should water treatment be used it is essential that dosing instructions of the manufacturer are strictly observed. It is recommended that formulations containing mineral oil are avoided.

RA2000 thermostatic sensors (4) supplied in separate boxes

Type	Code no.	Sensor (Max. sensor temperature 60°C)	Temp. range Xp = 2K
RA 2910	**013G2910**	Built-in	5 - 26 °C (1)
RA 2920	**013G2920**	Built-in, tamper proof	5 - 26 °C (1)
RA 2914	**013G2914**	Built-in, low temperature range model	5 - 22 °C (1)
RA 2912	**013G2912**	Remote sensor, 0 - 2 m capillary tube (2)	5 - 26 °C
RA 2922	**013G2922**	Remote sensor, 0 - 2 m capillary tube, tamper proof (2)	5 - 26 °C
RA 2916	**013G2916**	Remote sensor, 0 - 2 m capillary tube (2)	5 - 22 °C
RA 5062	**013G5062**	Remote temperature adjuster, 0 - 2 m capillary tube (3)	8 - 28 °C
RA 5065	**013G5065**	Remote temperature adjuster, 0 - 5 m capillary tube (3)	8 - 28 °C
RA 5068	**013G5068**	Remote temperature adjuster, 0 - 8 m capillary tube (3)	8 - 28 °C

(1) Temperatures shown are for units with built-in sensors which are subject to influence from radiation and flow temperature. Without these influences, max. temperature is 2 °C higher at design load condition.

(2) Remote sensors are supplied with all the capillary tube coiled within the sensor. When installing the sensor, only the length required should be uncoiled.

(3) Remote temperature adjusters are supplied with adapters for RA-valves. Adaptors for older valves can be ordered separately:
RAVL-adaptor, code no. 013G5192
RAV-adaptor, code no. 013G5193

(4) **Important note:** Do not use any RA2000 sensors with RA-FR bi-directional valve bodies.

Valve bodies for two-pipe systems type RA-FN

Pattern	Type	Code no.	Connections		kv-value (m^3/h at 1 bar pressure drop) P-band = K					Max. pressure			Max. working temp.
			Inlet	Outlet	0.5K	1.0K	1.5K	2.0K	Kvs(2)	Working (bar)	Diff. (bar)	Test (bar)	°C
Straight	RA-FN 10	**013G0022**	3/8" BSP	3/8" BSP	0.17	0.34	0.47	0.56	0.65	10	0.6	16	120
	RA-FN 15	**013G0024**	1/2" BSP	1/2" BSP	0.22	0.43	0.57	0.73	0.90	10	0.6	16	120
	RA-FN 15	**013G0084** (1)	1/2" BSP(15mm)	1/2" BSP	0.22	0.43	0.57	0.73	0.90	10	0.6	16	120
	RA-FN 20	**013G0026**	3/4" BSP	3/4" BSP	0.30	0.58	0.83	1.04	1.40	10	0.6	16	120
	RA-FN 25	**013G0028**	1" BSP	1" BSP	0.30	0.58	0.83	1.04	1.40	10	0.6	16	120
Horizontal Angle	RA-FN 10 UK	**013G0141**	3/8" BSP	3/8" BSP	0.17	0.34	0.47	0.56	0.65	10	0.6	16	120
	RA-FN 15 UK	**013G0149** (1)	1/2" BSP(15mm)	1/2" BSP	0.26	0.49	0.66	0.76	0.86	10	0.6	16	120
	RA-FN 20 UK	**013G0145**	3/4" BSP	3/4" BSP	0.25	0.50	0.67	0.80	1.00	10	0.6	16	120
Vertical Angle (3)	RA-FN 15	**013G0023**	1/2" BSP	1/2" BSP	0.22	0.43	0.57	0.73	0.90	10	0.6	16	120
	RA-FN 15	**013G0023AA** (1)	1/2" BSP(15mm)	1/2" BSP	0.22	0.43	0.57	0.73	0.90	10	0.6	16	120
	RA-FN 20	**013G0025**	3/4" BSP	3/4" BSP	0.30	0.58	0.83	1.04	1.40	10	0.6	16	120
	RA-FN 25	**013G0027**	1" BSP	1" BSP	0.30	0.58	0.83	1.04	1.40	10	0.6	16	120

(1) These valve bodies are supplied with compression fittings for copper tube to BS 864. When these connections are removed, a standard BSP screwed inlet BS 21 remains.
(2) Kvs-maximum indicates the water flow (Q) with valve fully open.
(3) Remote sensors are recommended.

Working pressure = static + differential pressures. The maximum differential pressure specified is the maximum pressure at which the valves give satisfactory control. As with any device which imposes a pressure drop in the system, noise may occur under certain flow/pressure conditions. To ensure quiet operation, maximum pressure drop should not exceed 40 to 45 kPa. The differential pressure can be reduced by the use of Danfoss differential pressure controls.

Valve bodies for one-pipe pumped or gravity systems, type RA-G

Pattern	Type	Code no.	Connections		kv-value (m^3/h at 1 bar pressure drop) P-band = K					Max. pressure			Max. working temp.
			Inlet	Outlet	0.5K	1.0K	1.5K	2.0K	Kvs(2)	Working (bar)	Diff. (bar)	Test (bar)	°C
Straight	RA-G 15	**013G3384**	1/2" BSP	1/2" BSP	0.48	0.92	1.29	1.42	2.06	10	0.2	16	120
	RA-G 20	**013G3386**	3/4" BSP	3/4" BSP	0.60	1.14	1.75	2.06	3.16	10	0.2	16	120
	RA-G 25	**013G3388**	1" BSP	1" BSP	0.71	1.42	2.04	2.69	4.75	10	0.16	16	120
Vertical Angle(1)	RA-G 15	**013G3383**	1/2" BSP	1/2" BSP	0.48	0.92	1.29	1.42	2.06	10	0.2	16	120
	RA-G 20	**013G3385**	3/4" BSP	3/4" BSP	0.60	1.14	1.75	2.06	3.16	10	0.2	16	120
	RA-G 25	**013G3387**	1" BSP	1" BSP	0.71	1.42	2.04	2.69	4.75	10	0.16	16	120

1) Remote sensors are recommended
2) Kvs-maximum indicates the water flow (Q) with valve fully open

When using RA2000 remote temperature adjusters the kv-values stated in the table above must be reduced by approximately 40% to take into account the different characteristics of these sensors.

Accessories

Accessories for RA 2000 sensors		**Code no.**
Anti.theft plugs for sensors	(50 pcs)	**013G1232**
Threaded range limiting pins	(30 pcs)	**013G1237**
RA 2020/2022 scale cover	(20 pcs)	**013G1233**
Toolkit, comprising allen key & locking pin tool		**013G1236**
Accessories for RA-FN and RA-G valves		**Code no.**
Gland seal for RA-FN and RA-G valves (Can be replaced without draining down)		**013G0290**
Manual positive shut-off knob		**013G5002**
Spare protective green cap		**013G0275**
Compression fittings for RA-FN valves		**Code no.**
3/8" x 10 mm	for RA-FN 10	**013G4100**
3/8" x 12 mm	for RA-FN 10	**013G4102**
½" x 10 mm	for RA-FN 15	**013G4110**
½" x 12 mm	for RA-FN 15	**013G4112**
½" x 15 mm	for RA-FN 15	**013G4115**

To support the range of RA2000 radiator thermostats, a wide selection of spare parts and accessories for both sensors and valve bodies is available. The table above lists the more popular parts including fittings.

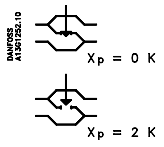
Replacement Gland Seals
All Danfoss radiator thermostats manufactured since the early 1960's have gland seals which are replaceable without the need to drain down the system.

Replacement Sensors for earlier Danfoss Thermostats
In order to provide a service and upgrade option for earlier RAV and RAVL valve bodies, a range of service sensors is available.
Please request details.

Setting the temperature

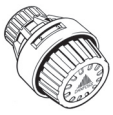
The required room temperature is set by rotating the sensor handle to match the scale number with the setting register. The correlation between scale numbers and room temperatures (at Xp=2K) is shown on the right.
The values shown are for guidance only.

RA 2914 RA 2916

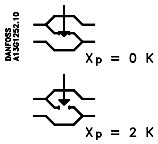


7 9,5 14 17 20 °C
I ✶ 1 2 3 •
5 7,5 12 15 18 °C

✶ = Frost protection setting



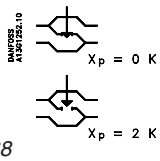
RA 2920, RA 2922
RA 2910, RA 2912



7 9,5 14 17 20 23 26 28°C
I ✶ 1 2 • • 3 • • 4 5 I
5 7,5 13 15 18 21 24 26°C

✶ = Frost protection setting

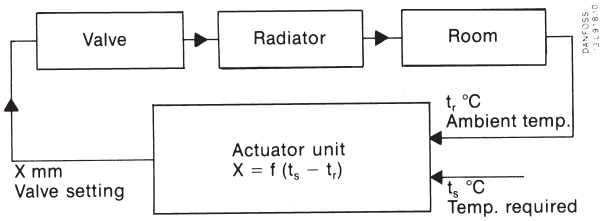
RA 5062, RA 5065, RA 5068



10 14 18 22 26 30°C
✶ 1 2 • • • 3 • • • 4 5
8 12 16 20 24 28°C

✶ = Frost protection setting

Setting the temperature



1

Radiator thermostats are sophisticated proportional control.

1) The operating principles of thermostats
The function of the actuator unit is to sense the ambient temperature, compare it with the required temperature, and correct the valve setting in accordance with the difference, as illustrated in fig. 1.

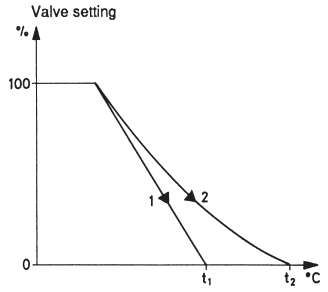
European Standard EN215 requires that radiator thermostats meet various operating criteria. Danfoss radiator thermostats meet or exceed these requirements in every respect. A brief description of the key considerations is given below.

2) Differential pressure dependence.
The closing characteristic of a radiator thermostat depends on the pressure conditions in the valve. In fig. 2, curve 1 applies to the actuator unit without counterpressure from system differential pressure, while curve 2 shows the offset when the counterpressure increases proportionately to the valve closure. The effect is a result of the elasticity of the actuator unit which should, therefore, not be too large.

3) Time constant
To give reasonably fast and stable control, a radiator thermostat must not be too slow in its reaction to temperature variations. The time constant (fig. 3) depends on the specific heat and surface of the sensor.
At a sudden change of the ambient temperature at time 0, the thermostat will react as shown, relative to time. The time constant is defined as the time used by the spindle for 63% of its full movement.

4) Flow temperature dependence
Flow temperature dependence occurs largely in the case of actuator units with built-in sensors since heat transmission takes place from the valve body to the sensor of the unit (Fig. 4), with the possible effect, under full load conditions, of controlling the room temperature at a lower temperature than required. Insulating plastic materials for thermostat base, internal heat shields and good product design in positioning the sensing element away from the heat source, help reduce this dependence. Danfoss recommend that radiator thermostat sensors are mounted horizontally, away from the effects of heat rising from hot valve and pipework.

5) Hysteresis
If the spindle movement of an actuator unit is measured at, first, increasing and then decreasing temperatures, there will be a difference between the point where the valve just closes and the point where it opens again – see fig. 5. This difference is termed hysteresis and is caused by friction in the actuator unit and valve body. It is desirable that hysteresis should be as small as possible.



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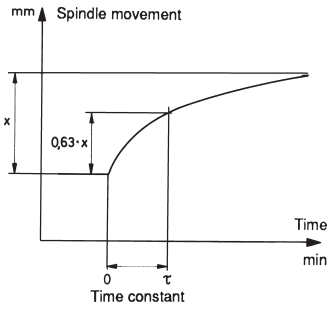

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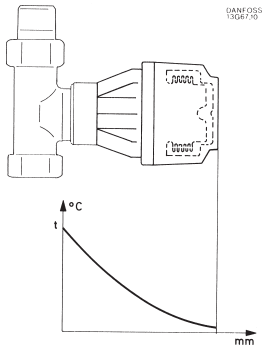

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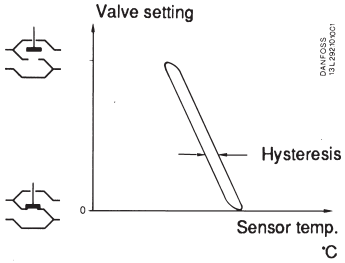
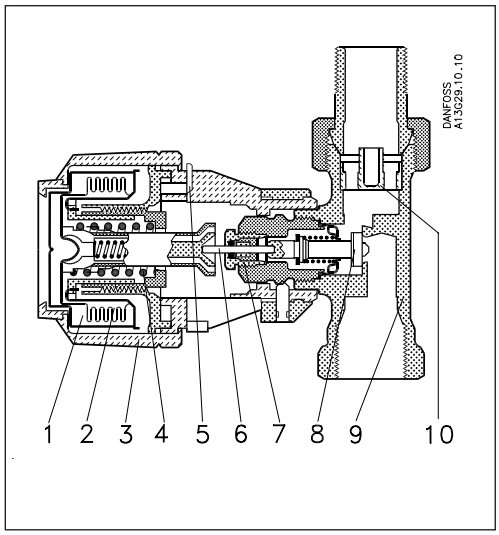


5

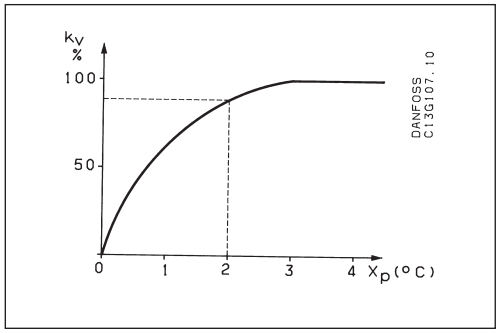
Sensor operating principle



1. Thermostatic element
2. Bellows
3. Setting dial
4. Setting spring
5. Limit pin
6. Pressure pin
7. O-ring seal
8. Valve cone
9. Valve body
10. Nozzle

The RA2000 thermostatic sensor consisting of a bellows system and saturated vapour charge provides proportional control, as opposed to On/Off. The sensor is actuated by ambient temperature changes. The calibrated pressure in the bellows corresponds to the temperature of the charge. This pressure is balanced by the force of a regulating spring.
On a rise in ambient temperature, the vapour pressure increases in the bellows, moving the valve cone towards the “closed” position, until equilibrium exists between the bellows and spring. On a drop in ambient temperature, the vapour pressure falls, allowing the bellows to contract and the valve cone to move towards the “open” position until a state of equilibrium is re-established.
The vapour charge will always condense at the coldest part of the sensor, usually that furthest away from the valve body. The radiator thermostat will therefore always respond to changes in room temperature and will not be affected by the water temperature itself. However, when the air around the sensor is heated by the hot valve body and pipework, then the sensor can register a higher temperature than that of the rest of the room. For this reason, Danfoss recommend that the sensor is mounted horizontally whenever possible.

Hydraulic balance



To ensure that the valve capacity of a fully opened valve is not significantly greater than that at 2 degrees C P-deviation, all RA-FN valves have a modified valve characteristic. This improved valve characteristic maintains hydraulic balance during start-up.

Definitions

kv-Coefficiant of flow
The kv-value of a valve shows the quantity of liquid, in m3/h, that the valve will pass with a pressure drop of 1 bar across the valve. This value is used in the following formulae to calculate flow rates for valve sizing purposes.

$$Q = Kv\sqrt{\Delta p} \quad \text{or} \quad \Delta p = \left[\frac{Q}{Kv}\right]^2 \quad \text{or} \quad Kv = \frac{Q}{\sqrt{\Delta p}}$$

Where: **Q** = Flow of water in **m³/h**

Kv = Flow co-efficient

Δp = Differential pressure (pressure drop), measured in **bar**, across the valve

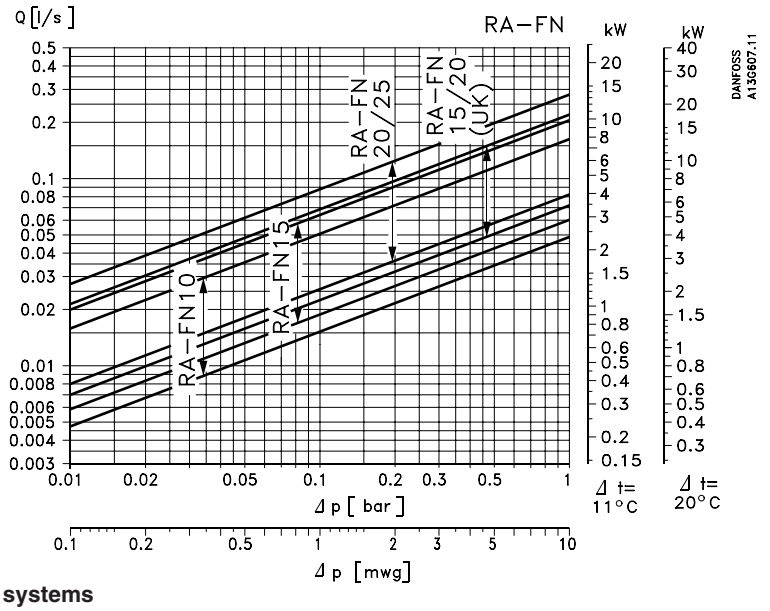
Note: Cv is the Imperial version of Kv, with flow rates measured in UK gallons/min. and pressure drops in lbf/in². Cv = 0.97 Kv.

Proportional band
Proportional temperature controls try to maintain equilibrium between heat loss and heat input. They react proportionately to any deviation from a set temperature level, until heat input is either completely shut off or is at its maximum. The temperature levels at which this occurs are presettable, and the band between the two levels, measured in K (degrees C) is the proportional band.

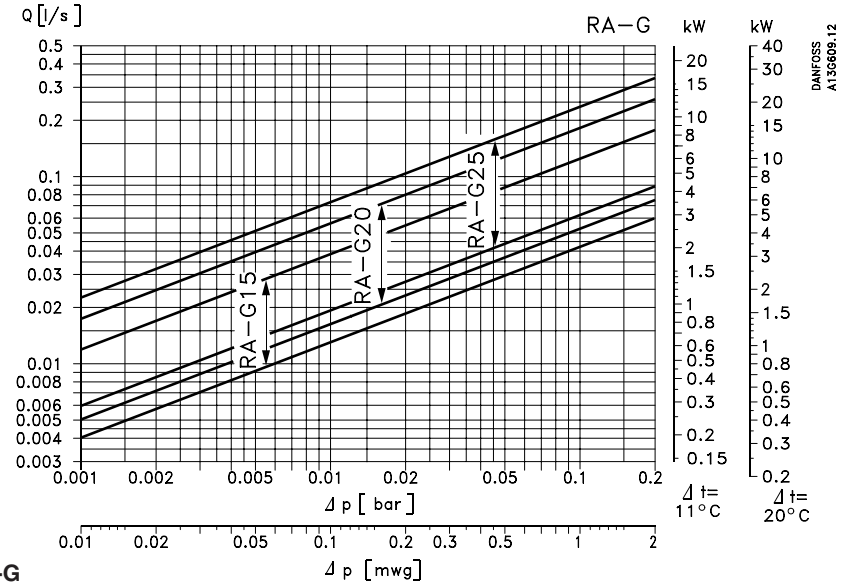
Danfoss radiator thermostats can be sized to operate across a defined proportional band. A range of 0,5 – 2K is recommended. In providing proportional control, they ensure smaller swings in room temperature than, say, a conventional room thermostat which gives on/off control and needs to cycle throughout its switching differential each time it operates.

Capacities

Use the following sizing charts to select the correct valve for the radiator in question.



RA-FN
for two-pipe systems



RA-G
for one-pipe systems

Capacity with P-band between 0.5K and 2K with RA 2000 sensor

Note:
As with any device which imposes a pressure drop system, noise may occur under certain flow/pressure conditions. To ensure quiet operation, maximum pressure drop should not exceed 40 to 45kPa.

Example

Heat requirement: 2.05 kW
Temperature drop: 11°C
Differential pressure across the radiator: 0.05 bar (5 kPa)

Solution:

Water flow through the radiator per hour:

$$Q = \frac{2.05}{4.2 \times 11} = 0.044 \text{l/s}$$

The P-band value depends on the chosen valve i.e. RA-FN 15 will work with a P-band of 2K.

RA-FN 20 will work with a P-band of about 1.4K.

The Kv-value can also be calculated on the basis of the formula

$$Kv = \frac{Q}{\sqrt{\Delta p}} \quad Q(m^3/h),\ \Delta p\ (bar)$$

$$0.044 = \frac{0.044 \times 3600}{1000} = 0.158\ m^3/h$$

$$Kv = \frac{0.158}{\sqrt{0.05}} = 0.71$$

Note: $1 m^3/h = 0.278$ l/s

Fitting Danfoss radiator thermostats

Built-in sensors

are best fitted horizontally so that the ambient air can pass freely over the sensor without being affected by heat from valve and possibly surface pipes.

Remote sensors

should be used when:

- curtains cover the sensor
- or the sensor is affected by surface pipes.
- It is necessary to mount the sensor in the vertical position because of adjacent obstructions and the valve body is flow mounted.

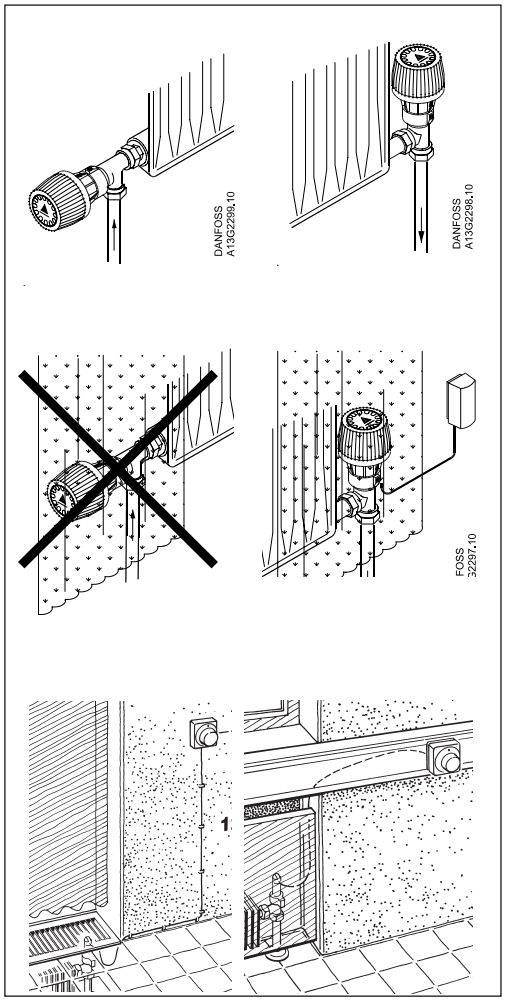
The remote sensor must be mounted on the wall, away from curtains, or on the skirting board beneath the radiator if free of surface pipes. All remote sensors are now supplied with ultra-thin capillary. Simply pull out the length required (2m max.) and fix using clips provided.

Remote temperature adjuster

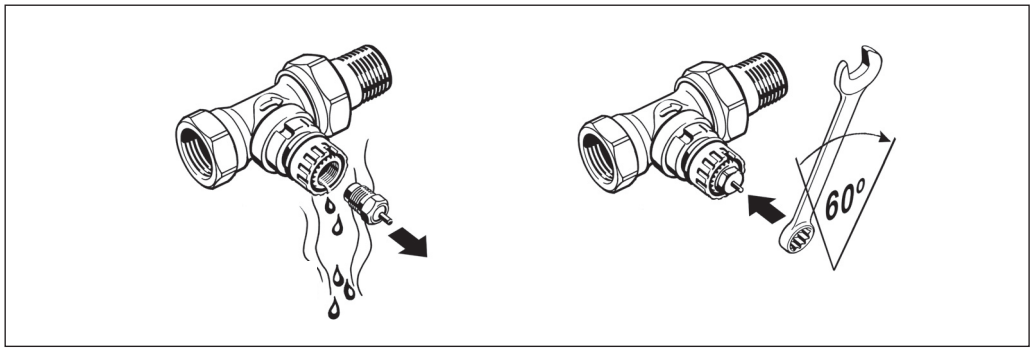
is ideal for use when the valve is positioned inaccessible to the user. The temperature adjuster should be mounted 1.5m above the floor.

IMPORTANT

Do not use RA 2000 sensors with RA-FR reversible valve bodies.



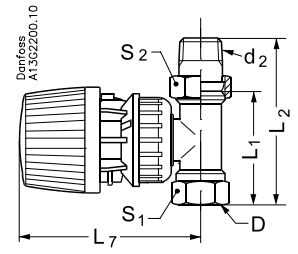
Changing the gland seal



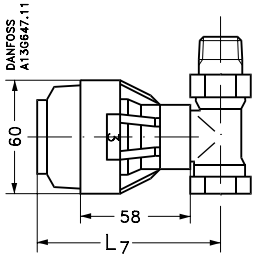
Should the valve body gland seal shows signs of weeping, the gland seal can be renewed in a few minutes with the system in operation.

Order gland seal 013U0070 for RAVL and RAV valves. 013G0290 for RA-FN and RA-G. (Sold in packs of 10 units, complete with instructions).

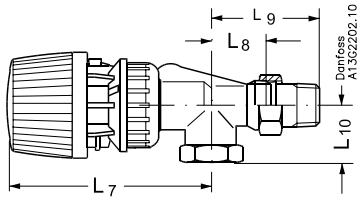
Dimensions



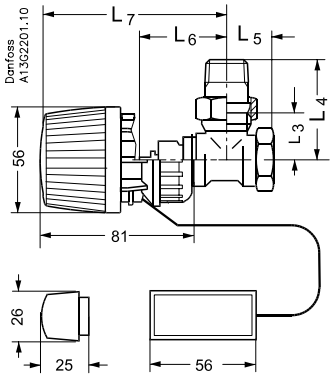
Built-in sensor
on RA-FN or RA-G body



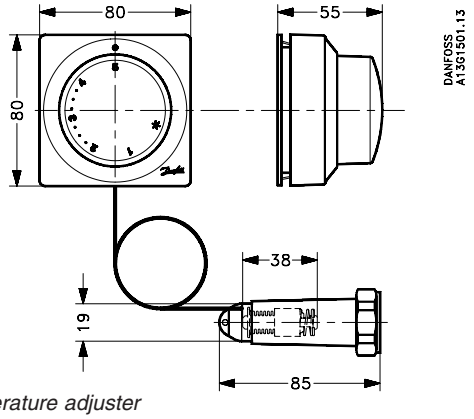
Built-in tamperproof sensor
on RA-FN or RA-G body



Built-in sensor
on RA-FN body, horizontal angle (UK)



Remote sensor
on RA-FN or RA-G body



Remote temperature adjuster

Type	Connection (ISO 7-1)			L_1	L_2	L_3	L_4	L_5	L_6	L_7*	L_8	L_9	L_{10}	Arc.flats	
	DN	D	d_2											S_1	S_2
RA-FN 10	10	$R_p\,^3/_8$	$R\,^3/_8$	60	85	27	52	22	47	96				22	27
RA-FN 10 UK**	10	$R_p\,^3/_8$	$R\,^3/_8$							103	26	51	22	22	27
RA-FN 15	15	$R_p\,^1/_2$	$R\,^1/_2$	67	95	30	58	26	47	96				27	30
RA-FN 15 UK**	15	$R_p\,^1/_2$	$R\,^1/_2$							104	29	57	44	27	30
RA-FN 20	20	$R_p\,^3/_4$	$R\,^3/_4$	74	106	34	66	29	47	96				32	37
RA-FN 20 UK**	20	$R_p\,^3/_4$	$R\,^3/_4$							105	34	66	30	32	37
RA-FN 25	25	$R_p\,^1/_1$	$R\,^1/_1$	90	126	40	76	34	47	96				27	30
RA-G 15	15	$R_p\,^1/_2$	$R\,^1/_2$	68	96	30	58	27	50	99				27	30
RA-G 20	20	$R_p\,^3/_4$	$R\,^3/_4$	74	106	34	66	30	50	99				32	37
RA-G 25	25	$R_p\,^1/_1$	$R\,^1/_1$	90	126	42	78	34	54	103				41	46

*) Add 32mm to L7 to allow for sensor removal fitting
**) "UK" indicates horizontal angle type valve body

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