DOMESTIC HEATING CONTROLS ARE EASY
PART 5 - RADIATOR THERMOSTATS

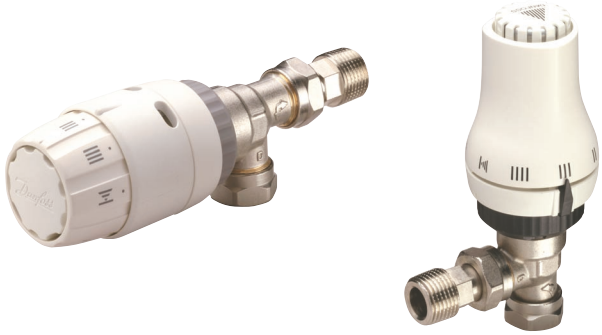


Fig. 1.

Radiator Thermostats (TRVs), the original and simplest room temperature controls, remain essential to achieving full energy efficiency with most 'wet' domestic central heating systems. Endorsing this fact, Good Practice Guide 302, the Government's current authoritative document on domestic heating controls, recommends radiator thermostats for all 'wet' systems – whether installed to its laid down 'Minimum Set' or 'Best Practice' standards.

These effective controls were invented by Danfoss and first became available in 1943. Considerable development has been carried out since then so that modern versions, although based on the original principles, are more efficient, smaller, smarter and easier to use.

Today, despite the arrival of numerous competitors to the market place, Danfoss still supplies a very large proportion of the millions used each year throughout the world and is the firmly established market leader for the UK. Installers and specifiers seeking information and advice on radiator thermostats could find no better source than Danfoss with its unsurpassed 60 years experience of product development and applications.

FUNCTION

Radiator thermostats, fitted to individual radiators, control required room temperatures to very high levels of accuracy and allow only essential heat energy to be used in the process. Also, they enable lower appropriate temperatures to be maintained in individual rooms to save heating costs and/or enhance comfort.

Requiring no external power to operate, they sense changes in room temperature in each room - including extraneous 'free heat' from sunlight, appliances, people, etc. - and adjust the hot water flow through the relevant radiators to maintain desired comfort levels; a benefit that an ordinary room thermostat system is seldom able to provide.

CONSTRUCTION

Radiator thermostats are made up of two basic sub-assemblies –**valve bodies** and **sensors**. These components can be purchased individually or in boxed sets.

Valve bodies**,** available in many configurations for different applications, provide the physical means of regulating the flow.

Sensors, settable for desired comfort levels, monitor room temperatures and adjust the valve accordingly. These two parts need to be fixed together correctly and positively for effective operation.

Fig. 2.

OPERATION

A wax, liquid or gas charged capsule-and-bellows assembly within the sensor head expands and contracts with changes in room temperature, operating a piston that acts on the valve pressure pin (spindle). As the room temperature increases, the valve throttles back the flow. A spring returns the piston promptly when contraction (cooling) occurs. Fig. 3 shows the internal components of a typical modern radiator thermostat.

1) Sensor
2) Bellows
3) Setting dial
4) reset spring
5) Pressure pin
6) Gland seal
7) Bi-directional valve cone
8) Valve body
9) Compression ring
10) Compression nut
11) Tail piece

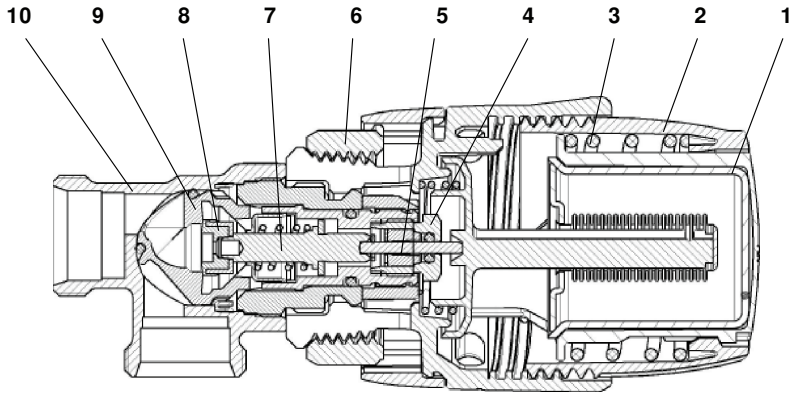


Fig. 3. Cut-away of a Danfoss Randall RAS-D radiator thermostat showing internal components.

Control action is **modulating**, i.e. makes appropriate slight adjustments to the valve spindle position to increase or reduce the volume of heated water passing through the radiator. This produces a closer temperature control band than the On/Off operating cycle of conventional room thermostats.

TEMPERATURE SETTING

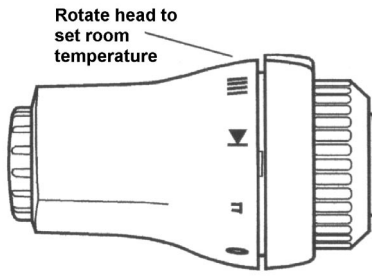


Fig. 4. Setting icons on a Danfoss Randall RAS-D Radiator Thermostat

The desired control temperature is simply set by rotating the setting dial (sensor head) until the appropriate comfort icon (number) coincides with the setting mark (see Fig. 4). Setting ranges vary with different manufacturers and types. Danfoss Randall Types RAS-D and RAS-C[2] have a setting range of 8°C - 28°C plus a positive shut-off position (see Fig. 5). Note that the frost protection setting is at 8°C whilst **0** represents the positive-off setting.

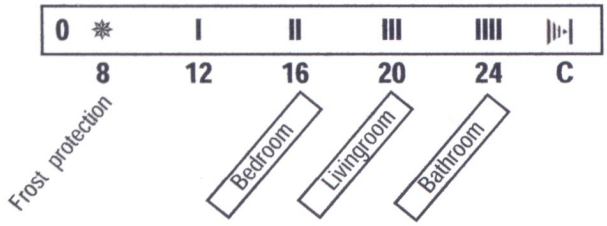


Fig. 5. Setting icons (in box) for Danfoss Randall RAS-D & RAS-C radiator thermostats. Beneath this is shown a guide to approximate temperatures and usage.

RAS-D sensors also provide range limiting (reducing the adjustment span) or locking completely to reduce energy wastage caused by tampering. Range limiting is very simply carried out by means of limiter tabs situated in the groove at the base of the setting head.

Setting upper limit: e.g. **IIII** as the highest possible temperature selection:

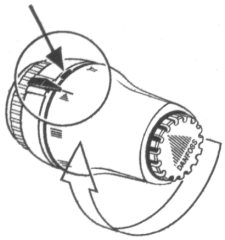
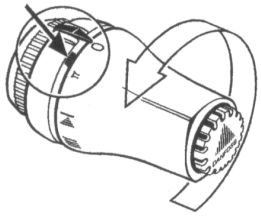


Fig. 6. Restricting the upper setting limit of an RAS-D radiator thermostat

1. Turn the head to maximum position (see Fig. 6)
2. Use a small screwdriver to hold down the limiter tab to the right of the black scale pointer.
3. Turn the head round to **IIII** and release the tab.



Setting lower limit: e.g. **II** as the lowest possible temperature selection:

Fig. 7. Restricting the lower setting limit of an RAS-D radiator thermostat

1. Turn the head to min. position i.e. **0** - positive off (see Fig. 7).
2. Use a small screwdriver to hold down the limiter tab to the left of the black scale pointer.
3. Turn the head to **II**. Release the tab.

Frost Protection Setting.
Using the frost setting with the heating system on will maintain a temperature of 8°C in the room where the radiator thermostat is installed, allowing temperature setback savings and providing protection against freezing in that area. However, it will not necessarily protect boilers situated in other rooms or outbuildings.

Positive-Off
The positive shut-off setting is a valuable feature as it allows radiators to be removed without any fear of the valve opening, and possible flooding, due to an unexpected change in room temperature.

TYPES

Today's most popular radiator thermostats for fully pumped (2-pipe) domestic central heating systems are 15mm bi-directional, reversible, angle types with built-in sensors. These allow total installation flexibility, i.e. sensor mounted vertically or horizontally in either flow or return.

However, many alternatives exist for other systems and situations that preclude the fitting of this type. Appropriate designs are available for virtually all requirements.

Valve Bodies. The following valve body choices exist in sizes from 3/8" to 1" BSP (Imperial) or 8,10 and 15mm (metric) for use in 2-pipe systems: -

horizontal angle

vertical angle or
straight.

They can be either *threaded* or provided *with compression fittings*, some models are also available with push-fit fittings for *plastic pipe.* Special high capacity versions are also available for 1-pipe systems

Fig. 8. Danfoss valve bodies for domestic radiator thermostats.

Others, such as *presetting versions* and *special 'radiator' valves,* are also obtainable.

Bi-directional valve bodies allow flow in both directions. Other flow-dependent valves carry arrows on their castings indicating flow direction to avoid the risk of water hammer.

Sensors. *Built-in (integral) sensors* can be secured to valve bodies by Allen screws, screw collars or snap-lock mechanisms.

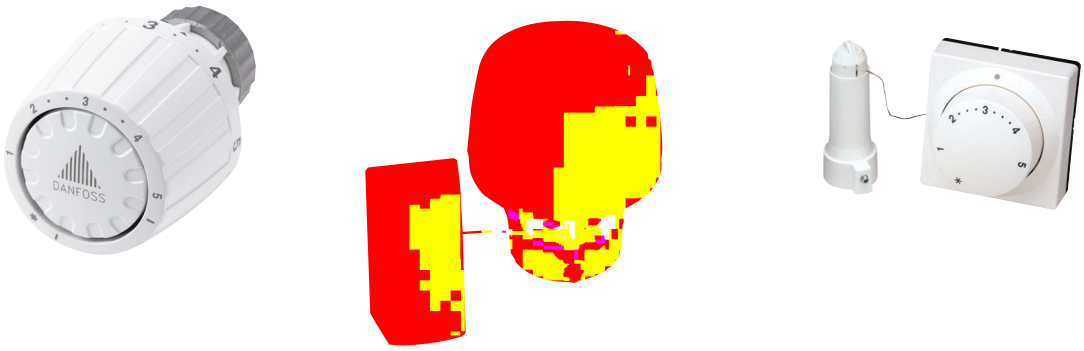


Fig. 9. Danfoss sensors for domestic radiator thermostats.

For installations where integral sensors are not practical, *remote sensors* or *remote adjusting sensors* are available. These sealed units connect to the valve-operating unit by a length of thin capillary tubing.

Recent introductions are *programmable sensors* that allow temperature-setting changes to be pre-set.

INSTALLATION

Most installers will not need advice on installation techniques. A simple plumbing job for the valve body, plus ensuring the sensor head is fixed correctly, is all it takes. No wiring is necessary. Detailed instructions that accompany each product should be followed.

However, care is required with valve positioning and sensor mounting.

To monitor air temperatures representing the room as a whole, the best installation position is in the radiator flow with the sensor mounted horizontally away from the hot valve body and pipes (*Fig. 10*). Mounting the sensor vertically above the hot valve is likely to prevent the room attaining the desired temperature.

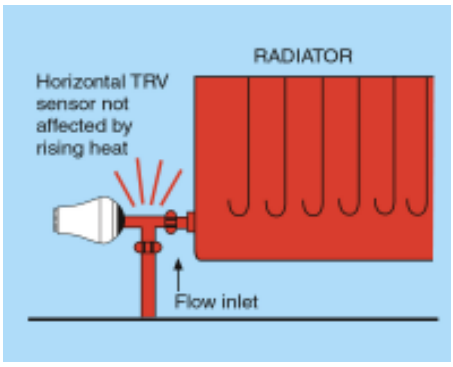
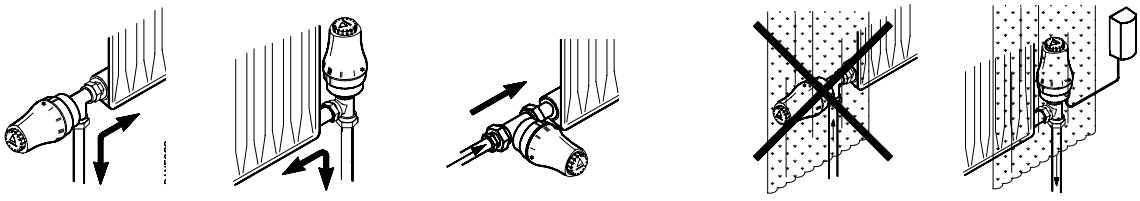


Fig. 10. The hot valve body and pipes should not be allowed to influence sensor performance.



For best performance fit valve in flow with sensor horizontal

When using straight pattern valves, observe flow direction stamped on body

Do not cover sensor with curtains or expose to extraneous heat gain. If in doubt fit remote sensor

Fig. 11. Mounting positions for radiator thermostats.

If sensors must be mounted vertically, for space limitations or other reasons, the units are best fitted in the return where valve temperatures are lower.

Also, sensors positioned behind curtains or furnishings, or in tight corners alongside hot pipes, will not control satisfactorily. These situations are best met with remote sensors/adjusters.

Where an automatic by-pass valve is installed in a system, radiator thermostats may be fitted to all radiators. Many boiler manufacturers specify by-passes and minimum flow rates through the boiler heat exchanger to maintain peak system efficiency, irrespective of load. Latest Building Regulations, Part L1, insist on the use of automatic by-pass valves in these installations; a by-pass alone or a manual by-pass valve is not considered adequate. Automatic by-pass valves open only when system flow/pressure conditions dictate, thus increasing efficiency and decreasing the risk of system noise.

The old method of leaving one radiator uncontrolled is wasteful and should be avoided.

In all domestic heating systems, including those controlled predominantly by radiator thermostats, an overriding room thermostat should be provided to meet the Building Regulations requirement for a boiler interlock arrangement to prevent wasteful boiler ‘dry’ cycling.

COMMERCIAL PRODUCTS

Danfoss Randall also provides the extensive and well proven RA2000 range of radiator thermostats designed to cope with the abuse and misuse frequently encountered in commercial and public premises. Full details are available on request.

TECHNICAL LITERATURE AND DATA SHEETS

Detailed information on all Danfoss Randall products is available. In most cases, this can be quickly downloaded from the company’s website - www.danfoss-randall.co.uk.