



SELECTION, INSTALLATION AND USE OF DIE-CAST ALUMINIUM RADIATORS

Selection of the most suitable model

The selection of the model affects the well-being and health of the surrounding air. Therefore, it should be made by taking into account the following factors:

- Room dispersion.
- Heating unit temperature.
- Room temperature.
- Thermal gradient.
- Available space for installation.

The heating unit must provide the environment with the proper amount of slow convective motions, yet capable of distributing heat uniformly and balancing room temperature. Furthermore, it must provide a fairly good amount of radiating heat, perceived immediately by people, therefore capable of contributing to a greater extent to the overall set of factors that create a local well-being.

Radiating heat is released by the flat surfaces of the heating unit towards the environment. Therefore, heating units with a low number of columns, smaller depth and larger front surface are to be preferred.

Selection of the most suitable installation position

The installation position is of paramount importance for performance and environmental well-being.

Heating units must be preferably placed along external walls at the most dispersing points, such as windows. The purpose is twofold:

- They should create an ascending air current in order to oppose the descending cold currents produced by dispersing walls, especially windows.
- They should also provide a radiating heat contribution in order to oppose the cool radiation from dispersing walls, as it would cause an increased heat loss from the bodies of people on the premises.

In this regard, the more the heating unit is extended in terms of front surface, the more the effect will be increased.

Effects of the installation position

Nominal thermal emission can be easily obtained by installing radiators at a distance of at least 30 mm from the wall and 120 mm from the floor, free from any obstacle.

Installation in niches or inside unscreened enclosing furniture reduces thermal emission.

Installation in recessed locations (such as behind a sofa, heavy curtains or in overly covered enclosures) more sensitively reduces performance and well-being, because such obstacles place the environment in an area shaded from the heating unit radiation.

The tables below provide some examples of decrease in thermal emission in the most common cases.

INSTALLATION EMISSION DECREASE	
Installation under a shelf	4%
Installation in a niche	7%
Installation behind a plate cover according to the type of screening	0 ÷ 5%
Installation behind a perforated plate radiator cover (according to the grid openings)	20 ÷ 30 %

TYPE OF RADIATOR BATTERY CONNECTION	THERMAL PERFORMANCE RATIO COMPARED TO CERT. EN 442/1/2
Double-pipe connection on opposite sides. Inlet from above, outlet from below	100%
Double-pipe connection same side left or right, > than 10 elements	96%
Single-pipe connection	93%
Double-pipe connection on opposite sides (without flow valve)	90%

Thermal emission – Effects of the various modes of connection

For double-pipe systems, heating units are fed in parallel; therefore, water temperature at the inlet of radiators is the same, unless there are temperature losses in the section of piping that connects the boiler to each radiator.

However, such losses are minor in case of small systems with insulated pipes.

For single-pipe systems, radiators are fed in series; therefore, temperature at the inlet of the heating unit is closely linked to the fall in water temperature in the upstream radiator.

Nominal thermal emission can be obtained in normal operating conditions, such as (see table above):

- ✓ Water inlet from above and water outlet from below on the same side.
- ✓ Water inlet from above and water outlet from below on opposite sides.

It sensitively decreases, to an extent that increases as the flow rate decreases, in the following cases:

- ✓ Water inlet from below and water outlet from above on opposite sides.
- ✓ Water inlet from below and water outlet from above on same side (single-pipe connection).

This phenomenon, which is quite typical, is expressed by the following formula:

$$G = \frac{Q}{K}$$

Where:

G = Flow rate used in the thermal performance test

Q = Reference output in the thermal performance test

K = Coefficient resulting from the difference in temperature between the heating unit inlet and outlet, equal to 11.63.

With reference to single-tube systems, installers often forget that these systems may experience circulation troubles if air is not bled off point-to-point, that is on every radiator.

This "air" can also be a corrosive or harmful gas, which can cause serious damage to the system, if not bled off correctly and periodically. Therefore, an automatic bleeding valve should always be installed on every battery.

Thermal inertia

A good heating unit must have the right thermal inertia.

Too low thermal inertia is the cause of sudden and troublesome changes in operating temperature at every intervention of the room thermostat, whereas excessive thermal inertia makes the heating unit rather inflexible to regulate.

Thermal inertia depends on the metal mass, its conduction, and its water content. The effects of these factors are proportional to their thermal outputs.

Such characteristics fully reflect the suitability of an aluminium panel radiator, where:

- Its mass conductivity ratio compared to cast iron is $1 \div 5$; for steel the value is $1 \div 3$.
- The average water content ratio is $1 \div 4$.

Therefore, it is questionable that a cast iron radiator is the best choice in terms of inertia just because its mass retains the achieved temperature for a longer time; one forgets to highlight that in such a case we are talking about latent heat transmission and not about heat emission.

Here, we shall not discuss well-known topics, such as:

- Emission performance, which is fully detailed in the thermal performance certificates issued by competent bodies (Thermo-technical Measurement and Research Laboratory at the University of Milan).
- Calculation of thermal emission at different supply temperatures, which is also fully detailed in the same certificates.

These specific topics can be reviewed in light of the new European Standard, EN 442 currently in force, according to which all thermal performance test values for radiators must comply with a Δt of 50°C.

Carrier fluid (water) in heating systems

The water used in heating systems is an element neglected by many people. On the contrary, it is the main factor to be evaluated.

Today, it is defined for application purposes by suitable laws at the national level (in Italy, the UNI - CTI 8065/89 standard is in force, which was made compulsory by Law no. 46 dated 3/5/90 and Presidential Decree no. 412 dated 8/28/93). Moreover, a European standard will soon be published.

Therefore, the water used in heating systems should comply with some thresholds in order to ensure their rational use, such as:

- A. Aspect: possibly limpid;
- B. PH control: value from $6.5 \div 8$ for aluminium and light alloys;
- C. Conditional limits: iron < 0.5 mg/kg (higher iron values are due to corrosive phenomena to be removed);

- D. Conditional limits: copper < 0.1 mg/kg (higher copper values are due to corrosive phenomena to be removed).

The definition of thresholds for the water contained in heating systems is aimed at eliminating and substantially reducing the troubles associated with water in such systems.

These troubles adversely affect their efficiency and substantially lead to energy losses and damage to the systems themselves. They can be summarised as follows:

- Scale;
- Corrosion;
- Deposits;
- Biological growth.

Scale

Scale is mainly due to the precipitation of salts that deposit on walls, partly in a hard form. Salts determine a water hardness index.

They cause decrease in system efficiency, reduced heat exchange, pipe occlusion, and often corrosive phenomena.

Corrosion

Corrosion is an electrochemical process that provokes a surface removal of metal up to its perforation.

Corrosion is normally favoured by the presence of oxygen and results from improper water characteristics or non-homogeneous situations (e.g. contact between different metals, contact between solid substances and installation mistakes).

Corrosion is also favoured by heat, increased salinity (especially chlorides) and high water speed.

Deposits

Deposits are the result of the precipitation of insoluble organic and inorganic substances. They differ from scale because they are incoherent.

They are due to filling water characteristics or atmospheric pollution, and they can give rise to the same troubles mentioned for scale.

Biological growth

Biological growth means all forms of organic life that are usually classified as algae, mushrooms, moulds and bacteria.

Their growth is favoured by light, heat, deposits, or casual pollutants.

The most important are iron bacteria and iron-reducing sulphate bacteria, which are especially relevant since they are a direct cause of localised corrosion.

In this sense, iron in the circuit can cause deposits and secondary corrosion. Iron in the circuit, resulting from corrosion, is an index of improper operation of heating or treatment systems.

Copper in the circuit can cause localised corrosion, which is fairly dangerous. It is hard to find it in raw

water in appreciable concentrations. Therefore, it can only result from corrosive processes in heating circuits.

Water treatments

The treatments that can be applied to filling and refilling water in heating systems are classified as follows:

- Physical and chemiophysical treatments;
- Chemical conditioning;
- Physical or chemiophysical treatments.

For systems supplied with aqueduct water or drinking water, two treatments are basically required:

- Safety filtering in order to protect downstream equipment and hydraulic circuits.
- Softening by means of ionic exchange resins.

Vice versa, if water does not comply with the aforementioned characteristics, special pre-treatments may be required.

Chemical conditioning

Chemical conditioning treatments are:

- Hardness stabilisation;
- Incoherent inorganic and organic deposit dispersion;
- Deoxygenation and passivation;
- Alkalinity correction;
- Protective film formation;
- Biological growth check;
- Protection against freezing.

The topics dealt with so far, although briefly, only relate to some of the problems that may affect heating systems. However, they highlight a few causes for circuit malfunction that are incorrectly attributed to a system component: radiator, boiler, etc.

There are obviously other causes associated with system installation that may affect a heating circuit functionality; to try and solve together some of the troubles that you may experience in your heating system, including the use of our radiators, the technical staff of "Pasotti S.p.A industries" is always at your disposal.

INDUSTRIE PASOTTI S.p.A.

Technical Management