Regulation of direct-heating convectors

Regulation is a very important part of every heating system and it has an important influence on the overall parameters of the heating system. This is twice as true in the case of electric heating systems and poorly-designed regulation can have an immense negative impact, particularly on operating costs.

Standard direct-heating convectors are equipped with thermostats (electronic or electromechanical); however, these integrated thermostats cannot be programmed as far as time is concerned and, when used without corresponding master regulation, they only prevent overheating of the room. Without a master control element, the convector heats practically without interruption, without taking account of the fact whether there is someone in the house or not.

A practical example can be the situation in 1990-1994 when a campaign supporting electric heating was launched, part of which was also a “guarantee” of low electricity prices. This campaign led to the massive installation of direct-heating convectors, unfortunately without corresponding regulation in most cases. A sudden increase in the price of electrical energy resulted in a significant increase in operating costs for these applications, which logically resulted in the opposite effect – i.e. the mass cancellation of heating systems with electric direct-heating convectors. Thus, for a long period electric heating wrongfully had the reputation of being a comfortable but disproportionately expensive heating system. At present, however, not only is the technical level of structures increasing but also the specialized awareness of builders, and therefore the proportion of electric heating systems is constantly increasing in the area of implementation.

Direct-heating convectors themselves rank among convection systems (see Principle of heating) and therefore their regulation is based on the air temperature in the heated room. As it isn’t possible to change the output of direct-heating convectors operatively - the on/off mode simply alternates – there is no sense in using regulation according to the outdoor temperature. This so-called equitherm regulation is suitable only for heating systems which can change their output as needed – typically, a warm-water system in which the temperature of heating water is set via mixing according to the outdoor temperature. In practice, it is possible to carry out the regulation of convectors according to the inside temperature in two ways:

a. via a master room thermostat
b. by control of attenuation via a pilot wire

Regulation with a master room termostat

This method of regulation is one of the types most widespread and most commonly used specifically in the Czech Republic. In the heated room, a digital room thermostat is installed which measures the room temperature and on the basis of the set programme, switches on or off the connected heater in such a way that the room maintains the

required temperature. As the master regulation reads the room temperature, the connected convector should be switched on for the whole heating season and the integrated thermostat should be set on maximum so that the two regulation units don't influence each other.
Several basic principles apply for this method of regulation:

1. digital programmable regulation is used, which enables the setting of an operating programme. The way to attain economical heating is to correctly set the mode of operation, i.e. when the heating should maintain comfort temperatures and when it should only provide the minimum necessary warmth. There is no point in using analogue thermostats which cannot be programmed because they have the same function as the thermostat which is integrated in the convector - their installation is thus purposeless.
2. each room should have its own thermostat (or a central regulation sensor), and it should be regulated individually. The one thermostat system (usually used for gas boilers), which reads the temperature in a reference room and switches on/off the heaters in all rooms according to this room, is absolutely unsuitable for combination with electric heating
3. the placement of the thermostat/sensor should correspond to common requirements for the reading of temperature – i.e. the thermostat/sensor should be placed on an internal non-cooled wall, at a height of approx. 1.2m above the floor, and it shouldn't be affected by direct solar radiation or another source of heat/cold
4. the value of the switching contact of the programmable thermostat mustn't be exceeded, and generally, if it is technically possible, it is more advantageous to switch only the power contact in the switchboard (contactor) using the thermostat. This extends the lifespan of the thermostat and the program back-up batteries, and the thermostat is often more accurate because it isn't heated by the current which flows through the switched contact

Attenuation control via a pilot wire

Control of convectors via a so-called pilot wire is used mainly abroad, particularly in France, which has many years of tradition in the production and use of electric convectors for heating. In the Czech Republic, this system is used on a smaller scale, mainly due to a lack of general awareness of this system. Originally, it was actually a basic regulation system for convectors, and therefore convectors aren't equipped with programmable thermostats. Basically, it is a central regulation system where the convectors are controlled from one place, and despite that, it is possible to maintain different temperatures in each room – from this point of view, it is one of the simplest and at the same time cheapest forms of central regulation.
Its principle lies in the fact that the temperature in the room is set and maintained by a thermostat which is integrated into the convector. These integrated thermostats, if they

receive an impulse via the pilot wire, can lower the room temperature by 4°C (so-called attenuation) in contrast with the set comfort temperature without any need for intervention. With a second impulse, the thermostat returns to the comfort temperature. So, temperatures which suit the purpose of the room and the requirements of the user are set on the convectors in the individual rooms. The pilot wires from all convectors lead to the attenuation regulators (basically, a time-switching clock) on which it is set when an impulse for a temperature decrease in the room to the attenuation level should take place, and when another impulse for a return to the comfort temperature should be sent.
Attenuation regulators usually facilitate the division of the heated building into two or three zones and select a different time mode for each of them. The pilot wires from the convectors in rooms which need to be heated to a comfort temperature at the same time (zone) are connected to one output of the attenuation regulator, heaters in rooms with a different time mode (second zone) are connected to the next output. In practice, this means that e.g. day rooms on the ground floor of a family house (workroom, dining room, kitchen, corridors) can be heated to a comfort temperature at a different time than the rooms on the second floor (living rooms, children's rooms, bedrooms) where the users move in the evening.

Attenuation regulators as such are made in different versions – in a KU68 wiring box (Flash Programer 2 SED).

1. even though some convectors are equipped with an integrated thermostat which can, according to the pilot wire signal, switch amongst more modes than only comfort/attenuation, it generally switches only between two temperatures and this with a fixed difference it switches between only two temperatures (comfort/attenuation) and has a fixed differential setting.
2. the building can only be divided into two or possibly three zones

In practice, however, the division of a building into two or three zones is completely sufficient, and if more zones are needed for any reason, this can easily be solved by the installation of another attenuation regulator. Also, switching between two temperatures is usually sufficient, and it basically makes no sense to set the temperature decrease to more than 4°C because it is energetically more demanding to heat the building to a

comfort temperature than to maintain it at a slightly higher temperature for the whole period. Newly-constructed buildings these days also have good thermal and technical properties, and so in an everyday operating mode the temperature cannot drop by itself by more than 4°C, providing the user doesn't "air" the room on purpose.

During attenuation regulation via a pilot wire, the advantage of convectors with an electronic thermostat increases significantly. Unlike convectors with an electromechanical thermostat, they are not only more accurate and quiet but also the temperature of the outflowing air is lower thanks to exact switching – thus, more economic operation is achieved, the risk that dust particles will be burned is decreased, and also the surface temperatures of the convector are lower, which extends its lifespan.