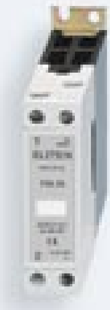
Connection and Control Accessories

1) Elstein TRD 1 temperature controller

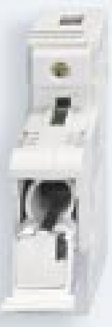
2) Elstein thyristor switching units

TSE 40 A

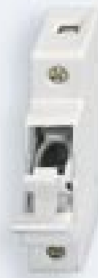


TSE 20 A

3) Elstein fuse holders



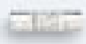
PST 14



PST 10

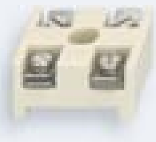
4) Elstein fuses

URG 50 A

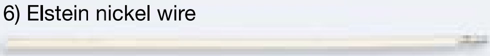


URG 20 A

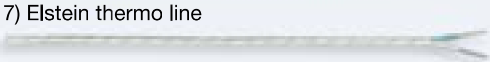
5) Elstein AK terminal clamp



6) Elstein nickel wire



7) Elstein thermo line



8) Elstein compensating line

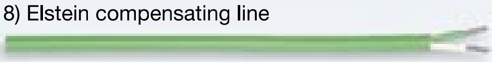


Figure 70: Electrical and temperature controlling accessories

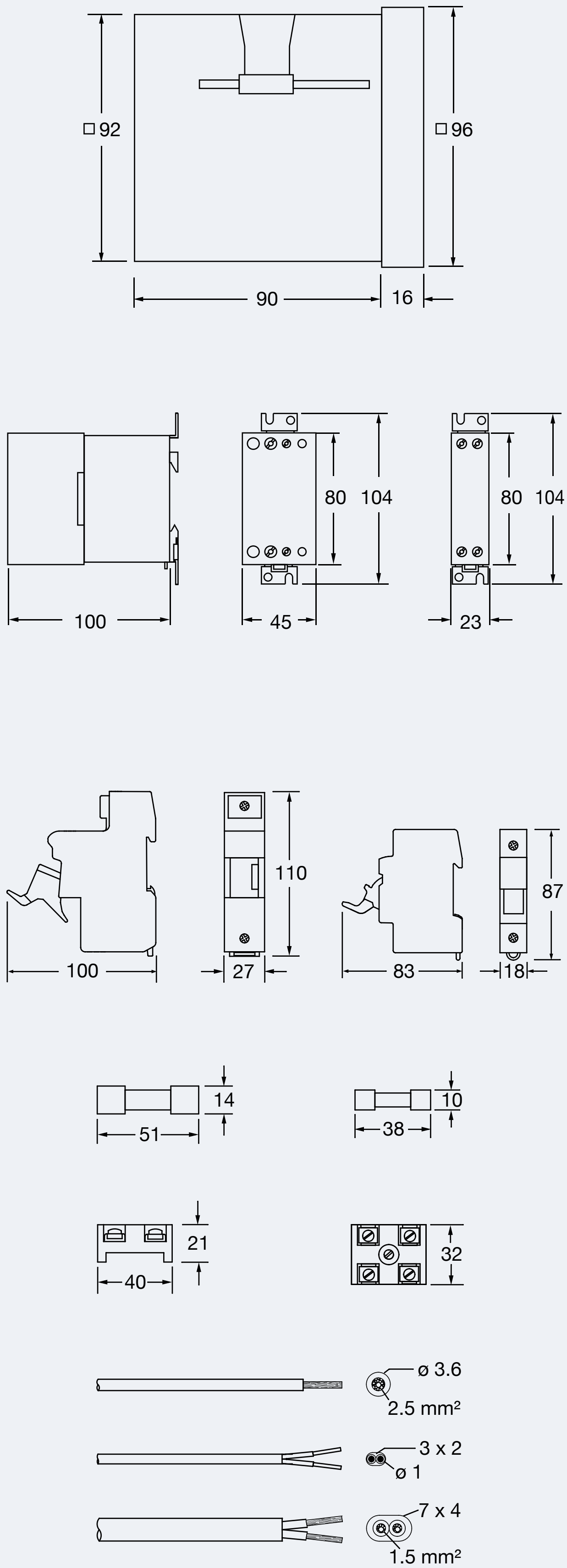


Figure 71: Electrical and temperature controlling accessories, Dimensions in mm

1) Elstein TRD 1 temperature controller

Type:	two point controller with PID performance
No. of switching units:	max. 6 TSE per controller
Temperature sensor:	NiCr-Ni + 16 further types
Control range:	up to 1100 °C
Setpoint setting:	in 1 °C steps, 4 setpoint values, distant access
Outputs:	2 x 0/12 V DC bi-stable load max. 30 mA and 2 relay outputs
Supply voltage:	95 V - 263 V, 48/63 Hz
Measuring circ. monit.:	outputs are switched off in case of break of sensor
Perm. ambient temp.:	0 - 55 °C
Perm. air humidity:	< 90%
Setpoint value display:	LCD 14.0 mm, green
Actual value display:	LCD 19.7 mm, red
Degree of protection:	front side IP 65 rear side IP 20
Connections:	screwed terminals
Installed position:	any
Dimensions:	DIN format 96 x 96 mm

The TRD 1 electronic temperature controllers analyse the signal of the thermocouple being integrated in each thermocouple radiator. The TRD 1 temperature controllers operate as quasi-continuous controllers and their factory settings are specially matched to the controlled process performance of Elstein infrared systems, so that practically no temperature fluctuations occur.

The two 0/12V DC logical outputs control the TSE thyristor switching units. In addition, two programmable floating relay contacts are available, which can be used, for example, as alarm contacts in conjunction with the limit comparators.

Further information and safety information are given in the TRD 1 operating instruction.

2) Elstein TSE thyristor switching units

The TSE thyristor switching units are used to switch the load circuits (infrared radiators) and are available in two power stages:

TSE 40 A, max. 40 A = 9.2 kW at 230 V
TSE 20 A, max. 20 A = 4.6 kW at 230 V

TSE thyristor switching units are supplied complete with heat sink and mounting clips for 35-mm standard rails. They are not subjected to any contact wear and therefore do not cause any switching noises. They are easy to install and their service-life is virtually unlimited.

The loads are switched on at voltage zero and switched off at current zero. This means there is no system perturbation.

The permissible voltage is 24 - 265 V for TSE 20 A and 42 - 660 V for TSE 40 A. A thyristor switching unit must be provided for each phase of a multi-phase connection to a 230/400 V alternating current mains.

The thyristor switching units must be protected against short circuits with super-agile fuses.

Transformers cannot be switched due to the Rush Effect.

Further information and safety information are given in the TSE 1 operating instruction.

3) Elstein PST 14 fuse holder for URG 50 and PST 10 fuse holder for URG 20

The fuse holders can be clipped onto 35-mm standard rails and make a disconnection from the voltage possible according to the technical rules for safety. When changing the fuses, the front lever only has to be pressed down to expose the fuse shaft.

4) Elstein URG 50 A fuse for TSE 40 A and URG 20 A fuse for TSE 20 A

The super-agile fuses are used to protect the thyristor switching units against short circuits. Conventional fuses are unsuitable.

5) Elstein AK terminal clamp, 2-pole, consisting of steatite socket and stainless steel metal parts for cables with a maximum wire cross-section of 2.5 mm.

6) Elstein nickel wire, max. 500 °C, max. 11 A, single core, 2.5 mm^2 wire diameter, for the electrical connection of the ceramic infrared radiators.

7)Elstein thermo line, NiCr-Ni, max. 400 °C, for connecting the thermocouple integrated in the thermocouple radiator with the temperature controller.

8) Elstein compensating line, NiCr-Ni, max. 100 °C, for extending the connection thermocouple-controller outside the IR radiation area.

Metal Parts

Figure 72: Metal accessories

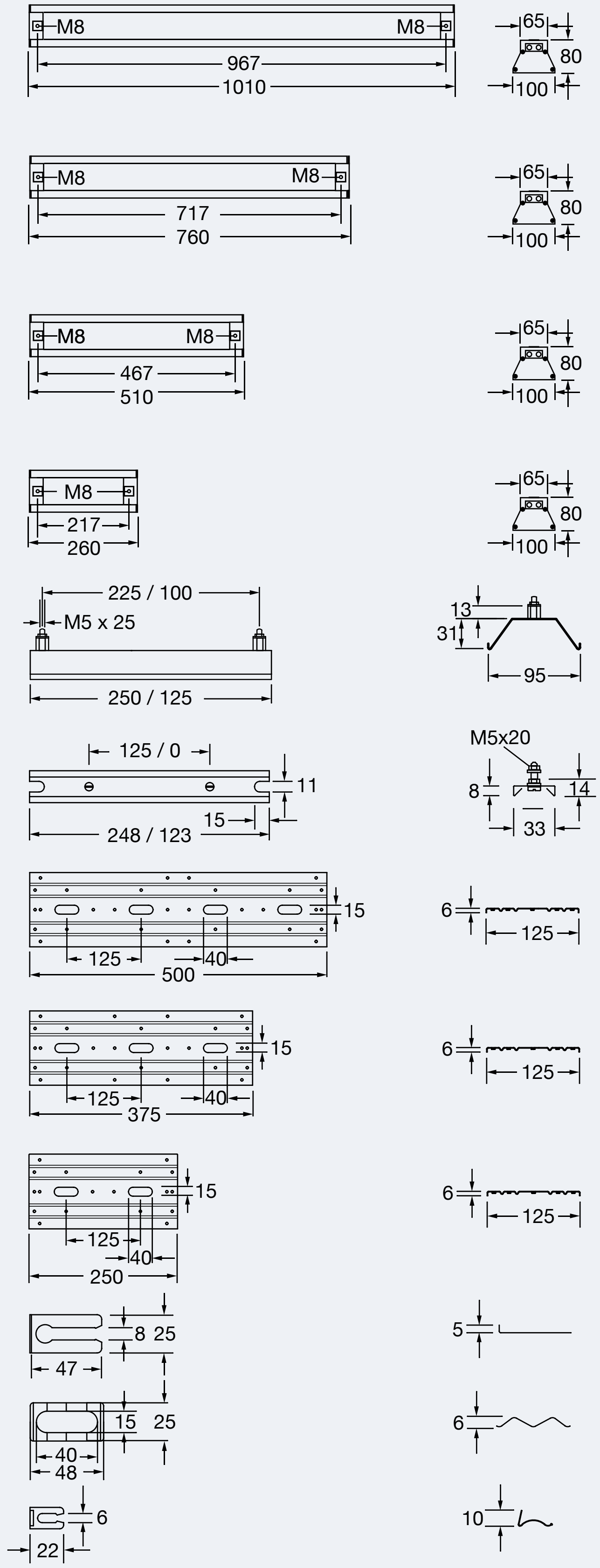


Figure 73: Metal accessories, Dimensions in mm

1) Elstein EBO housings

The EBO housings consist of an anodised, extruded aluminium section with an H-like cross-section, on which an aluminium capping section and two aluminium die cast end pieces are fitted.

Each die cast end piece contains a sliding nut with M8 thread for fixing the housings, for example on a steel section frame. They also contain a ceramic bushing for the electricity cables and a labelled safety earth terminal.

The EBO housings are available in the lengths 250 mm, 500 mm, 750 mm and 1000 mm. Other sizes beginning from 125 mm length are also possible.

EBO housings being equipped with Elstein radiators are available as ready-for-assembly construction elements by using the designation EBF (see there).

2) Elstein REO reflectors

The REO/250 and REO/125 reflectors are used to hold and fix the FSR, HFS/1, HSR/1, HTS/1, SHTS/1, and FSR/2, HFS/2, HSR/2, HTS/2 and SHTS/2 ceramic infrared radiators, and to reflect the IR radiation in the direction of the material to be heated.

They are made from polished stainless steel and have a protective foil on the inside which must be removed before installation.

REO reflectors are part of the ready to fit EBF construction elements and the fitted REF construction sets.

They are available in the two lengths 125 mm and 250 mm.

3) Elstein MPO mounting profiles

The MPO mounting profiles are made from stainless steel and are used to hold and fix HLS and IRS series radiators.

They are available in the two lengths 125 mm and 250 mm.

4) Elstein MBO mounting sheets

The MBO mounting sheets are designed for holding and fixing ceramic infrared radiators with the dimensions 122 mm x 122 mm.

They are made from stainless steel and have a protective foil on the upper side which must be removed before installation.

MBO mounting sheets are part of the ready to fit BSH construction panels and are available in the lengths 250 mm, 375 mm and 500 mm.

5) Elstein mounting set

All ceramic infrared radiators, which have a standard Elstein socket are fixed to the reflector or mounting sheet with the help of the mounting set.

The mounting set includes a wave mounting spring and a slide, both made from stainless steel.

The scope of delivery of the radiators with a standard Elstein socket includes one mounting set for each radiator.

6) Elstein fixing springs

The fixing springs are made from stainless steel and are used to fix HLS and IRS series radiators to the MPO and MPO/2 mounting profiles.

Two springs per radiator are included in the scope of supply of HLS and IRS series radiators.

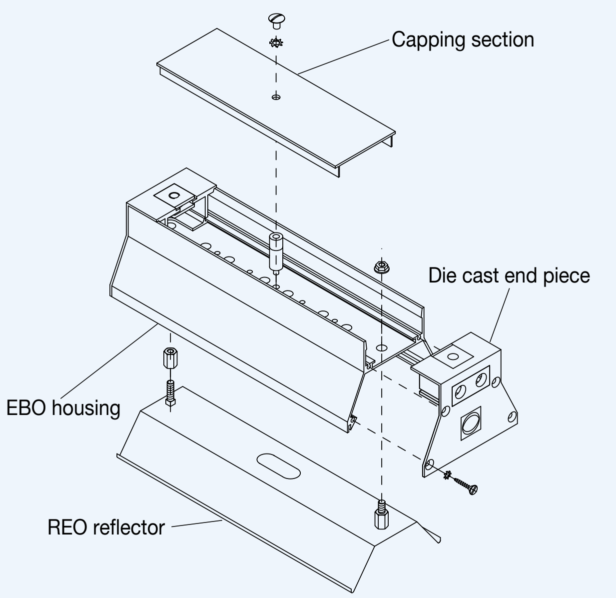


Figure 74: Example for the arrangement of metal parts using an EBO housing with REO reflector

Radiation Distribution

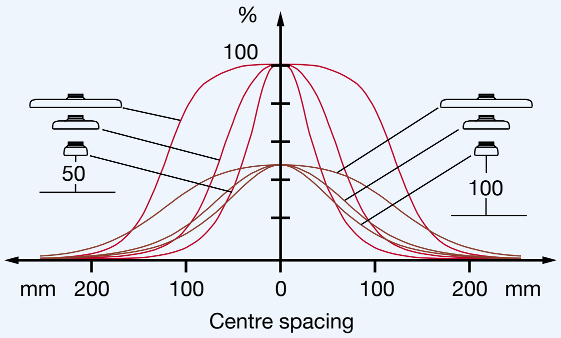


Figure 75: Spatial radiation distribution

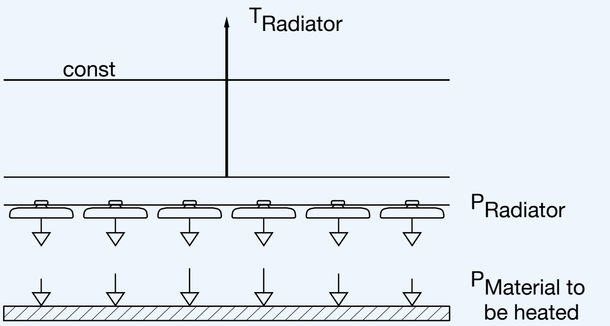


Figure 76: Power at the material to be heated with constant radiator power

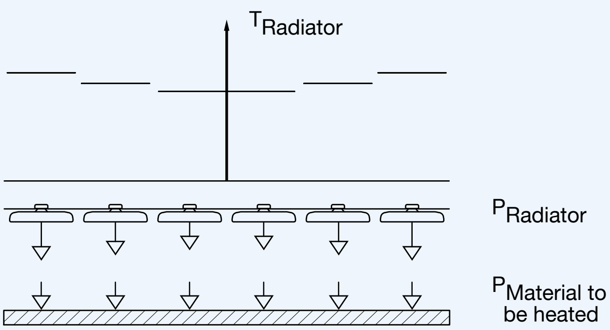


Figure 77: Power at the material to be heated with adjusted radiator power

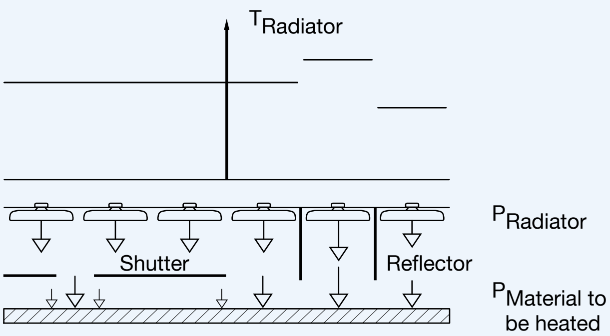


Figure 78: Power adjustment with reflector and shutter

Elstein infrared radiators are produced with all kinds of different dimensions. They are available with round, long, square, rectangular and even with hemi-sphere shapes. The spatial distribution of the diffuse energy radiated in all directions depends on the outer shape. Figure 75 shows the radiation distributions for 2 spacings of an Elstein HTS. Similar distributions also result for the other models. The intensity is determined by the respective surface temperature. At this point, please note that the curved shape of the FSR does not have any focussing effect with respect to the radiation.

In plants with a large number of radiators, the radiation distributions of all the radiators overlap. If, for example, several radiators with the same power output are installed next to each other in a machine, there is an increase in power in the middle of the material to be heated which is mostly unwanted (Figure 76). For uniform power density on the material to be heated, the radiators near the edge must be run with higher power or a higher temperature than the middle radiators (Figure 77).

The small design of Elstein infrared radiators enables the user to realise very different radiation distributions on the material to be heated. As radiation energy occurring at a point is the sum of the energy from all the radiators it is sometimes difficult to radiate narrow areas with a particularly intensive or weak radiation. In these cases considerable improvements can be achieved by using shiny metallic reflector plates or shutters. Figure 78 shows examples of possible designs.

One question often asked is whether additional thermal insulation is needed behind the radiators. This thermal insulation only has a useful effect if the requirements for the uniformity of the radiation distribution on the material to be heated are low. The thermal insulation causes heating of the inner radiators by the outer radiators of a heating area. In the most unfavourable case, the inner radiators can even become superfluous. The majority of the radiation areas are therefore not insulated. In addition, the modern HTS, SHTS and HSR series radiators already have integrated thermal insulation, which does not usually require any additional insulation.

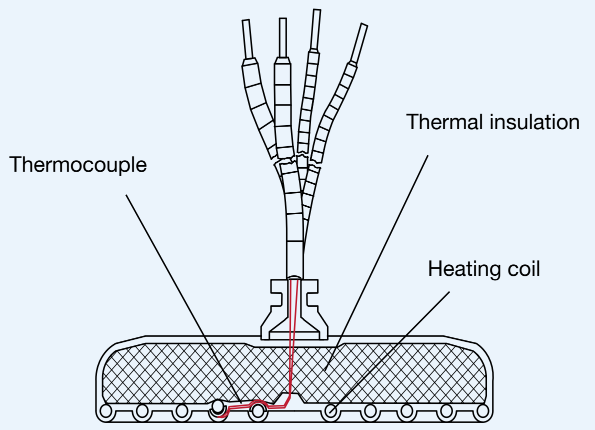


Figure 79: Thermocouple bedding

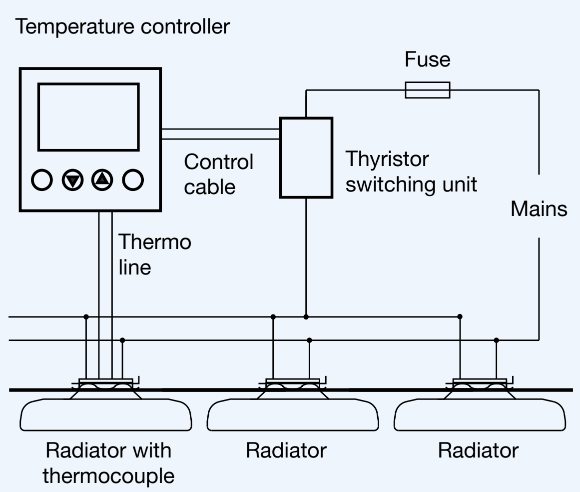


Figure 80: Block diagram of the temperature control circuit

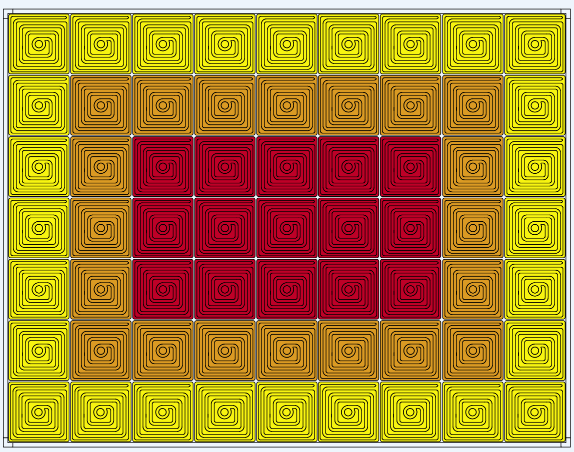


Figure 81: Heating area with 3 heating zones

Elstein infrared radiators are available with varying power levels. The HTS for example has power levels ranging from 250 W to 1000 W. In practice however powers different to these are mostly required. There are three ways of adjusting the radiator power to the power requirements of the material to be heated. The most simple way is to change the distance between the radiator and the material to be heated. This is only recommended if individual radiators are used. The second way is power control, for example using proprietary dimmers, like those used for lighting purposes.

The third and best way is to adjust the power via temperature control using radiators with an integrated thermocouple. In Elstein's infrared radiators with thermocouple, the thermocouple is located between the radiator surface and the heating coil (Figure 79).

The thermocouple signal is passed via a special thermo line, for example to the input of the Elstein TRD 1 digital temperature controller (Figure 80). The temperature controller switches individual or whole groups of radiators on and off with the help of one or several Elstein TSE thyristor switching units. An average power sets in at the radiators, depending on the length of time they are switched on. A super-agile fuse is fitted upstream of the thyristor switching units to protect them against short circuits.

This method enables compliance with the prescribed radiator temperature with an accuracy of one degree and thus enables the production conditions to be reproduced. It can also be modified so that the temperature of the material to be heated is measured. However, this requires reliable recording of the temperature of the material to be heated. In most cases it suffices to control the radiator temperature.

By using several controllers, zones can be formed in the heating areas, for example, to specifically heat certain areas of the product more strongly or weakly. Annular heating zones are frequently realised for large heating areas in order to uniformly heat up the material to be heated from the boundary area through to the middle (Figure 81).

Special programmable controls can also be used instead of a controller. Here it must be noted that the inputs for the thermocouples must be floating.

Performance

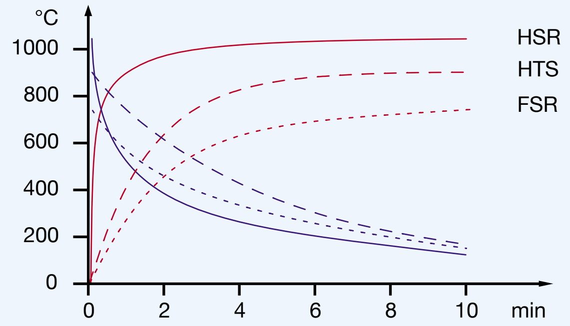


Figure 82: Heating-up and cooling performance

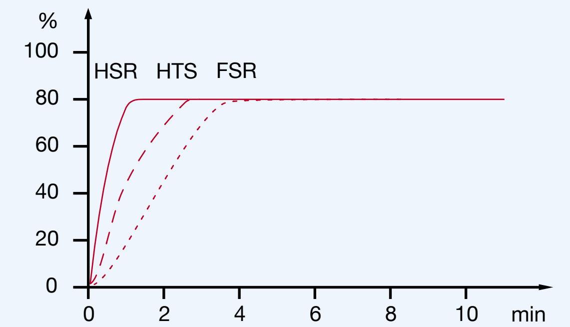


Figure 83: Power in controlled operation

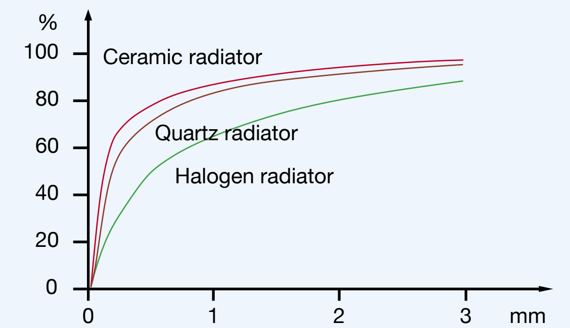


Figure 84: Absorption in transparent foils

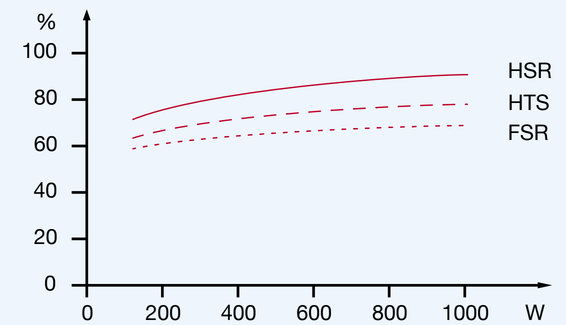


Figure 85: Efficiencies dependent on the power

Elstein infrared radiators differ in there mechanical structure. For example, the HTS series radiators have integrated thermal insulation materials, so that compared to the FSR series radiators, considerably reduced heating-up and cooling times are achieved (Figure 82). With the HSR series radiators the time performance was improved again by a factor of 3. Even if stationary heating tasks are to be solved mostly, fast heating up reduces the time taken before work can be started (Figure 83). Short cooling times are also advantageous in case of faults.

In this context, please note that the heating-up and cooling performance of an infrared radiator can be more easily judged with the heat sensitivity of the skin rather than with the eye. For example, if a halogen spotlight is switched off, the light goes off in a flash. But the hot glass tube continues to dissipate its stored heat to surrounding area for several minutes in the form of infrared radiation.

Infrared heating occurs close to the surface. The infrared radiation only penetrates transparent goods. Figure 84 shows this for 3 radiation sources for heating a foil. The more long-waved the radiation the more energy is absorbed near the surface. However, it should be noted that even the slightest additives harmonises the heating up performance in the direction of the ceramic radiator. If radiation can penetrate a material the absorption is poor, which in turn is reflected in the efficiency of a plant.

The efficiency of Elstein infrared radiators can reach values over 80 % in radiation areas. Figure 85 shows the typical curves for various panel radiators. You can see that the HTS and FSR radiators achieve very good efficiency values even at lower radiator powers. The HTS is clearly better than the FSR, thanks to its internal thermal insulation. The best efficiencies are achieved by the HSR radiators, as they dissipate little heat to the rear.

When using Elstein infrared radiators, the limit temperatures given on each radiator must be noted and observed. If it is exceeded, the ceramic and heating wire can be damaged. Equally, when installing the radiators ensure that the radiators are protected against knocks, impact, and moisture when cold. Due to the fixed installation of the heating coil, the radiators can be operated in any position.

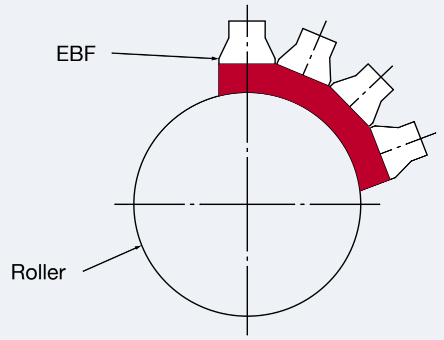


Figure 86: Roller heating using the EBF system

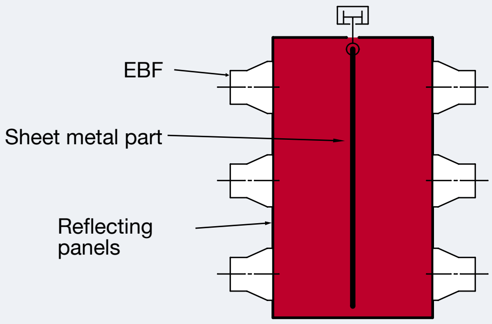


Figure 87: Radiation tunnel with several EBF systems

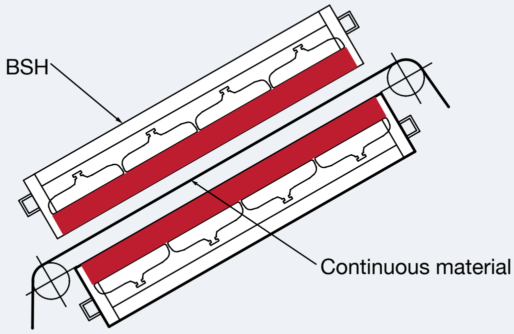


Figure 88: Heating a continuous material using 2 BSH systems

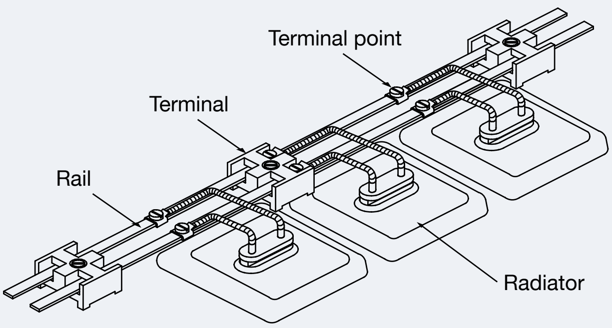


Figure 89: Rail wiring

When planning an infrared heating plant or system, it is the properties of the material to be heated which primarily determine the power and treatment time required. The easiest and most reliable way to determine the data concerned is to carry out a trial. We are always pleased to provide planning advice and if you wish can carry out heating trials for you.

The choice of radiator initially depends on the geometric circumstances of the heating task. The HTS series is the best choice for the radiator type. The integrated thermal insulation, the fast thermal performance and the ability to adjust the power via integrated thermocouples offer users optimum possibilities. If fast clock times or high material temperatures are required, the HSR and HLS series can be used. If a low overall height is required, FSF radiators can be used.

For systems, the choice is between BSH, EBF and REF. The EBF system is particularly advantageous for solving line-shaped or curved heating tasks and for individual applications. The BSH system on the other hand is ideal for heating goods with a large area. All systems can be used with both a one-sided and a double-sided arrangement. If two heating areas radiate each other, for safety reasons special attention must be paid to compliance with the maximum permissible radiator temperatures.

In operation, the EBF and the BSH system can reach housing temperatures of up to around 250 °C. Therefore, the user must plan in design measures to prevent contact with the hot metal parts. Elstein infrared radiators do not have any dazzling effects. However we recommend screening off the sides of the heating areas with polished aluminium or stainless steel plates. This prevents unnecessary heating of parts outside the actual oven and improves energy utilisation. For stability reasons, EBF and BSH systems must not have any additional thermal insulation.

When designing the industrial ovens, particular attention must be paid to ensuring all parts can thermally expand. Large, stiff constructions are therefore disadvantageous. In this context the wiring material is also important. Copper cables can only be used for individual radiators with a low power. The standard are cables made from nickel with heat resistant insulation or rail wiring.

General Information

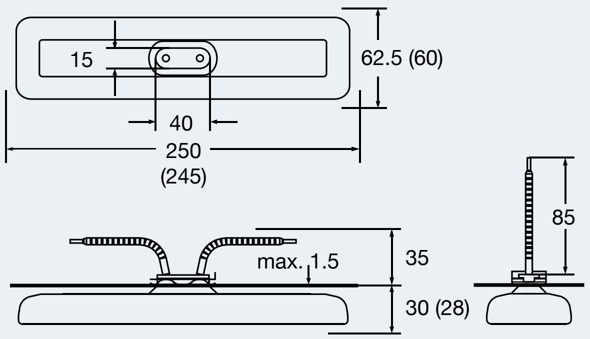


Figure 90: Example of installation dimensions

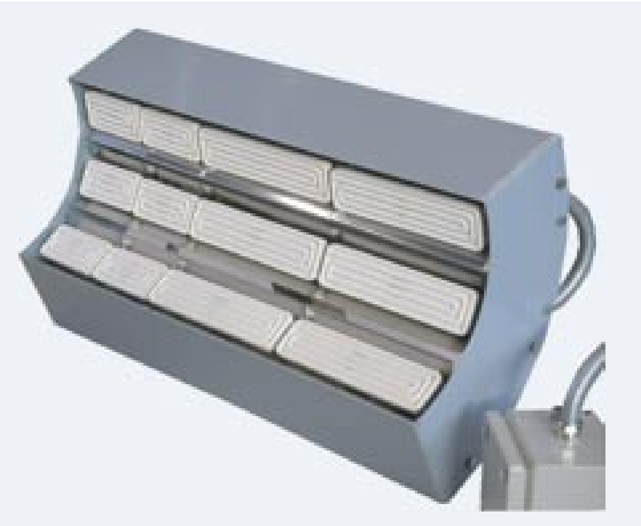


Figure 91: Roller heating

Figure 92: Heating area to heat up the bottoms of bottles

Due to the thermal expansion, when designing plant or systems you must ensure that the infrared radiators have adequate space. In general, a distance of 3 mm should be available between adjacent infrared radiators (Figure 90). The installed dimensions to be observed are given in the data sheets for Elstein infrared radiators.

The data sheets and the radiators themselves also list the limit temperatures to be observed. Exceeding these temperatures by a considerable amount can damage the ceramic.

A frequently asked question concerns the service life or longevity of Elstein infrared radiators. We only use raw materials and heat conducting materials of a particularly high quality to manufacture our products. All radiators are also subjected to permanent quality assurance. However, as the durability of an infrared radiator decisively depends on its use conditions, we are unable to give individual values.

The durability is primarily influenced by the temperatures reached during use. For example, an HLS at 1100 °C in continuous operation has an average service life of 2000 hours. An SHTS with 900 °C on the other hand reaches about 8000 hours. Radiators with a low power often reach more than double this useful life. On the other hand, there are applications in which the radiators can fail after 1000 hours due to materials, which attack the heating coil or the ceramic. Such materials are, for example, chlorine, fluorine, hydrofluoric acid, sodium hydroxide, nitrogen and peroxide.

Except for under atmospheric conditions, Elstein infrared radiators are also used in vacuums. They are however not available in an explosion-proof version. Nevertheless, there are ways to reach solutions which enable Elstein infrared radiators to be used. We will be pleased to advise you if you have corresponding heating tasks.

As a standard Elstein infrared radiators are designed for 230 V. Sometimes however, customers want or need to use other operating voltages. Most Elstein infrared radiators can also be supplied with other voltages. Operating voltages above 270 V, however require thinner heating wires than usual. The consequence is a lower durability under the same operating conditions.

Summary

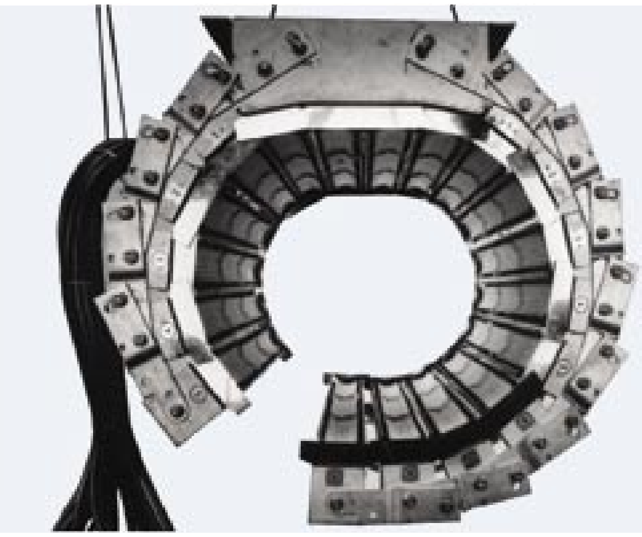


Figure 93: Heating head for heating GRP pipes

Figure 94: Heat therapy appliance

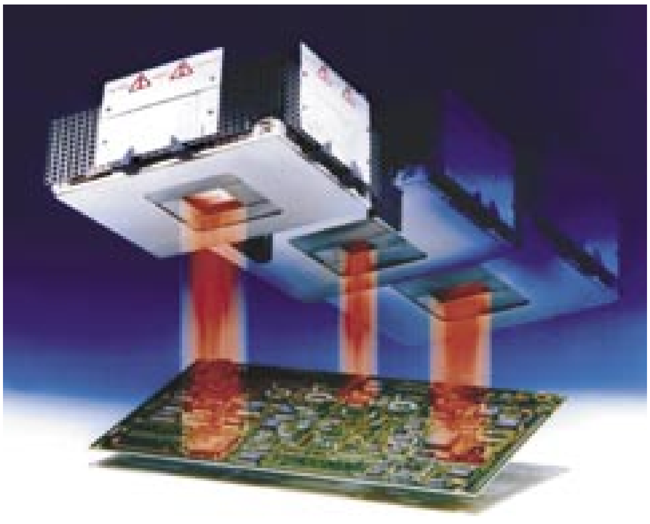


Figure 95: SMD soldering head for printed circuit board repairs

For decades, Elstein infrared radiators have been proven heating elements for solving heating tasks. They are available in various forms and power levels and therefore enable users, to optimally adjust to their heating task.

Elstein infrared radiators have the following advantages:

1. High emission capacity
2. Robustness
3. Long durability
4. Simple to control with degree accuracy
5. High surface rating up to 87 kW/m²
6. Standardised dimensions and powers
7. Modular structure
8. Scale free surfaces.

These advantages have helped to guarantee customer satisfaction over decades and guarantee this in future tasks too.

The information given in this brochure of course only represents the core of our experience. Please contact us if you require further help in solving your heating task.

We thank the companies D. Krieger/Mönchengladbach, Rewatronik/Wald-Michelbach, Technova/Paris and Depke/Lübeck for kindly providing us with photos of applications.