

Product catalogue | **Radiant Heaters**



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⚡ Electrically heated products ♠ Water heated products

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Frico saves energy

Thanks to our broad product range and our many years of experience, Frico is able to help you save energy. By offering total solutions, including both complete heating systems and products for additional heating, we can generate a comfortable indoor climate at a low energy cost. Our regulation systems for different levels ensure that you never use more energy than is required. Through our parent company, Systemair, we also possess knowledge about ventilation and can provide appropriate solutions.

Climate-smart

At Frico, we are proud to be able to offer energy-efficient products for a better indoor climate. In our product development work, the focus is on achieving the greatest possible function with the least possible energy consumption – without compromising on our core values of trust, competence and design.

This means that our products not only manage the local climate in business complexes, industrial buildings, offices or summer cottages; with optimum energy efficiency, we ensure that our products are climate-smart.



We are here

Frico's headoffice is located outside Gothenburg in Sweden and we are a part of the Systemair Group. Today Frico is represented in 85 countries world wide either by subsidiaries or distributors. Updated information is always available on our website www.frico.se.

We manufacture at production units in Skinnskatteberg, Sweden and at other ISO-certified production units in Europe. Our warehouses are strategically placed in several places in Europe.



Good reasons to choose Frico

More than 75 years of experience of developing products for the varied Nordic climate has provided us with a unique knowledge bank. This is our foundation when creating today's energy efficient solutions for a comfortable indoor climate.

Leading technique and design

Frico is the leading supplier of air curtains, radiant heaters and fan heaters in Europe. All our products are well designed in good Scandinavian tradition.

Knowledge and resources

Since we develop our own products, our knowledge on how to create an energy efficient indoor climate is constantly growing. We have one of Europe's most modern and advanced air and sound laboratories to aid us.

Frico Academy

The Academy is an important platform for networking and sharing inspiration and knowledge between us and our distributors around the world. Through the Frico Academy we share our knowledge on theory and technology, as well as product knowledge and experience in manufacturing and product development.

Qualified local support

Frico is present locally in some 85 countries worldwide with a network of wholly-owned subsidiaries and independent distributors. Our highly qualified representatives are carefully chosen and together we are

able to provide you with the best possible support. To find your nearest Frico subsidiary or distributor, please visit www.frico.se.

Quality and long life

Frico offers consistent and high product quality. Our product warranty is there for your safety. It covers manufacturing faults and is valid for five years and necessary components will be replaced.

Frico products are designed for long life and are easy to maintain. Through our distribution network we provide reliable maintenance and service support which includes the availability of spare parts for at least ten years.

References

Our products create comfortable indoor climates all over the world. Below are some of our references.

- Odeon, London
- Eiffel Tower, Paris
- Moscow Metro, Moscow
- Hurtigrutten, Norway
- Wasa Museum, Stockholm- LKAB mine, Sweden
- Chang'an Theatre, China
- McDonald's

More references can be found on www.frico.se.



Our product groups

Air curtains

It makes sound economic sense to create an efficient and invisible door that keeps the heat inside. Air curtains can be even more effective when used in air conditioned or cold storage buildings.

Thermozone technology with its precisely adjusted air velocity gives even protection throughout the opening. Frico air curtains provide the most efficient separation with the lowest possible energy consumption, regardless of whether it is the heat or the cold that you want to keep inside.



Radiant heaters

Frico radiant heaters imitate the sun, the most comfortable and efficient heat source available. The heat is emitted only when the rays hit a surface and the room temperature can thus be lowered while occupants experience a comfortable environment. This makes radiant heaters well suited not only for total heating but also for zone and spot heating, for example to avoid cold draughts from windows.

Radiant heaters are easy to install and require minimum maintenance. They heat directly when switched on and give no air movement.



Fan heaters

We are proud of the worldwide fame Frico fan heaters have gained. They are reliable and are designed for long life. Our range covers all needs. The investment cost is low compared to other heating systems.

A great advantage of fan heaters is the option of combining heating and ventilation. Frico fan heaters are compact, silent and light weight. They are available for electrical heating as well as for water heating.



The Frico story

Frico has a long tradition of creating technically highly developed, quality products for a comfortable indoor climate. Friberg and Co was founded in 1932 by civil engineers Mr. Eggertz and Mr. Friberg. The product groups we now offer have been introduced gradually. We have employed the same approach in starting up subsidiaries and distributors around the world.

Quality and sustainable design

Quality has always been a well known characteristic of Frico products, as well as high technical functionality. Beginning in 1956 research was emphasized and the final testing of all products was introduced to ensure that our high quality requirements are met.

Frico's oldest product still offered in the range is the ribbed pipe radiator that was introduced in the late 1930s. This product has even found a new market in modern houses and is popular among architects. Our aim is for all our products to become classics. They should have high quality, the best performance and a design that lasts.



5 August 1932
Friberg & Co is founded



1955
Fan heaters



1960
Frico goes abroad

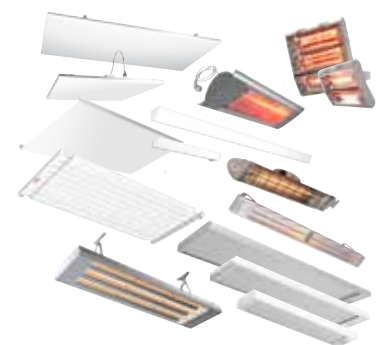
1938
The ribbed pipe radiator



1956
Technology and testing



1967
Radiant heaters



Frico's future

The demand for energy-saving products is increasing worldwide, along with increased environmental awareness and willingness to conserve the Earth's resources. Our experience of Sweden's changing climate means that we have traditionally always focused on energy efficiency in the development of our products.

As the market leader are at the forefront of the development of air curtains and heating products. We offer products for the worldwide market, regardless of climate, and we have products for both electrical and water heating. With more than 75 years of combined expertise and Europe's most advanced testing facility at our disposal, we will continue to supply climate-smart solutions.



1973
Air curtains



1994
Frico SAS, France
Frico rep. office in Russia



2004
Frico GmbH, Germany
Frico BV, Holland



2006
Frico GmbH, Austria

1981
Frico AS, Norway



1992
Merge with Systemair



2001
Frico Ltd, United Kingdom
Frico rep. office in China



2005
Frico rep. office in Spain



Research and development

Regular tests and measurements are made to develop new, but also to improve our existing, products. With radiant heaters it is primarily the temperature and heating capacity that we are interested in.

Temperature measurements in the black corner

In the black corner both external and internal temperatures are measured on the product as well as on walls and ceilings. Black surfaces have a very high capacity to absorb heat radiation and therefore give the least advantageous conditions during our tests.

The product is mounted according to the minimum distances to ceiling, walls and floor given in the manual. The temperatures are then registered in a data logger using the thermo-elements placed on the black corner and apparatus surfaces. The temperature inside the apparatus is measured and checked to ensure that it meets the requirements regarding safety standards.

IR camera

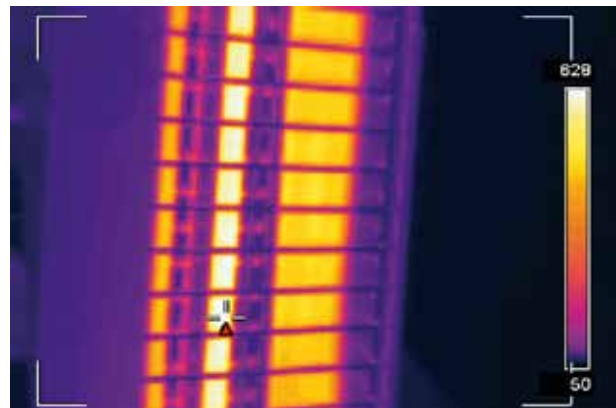
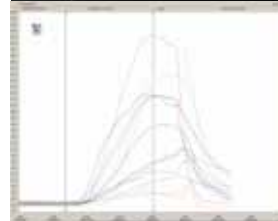
The external temperature can also be measured using an IR camera or heat camera as it is also known. It allows contact free measurement because no thermo-elements are necessary. The result is an illustration of entire surfaces that gives a good picture of the temperature distribution in the heater.

Air and sound tests

Our test facility for air and sound is among the most modern in Europe. The measurements are carried out according to the AMCA and ISO standards. AMCA stands for the "Air Movement Control Association", an international, non-profit organisation that contributes towards setting standards for the entire air industry.



Black corner



With the IR camera, the temperature differential between the element and sleeve in Comfortinfra CIR is clear.



The acoustic room has no parallel surfaces, sound-waves are therefore prevented to meet and to interrupt each other. The room also rests on 76 springs that eliminate vibration from the production. The background noise is 9 dB(A).

More than 75 years of collected knowledge

Not only does 75 years of experience provide us with invaluable knowledge in designing high quality products with the best performance, it also enables us to provide a knowledge bank that can be accessed on the web, in our printed material or can be obtained by contacting us or our distributors. We welcome you to share our knowledge!

Web

Get inspiration from our references and updated information from the product database which includes product details, manuals, wiring diagrams and pictures. Make sure you check out www.frico.se for the latest updated product information, references, news, etc.

Catalogues

The Frico catalogues contain in-depth information on all the products in our range, as well as the theoretical underpinnings. There are three catalogues, one for air curtains, one for radiant heaters and one for fan heaters and convectors. All catalogues include suitable regulators and accessories.

Mini catalogue

The mini catalogue presents brief information and basic technical data on all our products in one edition.

Assortment folders

Assortment folders give an overview of the product groups air curtains, fan heaters and radiant heaters in three separate editions.

Concept folders

For more specific applications we have produced the concept folders. Today they include the applications Entrances, Industry, Open air restaurants, Petrol Stations, Cold Storage and Maritime environments.

Marketing support

We are happy to provide you with the digital material of all of the above for your own presentations, translation, printing etc. We can also provide you with templates for marketing material such as advertising, banners etc.



Radiant heaters

Heating with radiant heaters is indirect. The heat is transferred from the radiant heaters at the ceiling to surfaces such as floors, walls, fixtures and the like, which in their turn give off heat to the air in the room.

No losses occur on the way from ceiling to floor. Radiant heating can be compared to ordinary light. Dispersion and reflection occur in relatively the same way.

Radiant heaters create a very equal temperature distribution between floor and ceiling. The expensive cushion of overheated air that is easily formed when using other heating systems can be avoided. In rooms with high ceilings, radiant heaters give significantly lower energy consumption.

Total heating

Radiant heaters heat people first, then the air. The operative temperature, being the temperature a person senses, is therefore a little higher than the actual air temperature.

For a specific comfort level, use of a radiant heating system will allow a reduction in air temperature of a couple of degrees when compared to a conventional system, and every degree reduction will reduce energy consumption by approx. 5 %.

Zone and spot heating

With a radiant heating system, different zones within

the same room can have different temperatures. It is therefore possible to divide any area into smaller zones and maintain a different comfort level in each zone.

It is also possible to focus the heat on a certain spot, such as a single workstation. A spot heating application can be controlled much as spot lighting, with the level of heating being increased when needed.

Complementary heating

As addition to other heating systems and when expanding an existing system, radiant heaters are often a simple, inexpensive solution. For a water heated building, putting up a single or a few electrical heaters is often a smoother and more flexible solution than extending the water pipe system.

Cold draught protection

A cool surface such as a window has a chilling effect on the neighbouring air. Radiant heaters provide efficient and economical protection against cold draughts caused by windows by heating the window's surface. The colder the window, the more radiant heat it will draw. The radiated heat "automatically" migrates to where it is most needed, which facilitates the creation of a comfortable indoor climate.

For more information about the different types of heating, see the Technical handbook.



Choose the right radiant heater

Radiant heaters are available in various designs – it is primarily the installation height, the surrounding environment and the type of heating wanted (see previous page) that determine the choice of product.

Our radiant heaters are divided into three main application areas: "Offices, shops and public premises", "Industry and large premises" and "Outdoors" but most of them can be used in several application areas as you can see in below table.

Comfort

To achieve good comfort, it is essential to choose the right type of radiant heater.

An infrared heater equipped with halogen lamps at approx. 2000 °C provides intense, short-wave radiation. It is well-suited to outdoor use or in rooms with high ceilings. For a similar but softer heat an infrared heater with tube elements at approx. 750 °C can be used. The heat emitted from these radiant heaters can be compared to the radiant heat felt from an open fireplace.

A Thermocassette with a large element surface and a surface temperature of approx. 100 °C, provides long-wave heat radiation, giving comfortable heating and good dispersion in rooms of normal height (2,7 m).

In a building with high demands on comfort, a larger number of heaters with low output should be used instead of fewer heaters with high output.

When zone- or spot heating an area, the heaters should be placed so that the heat comes from at least two directions. This is especially important when the heaters are mounted at lower heights.

Below table and the examples on the following pages will help you to choose the right radiant heater.



Quick selection guide radiant heaters

Type	Heating	Installation height [m]	Output [W]	Surface temp. [°C]	Application area*1			Heating element	Page
					Offices	Industry	Outdoors		
Thermoplus	⚡	2-3	300-900	160	++	+		Radiant aluminium panel	18
Thermocassette	⚡	< 3	300-600	100	++	+		Heating film	24
Elztrip EZ100	⚡	2,5-4	600-1500	280	++	+		Radiant aluminium panel	30
Comfort panel SZR	💧	2,5-10	100-580*2	80	++			Radiant steel panel	36
Elztrip EZ200	⚡	3-10	800-2200	340		++		Radiant aluminium panel	42
Elztrip EZ300	⚡	4-12	3600	350		++		Radiant aluminium panel	50
Infrared IR	⚡	4,5-20	3000-6000	700		++	+	Infrared heating rod	56
Infrared IRCF	⚡	3-5	1500-4500	2200*3		++	+	Halogen lamp	62
Comfort panel SZ	💧	3-15	50-1900*2	80		++		Radiant steel panel	68
Infrared CIR	⚡	2-2,5	500-2000	750		+	++	Infrared heating rod	74
Infrared ELIR	⚡	2-3	1200-1800	2200*3		+	++	Halogen lamp	80
Infrared IH	⚡	1,8-3,5	1000-2000	2200*3		+	++	Halogen lamp	86

*1) Our products are divided into three main application areas: "Offices, shops and public premises", "Industry and large premises" and "Outdoors" but most products can be used in several application areas.

*2) Per metre, depending on water temperature.

*3) Filament temperature

Radiant heaters

There are many advantages with radiant heaters:

Economy

- Heat people and objects first and then the surrounding air. This allows the temperature to be reduced while maintaining comfort.
- Produces instant heat, thus much quicker than traditional heating systems. This is especially useful outdoor and in buildings that is used occasionally such as sport centres and country houses.
- Heat at floor level, not at the ceiling.
- Reduced night temperature possible with right controls thanks to quick heat-up time.

Safety

- By positioning the heaters at high level the risk of getting in contact with the heater is greatly reduced. The heater is also protected against damage.
- Some radiant heaters are ideal for premises with fire risk or highly explosive environments (see radiant heaters Comfort Panel SZ and SZR).

Simplicity

- Easy and flexible installation.
- Requires a minimum of maintenance.

Space

- By putting the heater on the ceiling, valuable wall and floor space is saved.

Comfort

- Using the radiation principle air is not heated directly. This results in a soft, draught-free, comfortable indoor climate and an even temperature.
- Does not cause any air movement, as traditional heating systems often do. Reducing the spread of dust, bacteria or odours improves the quality of the indoor environment.

Discreet

- The system is completely silent.
- Mounting on the ceiling or recessed in a false ceiling gives a discreet heating.



Installation examples for radiant heaters

Frico radiant heaters are available for different kinds of heating and for different application areas. To facilitate your choice of product, you will find some typical cases on the following pages. More detailed information on important factors to consider when choosing a radiant heater is found on the previous pages.

Basic criterias:

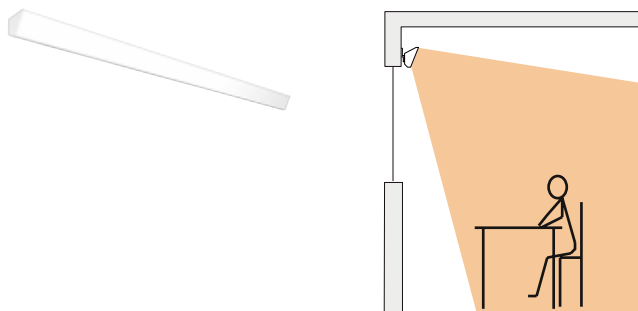
1. Type of premises – store, warehouse etc.
2. Type of heating - total heating, zone heating, cold draught protection
3. Height, installation height
4. Mounting: wall or ceiling
5. Connection: with electrical heat or water heat

Offices, shops and public premises

Cold draught protection, office

1. Type of premises: office
2. Type of heating: cold draught protection
3. Height: 3 metres
4. Mounting: wall
5. Connection: electrical

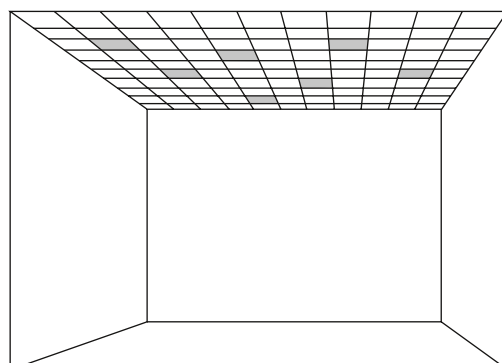
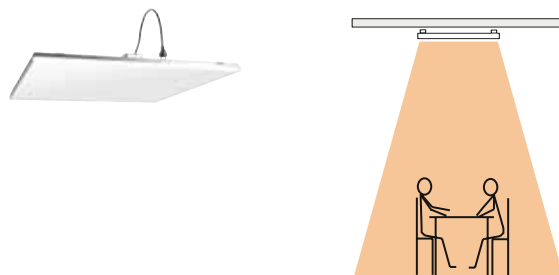
Recommendation: Thermoplus is designed for cold draught protection for normally sized windows. The heaters are mounted above the windows, covering their whole width for maximum protection.



Total heating, cafeteria

1. Type of premises: cafeteria
2. Type of heating: total heating
3. Height: 2,80 metres
4. Mounting: ceiling
5. Connection: electrical

Recommendation: Thermocassette can be recessed into a false ceiling. When using Thermocassette for total heating, the units should be spread out through the ceiling for example as shown.



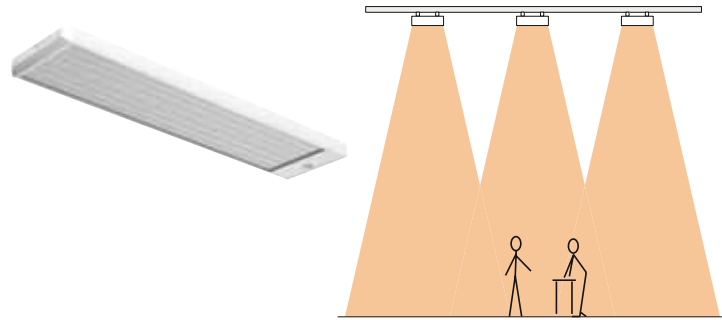
Radiant heaters

Industry

Total heating, workshop

1. Type of premises: workshop
2. Type of heating: total heating
3. Height: 5 metres
4. Mounting: ceiling
5. Connection: with electrical heat

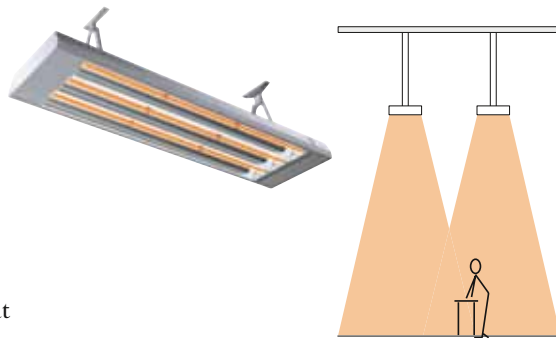
Recommendation: A number of EZ300 evenly positioned over the area to be heated creates comfortable heat.



Zone heating, factory

1. Type of premises: work station in factory
2. Type of heating: zone heating
3. Height: 6 metres
4. Mounting: ceiling
5. Connection: with electrical heat

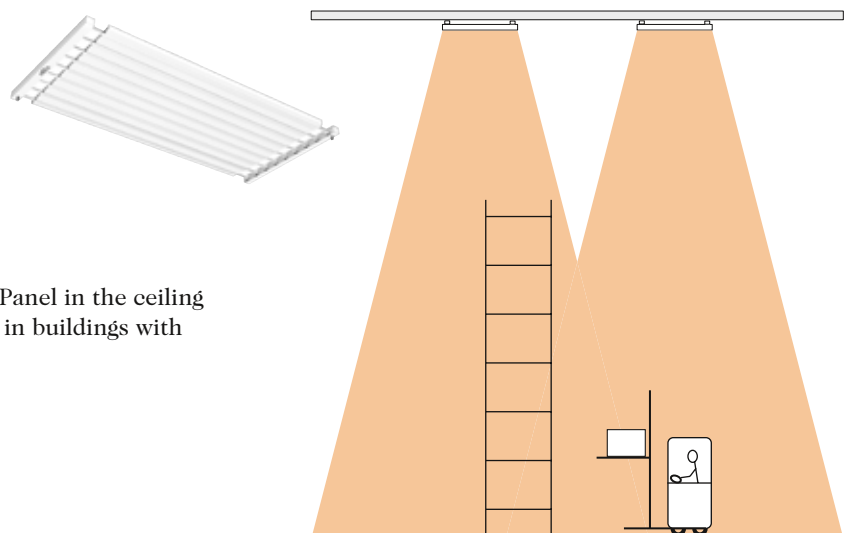
Recommendation: The reflectors of IR reduces the heat dispersion making IR emitting heat on a defined area. This makes IR well suited for zone heating in industrial applications.



Total heating, warehouse

1. Type of premises: warehouse
2. Type of heating: total heating
3. Height: 8 metres
4. Mounting: ceiling
5. Connection: with water heat

Recommendation: Lines of Comfort Panel in the ceiling ensure a comfortable indoor climate in buildings with water supplied heating systems.

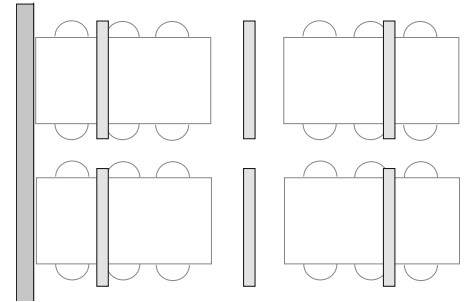
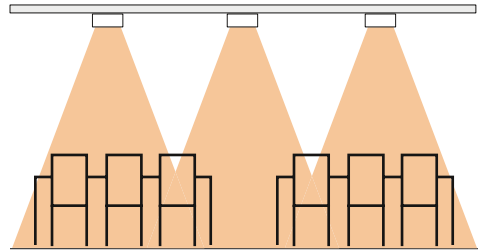


Outdoors

Zone heating, restaurant terrace

- 1. Type of premises: restaurant terrace
- 2. Type of heating: zone heating
- 3. Height: 3 metres
- 4. Mounting: ceiling (above the tables)
- 5. Connection: with electrical heat

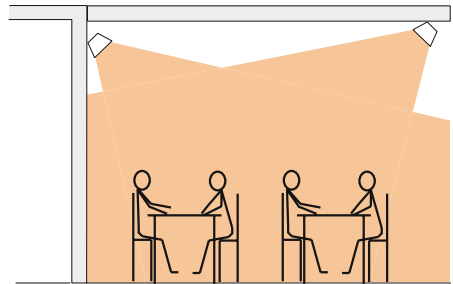
Recommendation: Several CIR mounted in line above the tables ensure the comfort for all customers in deep terraces.



Zone heating, café

- 1. Type of premises: café
- 2. Type of heating: zone heating
- 3. Height: 3 metres
- 4. Mounting: wall and ceiling
- 5. Connection: with electrical heat

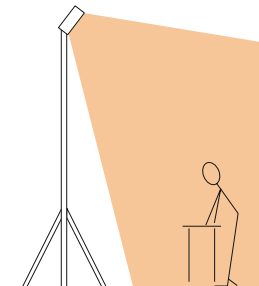
Recommendation: IH can be mounted on the wall or ceiling of the restaurant. Best comfort is given if the heaters heat from two directions.



Zone heating, anywhere

- 1. Type of premises: anywhere
- 2. Type of heating: portable zone heating
- 3. Height: 3 metres
- 4. Mounting: standing support
- 5. Connection: with electrical heat

Recommendation: ELIR can be mounted on a floor stand, available as accessory, making it possible to bring the heater where it is needed, outdoors or indoors.



Offices, shops and public premises



Offices, shops and public premises

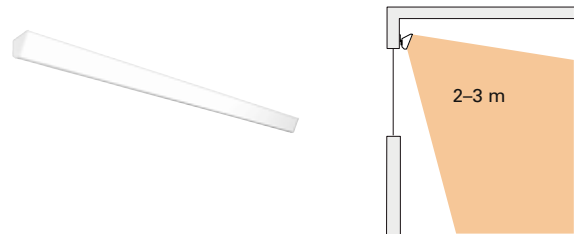
Radiant heaters offer many advantages for applications where silent, discreet and efficient heating is required. They give a safe, hygienic and pleasant heat.

Mounting on the ceiling or recessed in a false ceiling leaves the walls free and gives a discreet heating. Ceiling mounting also protects the heaters from damage, which ensures longer life.

With zone and spot heating as well as protection against cold draughts it is possible to create a comfortable indoor climate with the best economy.

Slim

Thermoplus is mounted above windows and gives an efficient protection against cold draught. The slim shape also makes it suitable for heating areas with limited space, like for example bathrooms. Thermoplus can furthermore be a cost-effective and flexible alternative to floor heating.



Discreet

Thermocassette is intended for discreet heating in offices, bathrooms, schools etc. Designed for either surface or recessed mounting it is well suited for total heating as well as for spot heating of for example a reception desk. Mounted in a false ceiling it is well protected against damage and can easily be moved if necessary (model with cable and plug).



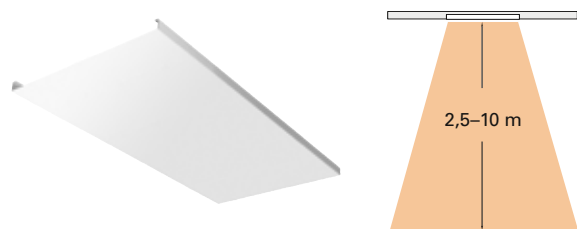
Flexible

EZ100 is intended for total and supplementary heating as well as protection against cold draughts from windows in environments such as offices, shops, restaurants etc.

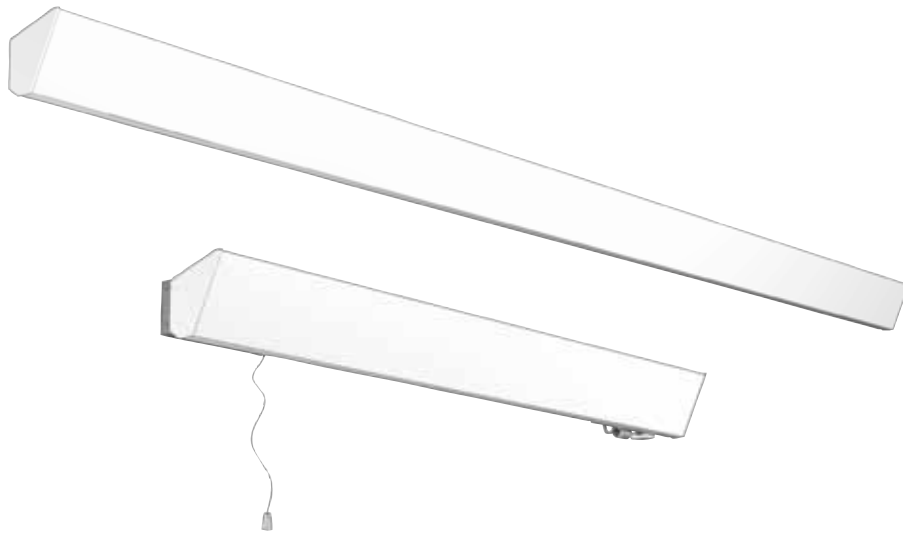


Water heated

Comfort Panel SZR is used for water supplied heating/cooling systems. It can be mounted free hanging or integrated in false ceilings and perfectly suits in fine environments such as offices, shops, etc.



Thermoplus



⚡ 300-900 W Electrical heat

18 models



Thermoplus Slim radiant heater for protection against cold draughts

Application

Thermoplus is mounted above windows and gives an efficient protection against cold draught. The slim shape also makes it suitable for heating areas with limited space, like for example bathrooms. Thermoplus can furthermore be a cost-effective and flexible alternative to floor heating.

Comfort

Radiant heaters give a soft, pleasant heat and individual comfort can be created with spot and zone heating. They also provide excellent protection against cold draught from windows. No moving parts mean a silent system that does not cause air movements and the hygiene is improved when the spread of dust, bacteria or odours is reduced.

Operation and economy

Radiant heaters have an easy and flexible installation and require a minimum of maintenance. Ceiling mounting leaves the walls free and increases safety. They give instant heat and the room temperature can be reduced with maintained comfort. The enamelled front panel gives an enhanced heating emission.

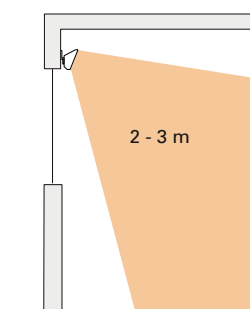
Design

Thermoplus is covered with white enamel which makes it discreet and scratch-resistant. The slim shape makes it practically invisible when mounted in the ceiling angle.

Product specifications

- Thermoplus is available in three versions:
 - **Type EC**, for dry rooms. Controlled by a separate thermostat or output control. IP20.
 - **Type ECVT**, for wet rooms. With a built-in cord switch and thermostat. IP44.
 - **Type ECV**, for wet rooms. Primarily designed for connection as slave device to ECVT, but can also be controlled separately using the same methods as for EC. IP44.
- Brackets for wallmounting are included. Fixtures for ceiling mounting are extra.
- Mounted above the window.
- Cable entry on the left side seen from the front.
- Front panel of white scratch-resistant enamelled aluminium. Colour: RAL 9010. Rear panel of hot zinc-plated steel panels.

Installation height





The space close to the window can be used when the cold draught is eliminated. Mounted close together several Thermoplus form a continuous plinth.



Thermoplus is used for cold draught protection. The radiant heat moulding is very discreet as it is positioned high up along a beam.



Thermoplus take up minimum space mounted in the ceiling angle.



Thermoplus creates a pleasant heat in the room and on the floor and can be a cost effective alternative to floor heating.

Technical specifications | Thermoplus EC. For dry rooms. ⚡

Type	Heat output [W]	Voltage [V]	Amperage [A]	Surface temperature [°C]	Dimensions LxHxD [mm]	Weight [kg]
EC45021	450	230V~	2,0	180	1076x100x90	2.6
EC45031	450	400V~	1,1	180	1076x100x90	2.6
EC60021	600	230V~	2,6	180	1505x100x90	3.7
EC60031	600	400V~	1,5	180	1505x100x90	3.7
EC75021	750	230V~	3,3	180	1810x100x90	4.4
EC75031	750	400V~	1,9	180	1810x100x90	4.4
EC90021	900	230V~	3,9	180	2140x100x90	4.8
EC90031	900	400V~	2,3	180	2140x100x90	4.8

Technical specifications | Thermoplus ECVT. For wet rooms. Built-in thermostat, electric switch, signal lamp. ⚡

Type	Heat output [W]	Voltage [V]	Amperage [A]	Surface temperature [°C]	Dimensions LxHxD [mm]	Weight [kg]
ECVT30021	300	230V~	1,3	180	870x100x90	2.6
ECVT55021	550	230V~	2,4	180	1505x100x90	4.3
ECVT55031	550	400V~	1,4	180	1505x100x90	4.3
ECVT70021	700	230V~	3,0	180	1810x100x90	5.0
ECVT70031	700	400V~	1,8	180	1810x100x90	5.0

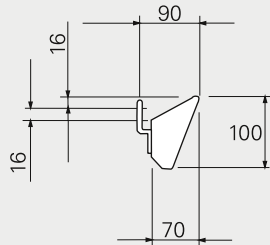
Technical specifications | Thermoplus ECV. For wet rooms. Connected as slave device to ECVT. ⚡

Type	Heat output [W]	Voltage [V]	Amperage [A]	Surface temperature [°C]	Dimensions LxHxD [mm]	Weight [kg]
ECV30021	300	230V~	1,3	180	870x100x90	2.3
ECV55021	550	230V~	2,4	180	1505x100x90	4.0
ECV55031	550	400V~	1,4	180	1505x100x90	4.0
ECV70021	700	230V~	3,0	180	1810x100x90	4.7
ECV70031	700	400V~	1,8	180	1810x100x90	4.7

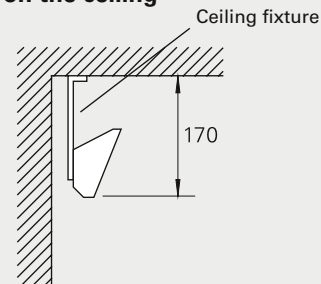
Protection class: Thermoplus EC: (IP20) normal design. Thermoplus ECVT and ECV: (IP44) splash-proof design. CE compliant.

Dimensions

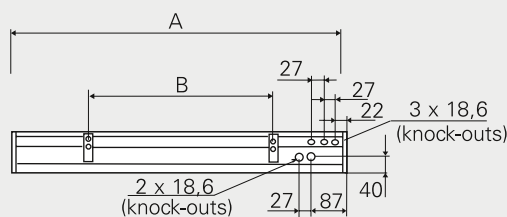
Mounting on the wall



Mounting on the ceiling

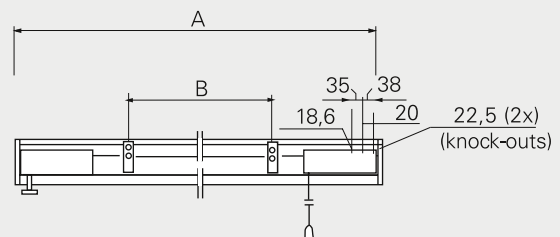


Type EC



	A [mm]	B [mm]
EC450	1076	600
EC600	1505	900
EC750	1810	1200
EC900	2140	1800

Type ECV, ECVT



	A [mm]	B [mm]
ECV(T)300	870	400
ECV(T)550	1505	900
ECV(T)700	1810	1200

Mounting and connection

Mounting

Thermoplus among other things is used to protect against cold draughts from windows and is mounted horizontally above the window. In comparison to conventional radiators, Thermoplus is mounted above instead of below the window and is thus especially suitable for areas where there are children.

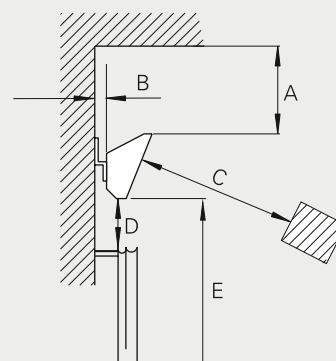
Two wall mounting brackets are included as standard.

Fixtures for ceiling mounting are extra, TF1. For minimum mounting distance, see Fig. 1.

Connection

Thermoplus is intended for permanent installation. There is a 5-poled plinth (4 x 6 mm² + earth) in the terminal box which allows bridge connection. Several Thermoplus can be connected to one thermostat or electric heating control.

Type EC is controlled by a separate thermostat or output control. ECVT has a built-in cord switch and thermostat. ECV is primarily designed to be a slave connected to ECVT, maximum 3600 W at 230 V~ or 4000 W at 400 V~, but can also be regulated separately using the same methods as for EC.

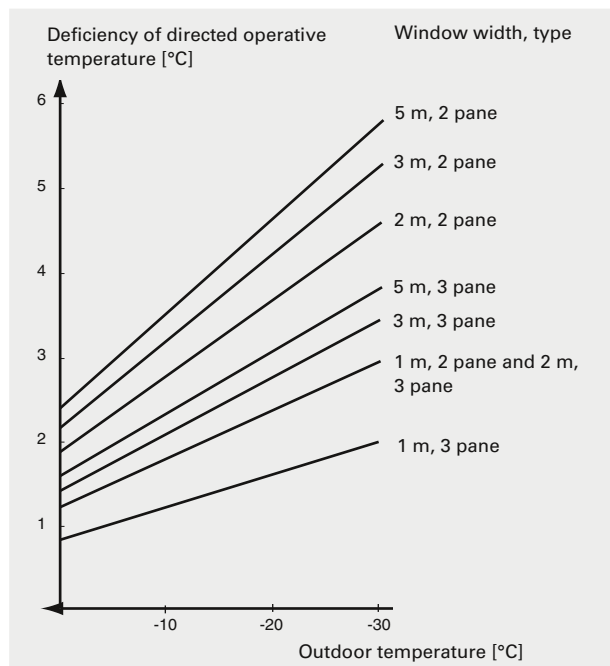


Flammable material, e.g. curtain

		Min.distance [mm]
Ceiling	A	60
Wall, long side of the unit	B	25
Flammable material, front of the unit	C	90
Flammable material, bottom of the unit	D	25
Floor	E	1800

Fig. 1: Minimum distance for fixed installation.

Effect on the temperature near windows

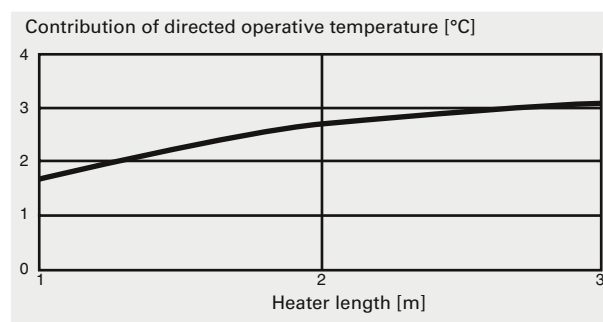


Temperature differentials

The diagram to the left refers to temperature loss through a window that is 1.7 metre high and is measured 1.0 metre into the room from the centre of the window.

Heat contribution

The contribution to operative temperature is measured at a ceiling height of 2.4 metres, one meter into the room from the centre of the window.



Control options

Output control

Stepless control that precisely adapts energy use to the current demand, giving maximal benefit from radiant heating. This results in a soft comfortable heating and lower energy costs.

- ERP, electric heating control
- ERPS, electric heating control (slave)

Control by thermostat

The choice of thermostat depends on needs and environment. If the load exceeds the limits of the thermostats or if you want to control large systems, a contactor can be used.

- T10, electronic thermostat with concealed knob
- TKS16, electronic thermostat with visible knob, 1-pole switch
- TD10, thermostat with digital display
- KRT1900, capillary room thermostat, IP55

Controls and other accessories

Type	Description	HxWxD [mm]
ERP	Electric heating control	153x94x43
ERPS	Electric heating control (slave)	153x94x43
T10	Electronic thermostat	80x80x31
TKS16	Electronic thermostat, knob, 1-pole switch	80x80x39
TD10	Electronic thermostat, display	80x80x31
KRT1900	Capillary room thermostat, IP55	165x57x60
TF1	Fixture for ceiling mounting	
OS1	Protection net 1070 mm	L:1070
OS2	Protection net 1500 mm	L:1500

Accessories

TF1, fixture for ceiling mounting

To mount Thermoplus on the ceiling.

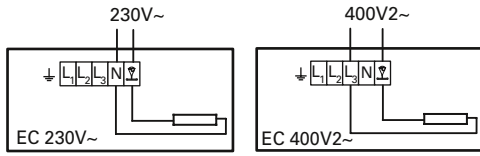
OS1/2, protection net

The protection net prevents direct contact with the top of the heater and is of galvanized thread net. It is braced between the wall and the heater. Available in two lengths: 1070 and 1500 mm.

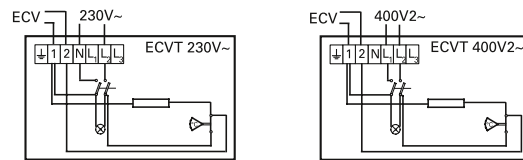
For further options, see section on thermostats and controls or contact Frico.

Wiring diagrams

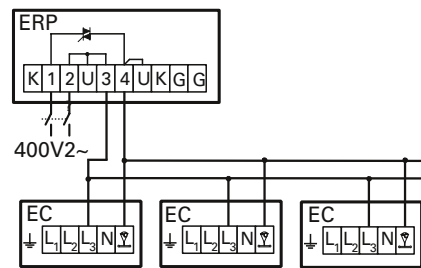
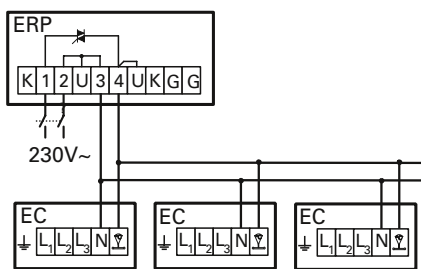
Internal wiring diagram EC



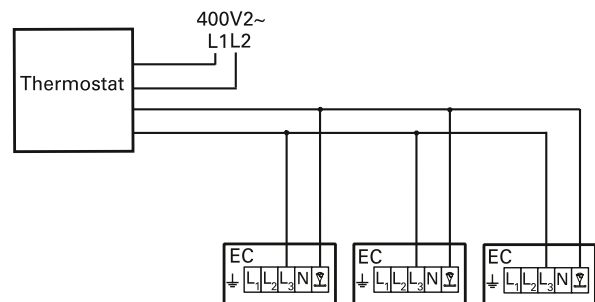
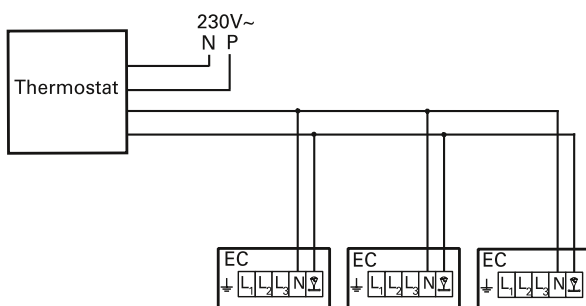
Internal wiring diagram ECVT



Output control



Control by thermostat



Thermocassette HP



⚡ 300–600 W Electrical heat

4 models



Thermocassette HP

Discreet radiant heat cassette for recessed or surface mounting

Application

Thermocassette is intended for discreet heating in offices, bathrooms, schools etc. Designed for either surface or recessed mounting it is well suited for total heating as well as for spot heating of for example a reception desk. Mounted in a false ceiling it is well protected against damage and can easily be moved if necessary (model with cable and plug).

Comfort

Radiant heaters give a soft, pleasant heat and individual comfort can be created with spot and zone heating. They also provide excellent protection against cold draught from windows. No moving parts mean a silent system that does not cause air movements and the hygiene is improved when the spread of dust, bacteria or odours is reduced.

Operation and economy

Radiant heaters have an easy and flexible installation and require a minimum of maintenance. Ceiling mounting leaves the walls free and increases safety. They give instant heat and the room temperature can be reduced with maintained comfort.

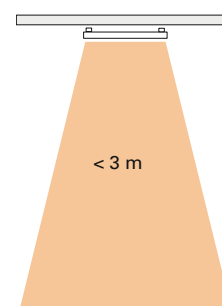
Design

Recessed mounting make the heater an integral part of the ceiling.

Product specifications

- Thermocassette is available in two versions:
 - **HP300/600**, for false ceiling systems. IP20.
 - **HP305/605**, standard model with brackets, approved for rooms where there is risk of fire and recommended for use in agricultural buildings. IP55.
- The low surface temperature (max. 100 °C) make Thermocassette well suited for low ceiling heights. There is no risk of burns to the person(s) in this vicinity.
- Corrosion proof casing of hot zinc-plated and powder lacquered steel panels. Colour: RAL 9016.

Installation height



Thermocassette HP



Comfortable heat where you need it. Thermocassette can easily be moved if necessary.



Mounting on the ceiling protects Thermocassette against damage.



Thermocassette creates a pleasant heat on the floor in premises where you might want to be barefooted.



An attractive and almost invisible heating is created when Thermocassette is mounted in a false ceiling. The heating cassettes can easily be moved if the furnishing is rearranged.

Thermocassette HP

Technical specifications | Thermocassette HP. False ceiling model. Without brackets. ⚡

Type	Heat output [W]	Voltage [V]	Amperage [A]	Max. surface temperature [°C]	Dimensions LxWxH [mm]	Weight [kg]
HP300	300	230V~	1,3	100	593x593x30	5,4
HP600	600	230V~	2,6	100	593x1193x30	10,3

Technical specifications | Thermocassette HP. Special model. With brackets. ⚡

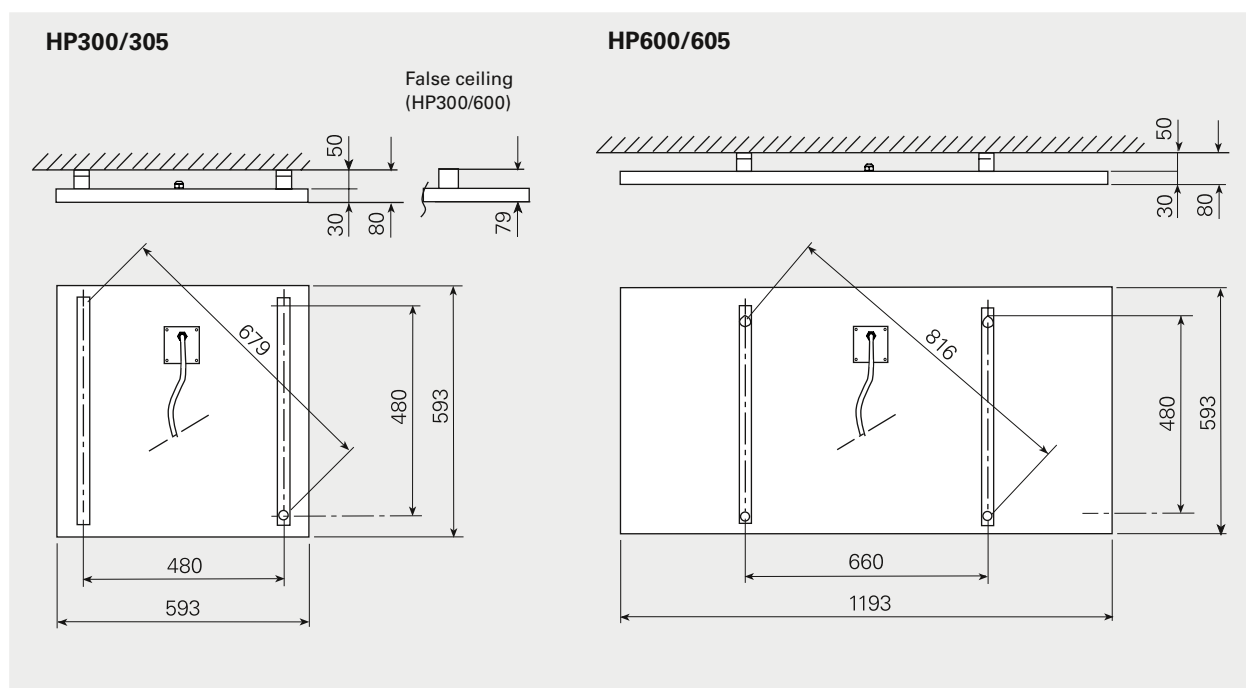
Type	Heat output [W]	Voltage [V]	Amperage [A]	Max. surface temperature [°C]	Dimensions LxWxH [mm]	Weight [kg]
HP305	300	230V~	1,3	100	593x593x80*	5,8
HP605	600	230V~	2,6	100	593x1193x80*	10,7

*) Height with brackets

Protection class:

HP300/600: (IP20), normal design. CE compliant.

HP305/605: (IP55), jet-proof design. CE compliant. Approved for use in rooms where there is risk of fire and recommended for use in agricultural buildings.



Positioning, mounting and installation

Positioning

To estimate approximately how many radiant heaters are needed to cover an area the formula is:

$$\text{Min. number of heaters} = \frac{\text{Area of the premises [m}^2\text{]}}{\text{Installation height [m]} \times \text{Installation height [m]}}$$

This formula is a basic estimation of the minimum number of radiant heaters needed to maintain the comfort. To calculate the right output for each heater, the total heating requirement must be calculated, see the Technical handbook.

Mounting

HP300/600 is designed to be mounted in false ceilings. HP305/605 can be mounted in false ceilings, but are primarily intended for mounting on the ceiling or hung from wire. Wire mounting set, 74701, is extra. For minimum mounting distance, see Fig. 2.

Connection

HP300/600 is equipped with a 4 metres cable and plug, as well as special plugs that make joint connection very easy. HP305/605 is equipped with a 1,8 meter cable, plug excluded.

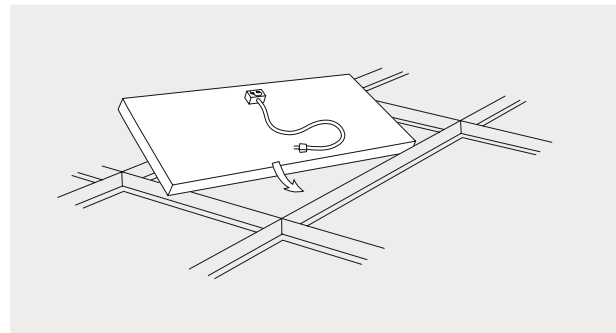


Fig. 1: Mounting in false ceilings.

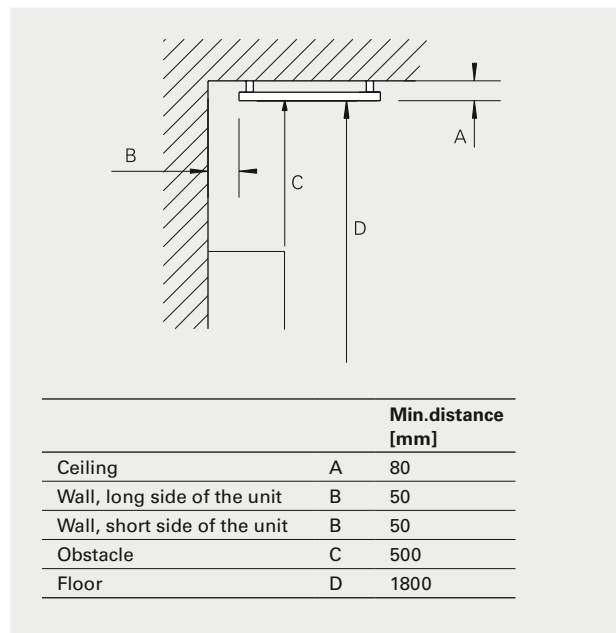


Fig. 2: Minimum mounting distance.

Control options

Output control

Stepless control that precisely adapts energy use to the current demand, giving maximal benefit from radiant heating. This results in a soft comfortable heating and lower energy costs.

- ERP, electric heating control
- ERPS, electric heating control (slave)

Control by thermostat

The choice of thermostat depends on needs and environment. If the load exceeds the limits of the thermostats or if you want to control large systems, a contactor can be used.

- T10, electronic thermostat with concealed knob
- TKS16, electronic thermostat with visible knob, 1-pole switch
- TD10, thermostat with digital display
- KRT1900, capillary room thermostat, IP55

For further options, see section on thermostats and controls or contact Frico.

Accessories

SKB10, shelter bars

Extra fixture bars for shelters.

74701, wire mounting kit

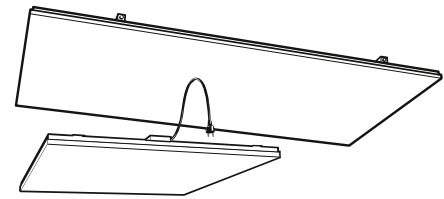
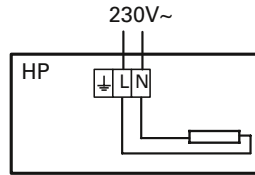
Complete mounting kit for mounting on wire, gives a drop of approx. 0.5 metres.

Controls and other accessories

Type	Description	HxWxD [mm]
ERP	Electric heating control	153x94x43
ERPS	Electric heating control (slave)	153x94x43
T10	Electronic thermostat	80x80x31
TKS16	Electronic thermostat, knob, 1-pole switch	80x80x39
TD10	Electronic thermostat, display	80x80x31
KRT1900	Capillary-room thermostat, IP55	165x57x60
SKB10	Shelter bars	
74701	Wire mounting kit	

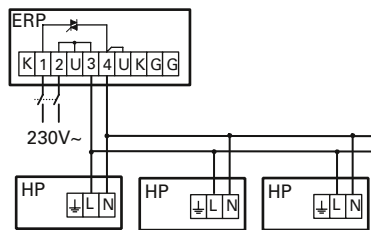
Wiring diagrams

Internal wiring diagram

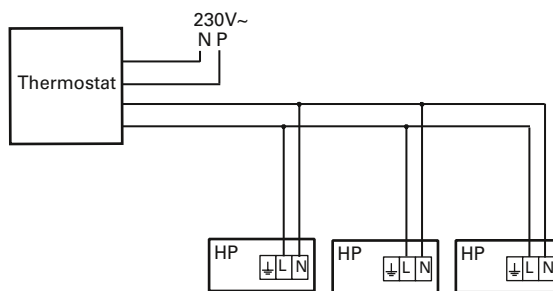


Thermocassette HP

Output control



Control by thermostat



Elztrip EZ100



 600-1500 W Electrical heat

3 models



Elztrip EZ100

Single panel radiant heater for offices, shops etc.

Application

EZ100 is intended for total and supplementary heating as well as protection against cold draughts from windows in environments such as offices, shops, restaurants etc.

Comfort

Radiant heaters give a soft, pleasant heat and individual comfort can be created with spot and zone heating. They also provide excellent protection against cold draught from windows. No moving parts mean a silent system that does not cause air movements and the hygiene is improved when the spread of dust, bacteria or odours is reduced.

Operation and economy

Radiant heaters have an easy and flexible installation and require a minimum of maintenance. Ceiling mounting leaves the walls free and increases safety. They give instant heat and the room temperature can be reduced with maintained comfort.

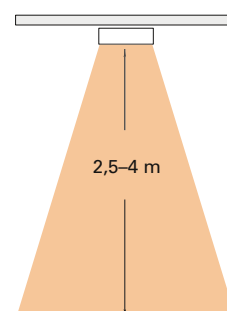
Design

EZ100 is a single panel radiant heater with clean and simple design that blends well with electrical fittings.

Product specifications

- Surface structure for best efficiency.
- The heaters are approved for serial connection.
- Fixtures for easy mounting on the ceiling are included.
- Bracket for wall mounting (EZMVK) is available as an accessory.
- Corrosion proof casing of hot zinc-plated and powder lacquered steel panels. Colour: RAL 9016.

Installation height





Corridors can be difficult to heat, but ceiling mounted EZ100 give off heat just where it is needed.



The nice wooden walls are kept free with EZ100 mounted on the ceiling.



Buildings that are used on an irregular basis can be heated fast without a high energy consumption. EZ100 blends well with electrical fittings.



Spot heating with EZ100 is safe and hygienic.

Elztrip EZ100

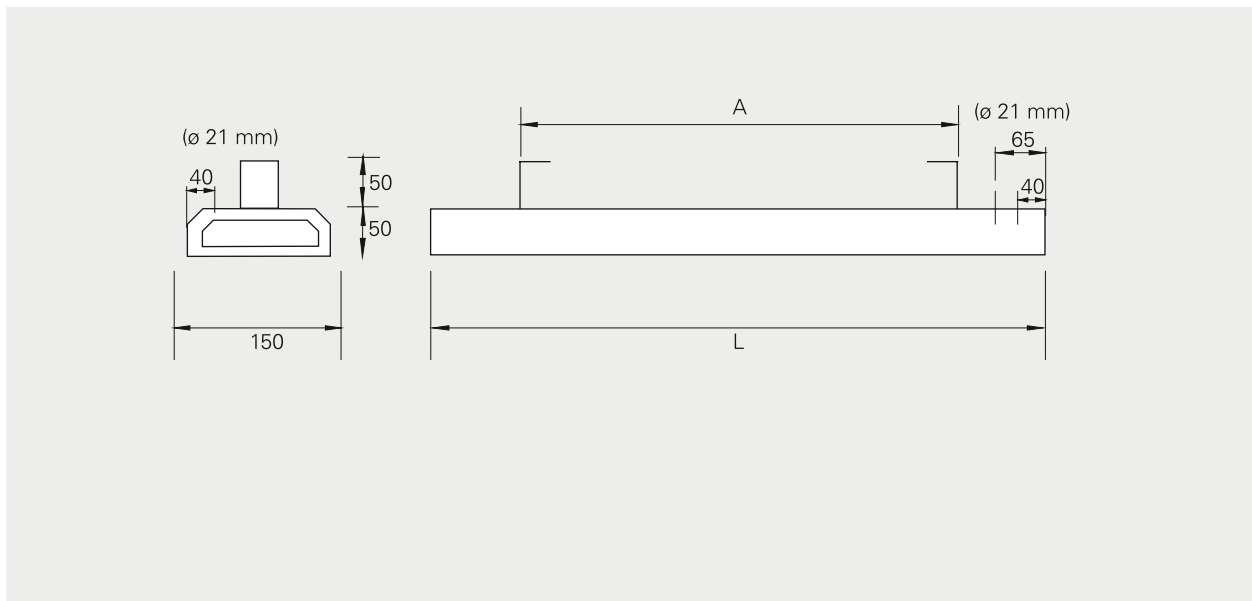
Technical specifications | Elztrip EZ 100 ⚡

Type	Output [W]	Voltage [V]	Amperage [A]	Max. surface temperature [°C]	Dimensions LxHxW [mm]	Weight [kg]
EZ106	600	230V~	2.6	280	1000x50x150	3.7
EZ111	1050	230V~	4.6	280	1500x50x150	5.4
EZ115	1500	230V~	6.5	280	2000x50x150	7.8

Protection class: IP44.

Approved by SEMKO and CE compliant.

Dimensions



Positioning, mounting and installation

Positioning

To estimate approximately how many radiant heaters are needed to cover an area the formula is:

$$\text{Min. number of heaters} = \frac{\text{Area of the premises [m}^2\text{]}}{\text{Installation height [m]} \times \text{Installation height [m]}}$$

This formula is a basic estimation of the minimum number of radiant heaters needed to maintain the comfort. To calculate the right output for each heater, the total heating requirement must be calculated, see the Technical handbook.

When planning an Elztrip installation, the distance between the heaters should not be greater than the height between heater and floor, that means (a) should be less than (H). See Fig. 1. In rooms not often used, the comfort demands are usually lower and the distance between the heaters can be increased. In rooms frequently used, the distance between a sedentary person and heater should be at least between 1.5 to 2 metres (Δh). When these two guide lines are followed, the difference in operative temperature will not exceed the comfort level $\Delta t_{op} = 5\text{ }^\circ\text{C}$. This means that the difference between the real temperature and the temperature that we sense, will not be more than $5\text{ }^\circ\text{C}$.

Mounting

Elztrip EZ100 is mounted on the ceiling, on armature rails, on wire or suspended etc. EZ100 should always be mounted horizontally. For minimum mounting distance, see Fig. 2. Ceiling fixtures and screws are found inside the connection box. Brackets for wall mounting (EZMVK) are extra. See Fig. 3.

Connection

EZ100 is intended for permanent installation. Connection and serial connection of EZ100 is done with a maximum cable size of $4 \times 2.5\text{ mm}^2 + \text{earth}$.

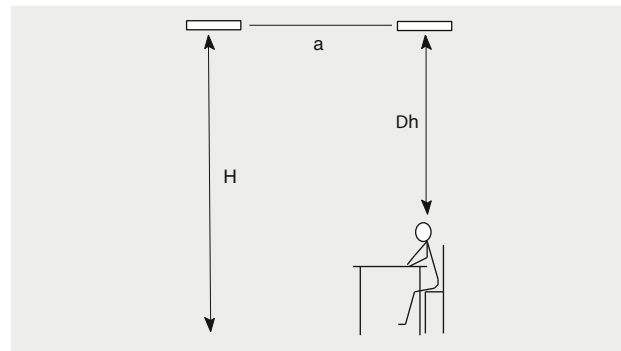
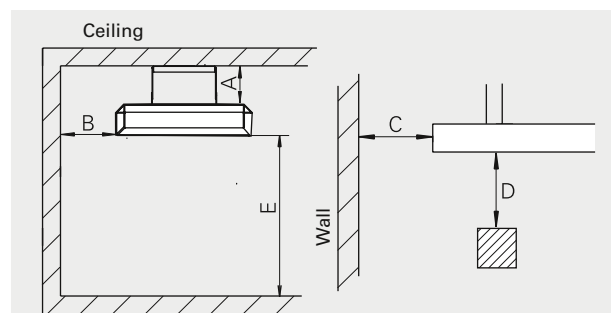


Fig. 1: Positioning vertically.



		Min.distance [mm]
Ceiling	A	50
Wall, long side of the unit	B	50
Wall, short side of the unit	C	50
Flammable material	D	500
Floor	E	1800

Fig. 2: Minimum mounting distance.

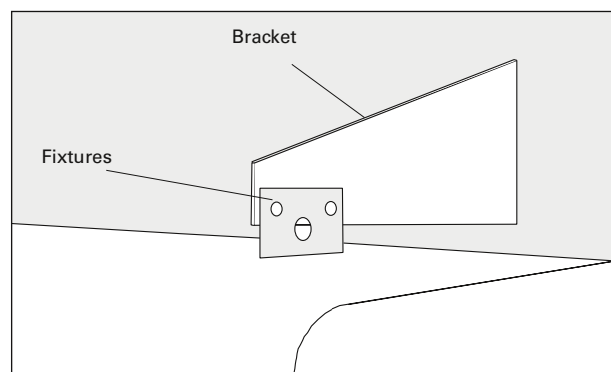


Fig. 3: Brackets for wall mounting EZMVK (extra).

Control options

Output control

Stepless control that precisely adapts energy use to the current demand, giving maximal benefit from radiant heating. This results in a soft comfortable heating and lower energy costs.

- ERP, electric heating control
- ERPS, electric heating control (slave)

Control by thermostat

The choice of thermostat depends on needs and environment. If the load exceeds the limits of the thermostats or if you want to control large systems, a contactor can be used.

- T10, electronic thermostat with concealed knob
- TKS16, electronic thermostat with visible knob, 1-pole switch
- TD10, thermostat with digital display
- KRT1900, capillary room thermostat, IP55

Output control with timer

Stepless control especially suitable for spot and zone heating. The heat contribution is controlled for best comfort. Built-in timer is set to desired time.

- CIRT, stepless output control with timer

For further options, see section on thermostats and controls or contact Frico.

Accessories

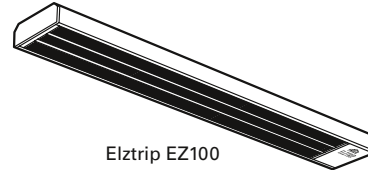
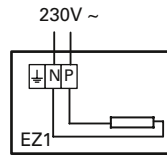
EZMVK, mounting bracket

To mount EZ100 on the wall, see Fig.3.

Controls and other accessories

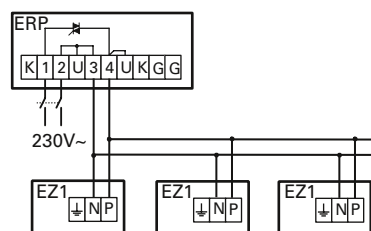
Type	Description	HxWxD [mm]
ERP	Electric heating control	153x94x43
ERPS	Electric heating control (slave)	153x94x43
T10	Electronic thermostat	80x80x31
TKS16	Electronic thermostat, knob, 1-pole switch	80x80x39
TD10	Electronic thermostat, display	80x80x31
KRT1900	Capillary room thermostat, IP55	165x57x60
CIRT	Stepless output control with timer	155x87x43
EZMVK	Mounting bracket	

Wiring diagrams

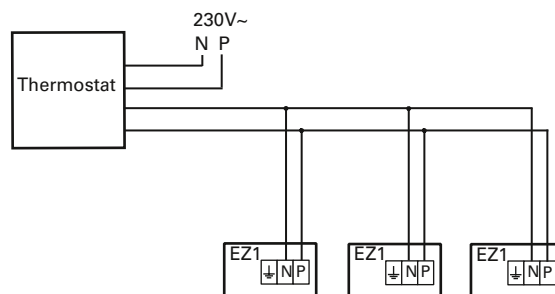


Elztrip EZ100

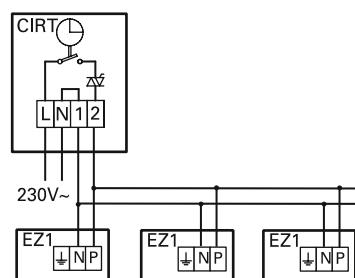
Output control



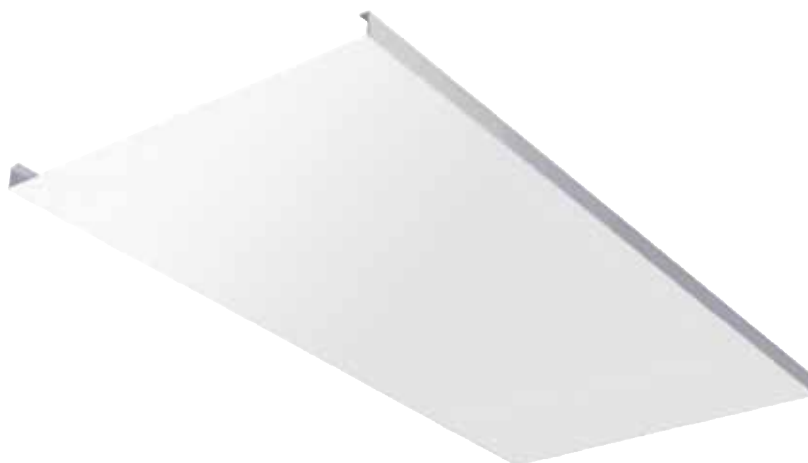
Control by thermostat



Output control with timer



Comfort Panel SZR



Water heat

Lengths: 0,6; 1,2; 1,8; 2,4; 3,0 metres **CE**

Comfort Panel SZR

Water heated radiant heater for recessed mounting in false ceilings or free hanging

Application

Comfort Panel SZR is used for water supplied heating/cooling systems. It can be mounted free hanging or integrated in false ceilings and perfectly suits in fine environments such as offices, shops, etc.

Comfort

Radiant heaters give a soft, pleasant heat and individual comfort can be created with spot and zone heating. They also provide excellent protection against cold draught from windows. No moving parts mean a silent system that does not cause air movements and the hygiene is improved when the spread of dust, bacteria or odours is reduced.

Operation and economy

Radiant heaters have an easy and flexible installation and require a minimum of maintenance. Ceiling mounting leaves the walls free and increases safety. They give instant heat and the room temperature can be reduced with maintained comfort.

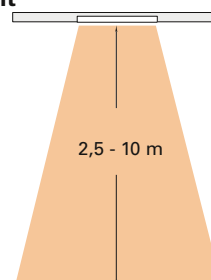
Design

Discreet flat satin finished surface that matches most false ceiling panel designs. A perfect symmetry can be created with heating/cooling panels in combination with non active panels.

Product specifications

- Comfort Panel SZR is available in following versions:
 - **SZRxxxP** for recessed mounting in false ceilings.
 - **SZRxxxM** for free hanging mounting.
- The panels are available in five lengths with three different pipe settings. The lengths can be combined to a total panel length desired. Non active panels are available.
- Complies to EN14037 which is based on the EU Construction Product Directives 89/106/CEE. EN14037 is compulsory for a CE mark for water heated radiant heaters.
- Optimal heat distribution. For best possible contact the water tube is fixed by a cover plate welded to the radiating panel.
- Suspension accessories are available.
- Epoxy-polyester coating in RAL 9010 (white) as standard.

Installation height





The satin finished surface matches most false ceiling panel designs. A perfect symmetry can be created with heating/cooling panels in combination with non-active panels.



Comfort Panel SZR can be recessed into the false ceiling or be mounted free hanging with a skirting accessory kit available if required.

Comfort Panel SZR

Technical specifications | Comfort Panel SZR water heated for recessed mounting

Type	Heat output* ² [W/pcs]	Max working pressure [bar]	Max water temperature [°C]	Weight [kg]	LxHxW [mm]
SZR060P* ¹	178	4	90	7	595x35x595
SZR120P* ¹	355	4	90	14	1195x35x595
SZR180P* ¹	534	4	90	21	1795x35x595
SZR240P* ¹	713	4	90	28	2395x35x595
SZR300P* ¹	893	4	90	35	2995x35x595
SZRN60P	Non active panel	-	-	4	595x35x595
SZRN120P	Non active panel	-	-	8	1195x35x595

*1) Panels are available with three different pipe settings; P, A and B (SZRxxxPP, SZRxxPA and SZRxxxPB). See next page.

*2) Applicable at water temperature 80/60 °C, air temperature +20 °C.

Technical specifications | Comfort Panel SZR water heated for free hanging mounting

Type	Heat output* ² [W/pcs]	Max working pressure [bar]	Max water temperature [°C]	Weight [kg]	LxHxW [mm]
SZR060M* ¹	178	4	90	7	610x35x610
SZR120M* ¹	355	4	90	14	1234x35x610
SZR180M* ¹	534	4	90	21	1858x35x610
SZR240M* ¹	713	4	90	28	2482x35x610
SZR300M* ¹	893	4	90	35	3106x35x610
SZRN60M	Non active panel	-	-	4	610x35x610
SZRN120M	Non active panel	-	-	8	1234x35x610

*1) Panels are available with three different pipe settings; M, A and B (SZRxxxMM, SZRxxMA and SZRxxxMB). See next page.

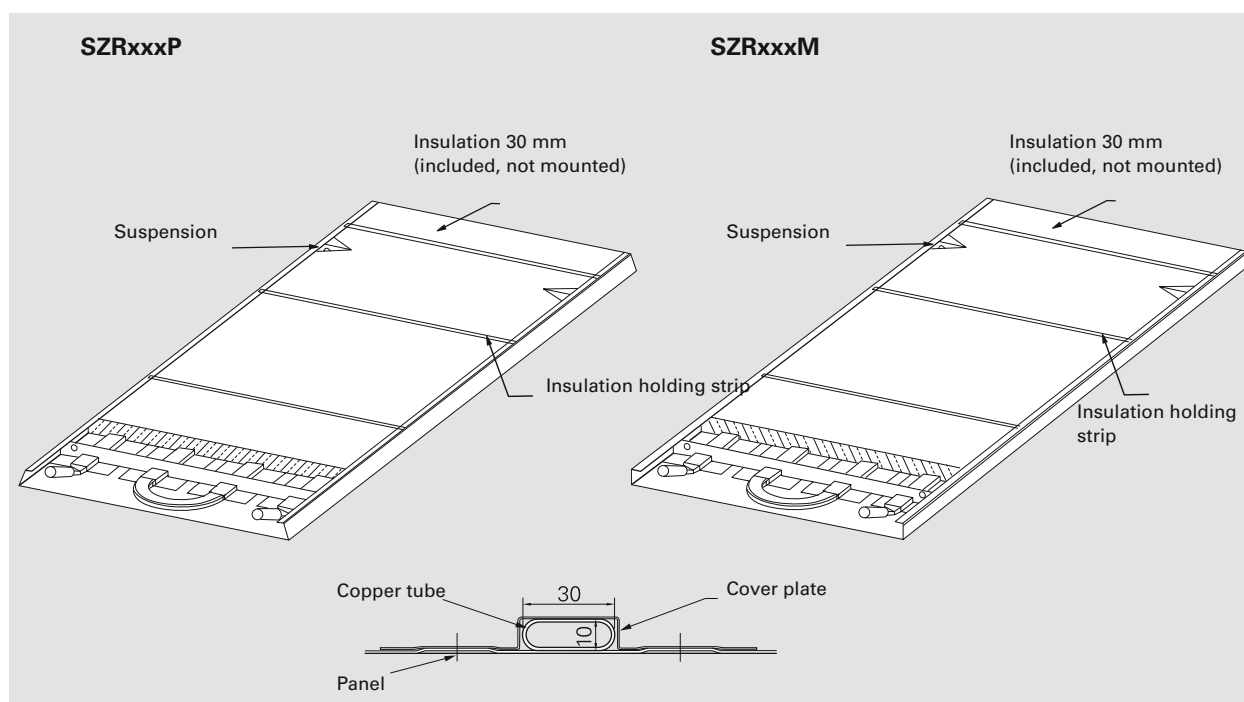
*2) Applicable at water temperature 80/60 °C, air temperature +20 °C.

CE compliant according to EN14037.

Construction

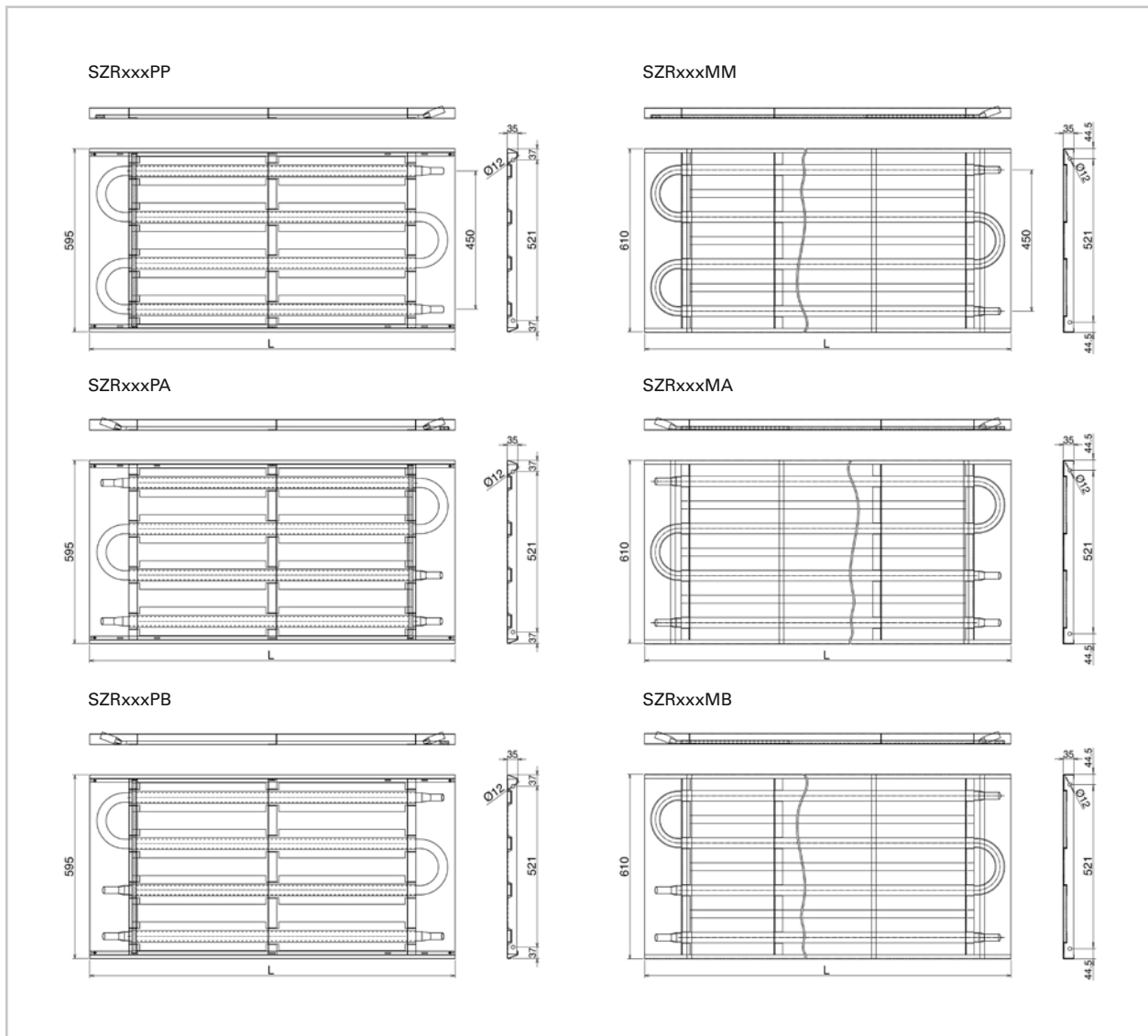
The Comfort Panel SZR radiant panels are made of a 1 mm thick galvanized steel plate. A 0,75 mm thick oblong-shaped copper tube is fixed to the panel. A galvanized cover plate is welded to the panel in order to hold the tube in place and to secure the best surface contact between the tube and the panel.

An insulating layer of mineral wool (30 mm thick) protected by an aluminium sheet (25 micron thick) is supplied with Comfort Panel SZR to be mounted on the top of the panel.

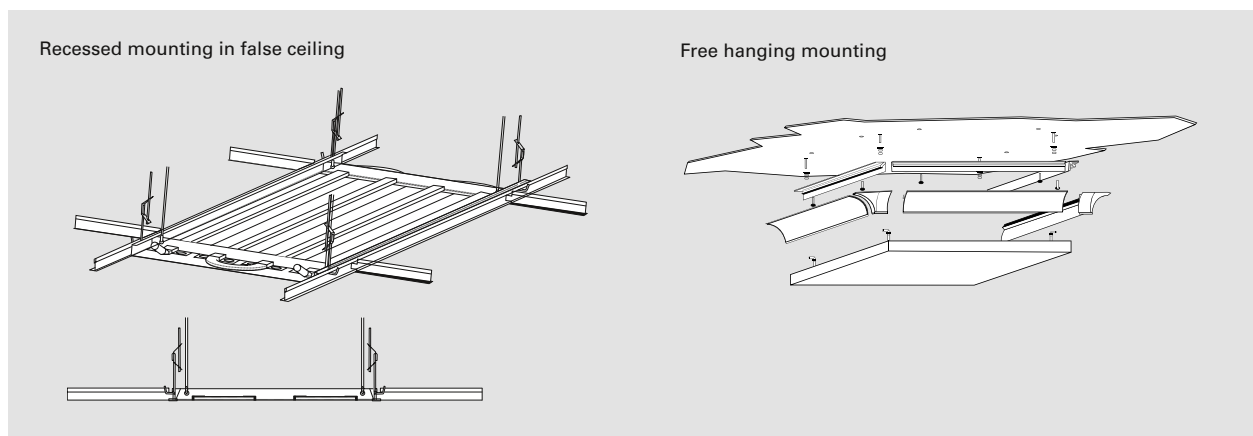


A Comfort Panel handbook with detailed information is available at www.frico.se. Further information can also be obtained by contacting Frico.

Dimensions



Mounting



A Comfort Panel handbook with detailed information is available at www.frico.se. Further information can also be obtained by contacting Frico.

Industry and large premises



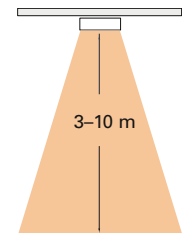
Industry and large premises

The principle of radiant heaters is well used in buildings with high ceilings such as industrial premises. There are no heat losses between heater and floor since radiant heaters only create the heat when they hit a surface.

An industrial building often consists of zones that require different temperatures. With radiant heaters it is possible to direct the heat where it is needed and create different temperature zones.

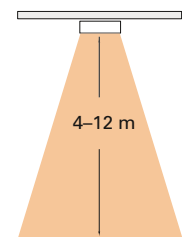
Allround

EZ200 is intended for total and supplementary heating as well as protection against cold draughts from windows in environments such as, department stores, assembly halls, industrial premises etc.



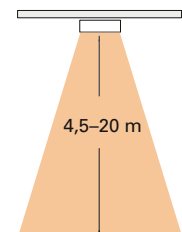
Flexible

EZ300 is intended for total and supplementary heating in industrial environments such as warehouses, workshops etc.



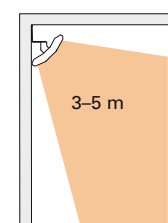
Powerful

IR is suitable for total or supplementary heating of premises with large volume and high ceilings. It can also be used outdoors for example on sport arena stands or to keep loading bays dry and frostless.



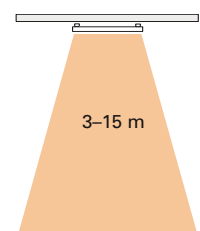
Intense

IRCF is especially designed for spot heating of premises with large air volumes, such as churches, aircraft hangars and marquees. With its high efficiency and compact size it is perfect for many difficult applications.

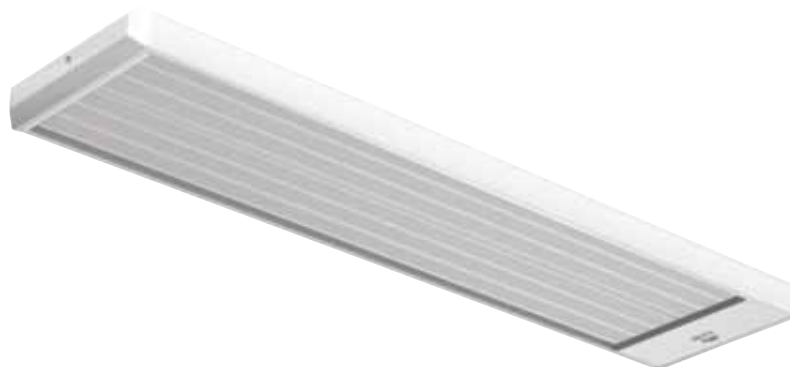


Water heated

Comfort Panel SZ is the ideal system solution for water supplied heating of larger buildings such as industrial buildings, commercial buildings and sports centres. Comfort Panel SZ is suitable for both high and low installation, and extremely high installations are possible with pressurized hot water.



Elztrip EZ200



 800–2200 W Electrical heat

8 models



Elztrip EZ200

Double panel radiant heater for department stores, industrial premises etc.

Application

EZ200 is intended for total and supplementary heating as well as protection against cold draughts from windows in environments such as, department stores, assembly halls, industrial premises etc.

Comfort

Radiant heaters give an efficient and pleasant heat in the dwelling zone and individual comfort can be created with spot and zone heating. No moving parts mean a silent system that does not cause air movements and a hygienic indoor climate is created when the spread of dust, bacteria or odours is reduced.

Operation and economy

Radiant heaters have an easy and flexible installation and require a minimum of maintenance. They give instant heat and no preheating is necessary. Radiant heaters can give cost savings of up to 25 % compared to convector heaters, especially in buildings with high ceilings that are used on an irregular basis.

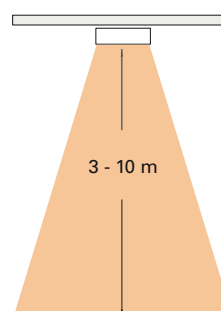
Design

EZ200 is a double panel radiant heater with clean and simple design that blends well with electrical fittings.

Product specifications

- Surface structure for best efficiency.
- The heaters are approved for serial connection.
- Fixtures for easy mounting on the ceiling are included.
- Heating panel of naturally anodized aluminium.
- Corrosion proof casing of hot zinc-plated and powder lacquered steel panels. Colour: RAL 9016.

Installation height





Elztrip is an elegant and effective solution to cold draught problems Hilton in Malmö has adopted this solution in their large glass lobby.



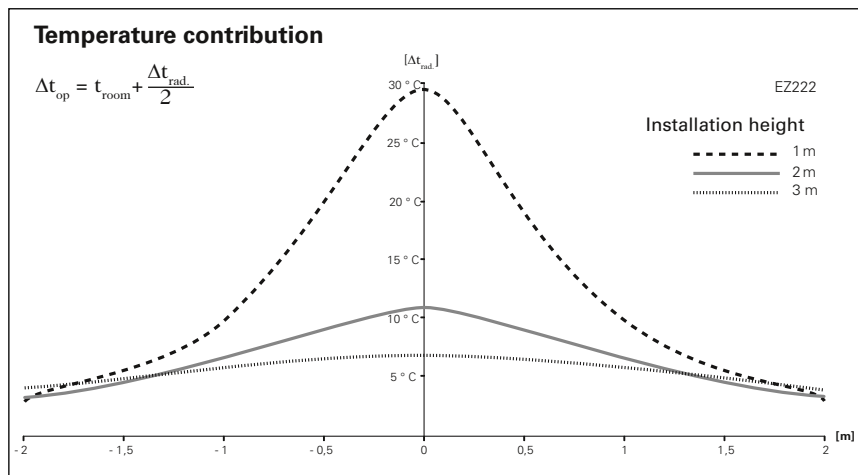
EZ200 is a perfect solution for heating working stations.



EZ200 gives instant heat and no preheating is necessary which makes it ideal for buildings that are used on an irregular basis.



Heating with EZ200 is hygienic since it does not cause any air movements.



Elztrip EZ200

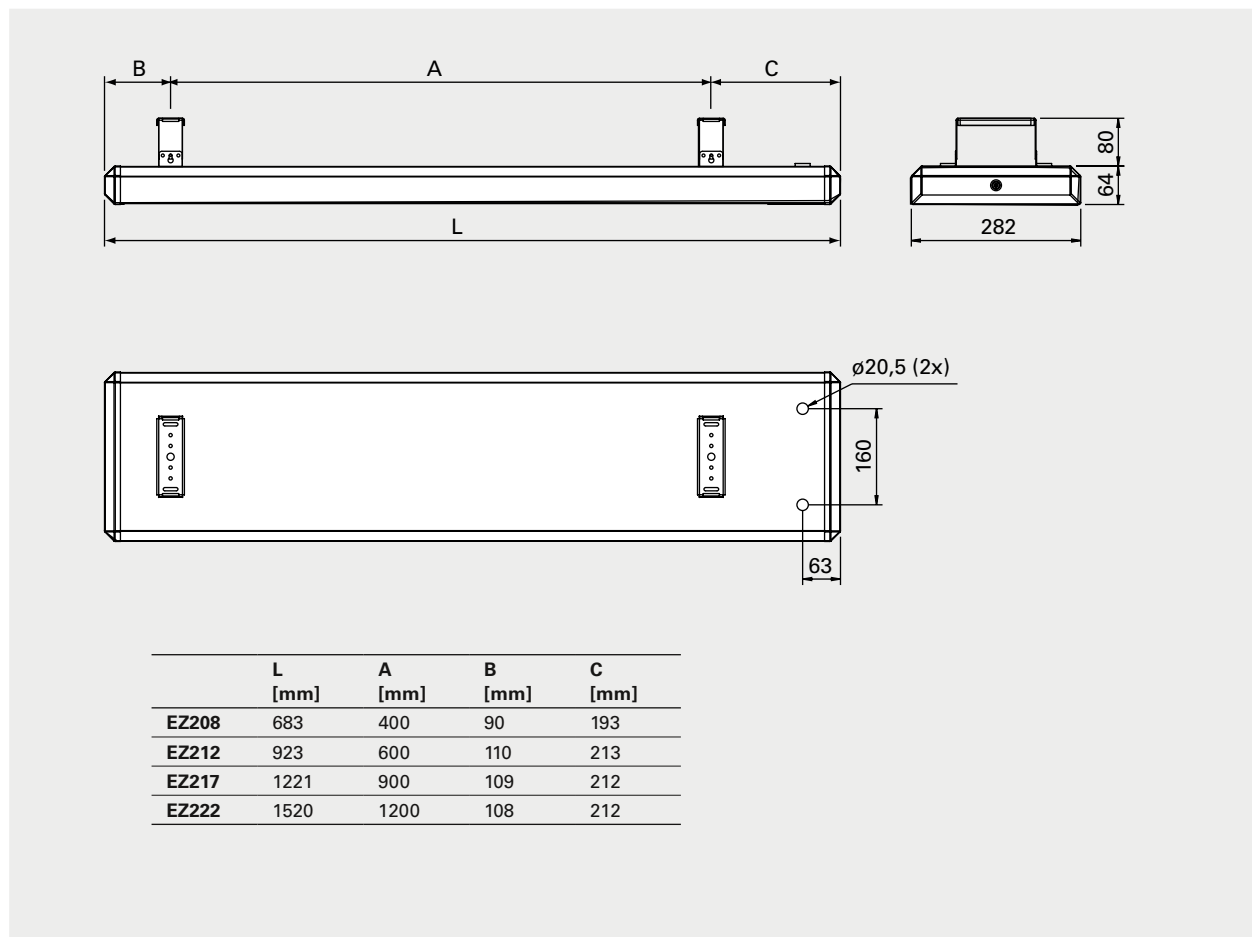
Technical specifications | Elztrip EZ200 ⚡

Type	Heat output [W]	Voltage [V]	Amperage [A]	Max. element temperature [°C]	Dimensions LxHxW [mm]	Weight [kg]
EZ208	800	230V~	3,5	340	683x64x282	4,9
EZ212	1200	230V~	5,2	340	923x64x282	6,8
EZ217	1700	230V~	7,4	340	1221x64x282	8,8
EZ222	2200	230V~	9,6	340	1520x64x282	10,7
EZ20831	800	400V2~	2,0	340	683x64x282	4,9
EZ21231	1200	400V2~	3,0	340	923x64x282	6,8
EZ21731	1700	400V2~	4,3	340	1221x64x282	8,8
EZ22231	2200	400V2~	5,5	340	1520x64x282	10,7

Protection class: IP44.

Approved by SEMKO and CE compliant.

Dimensions



Positioning, mounting and installation

Positioning

To estimate approximately how many radiant heaters are needed to cover an area the formula is:

$$\text{Min. number of heaters} = \frac{\text{Area of the premises [m}^2\text{]}}{\text{Installation height [m]} \times \text{Installation height [m]}}$$

This formula is a basic estimation of the minimum number of radiant heaters needed to maintain the comfort. To calculate the right output for each heater, the total heating requirement must be calculated, see the Technical handbook.

When planning an Elztrip installation, the distance between the heaters should not be greater than the height between heater and floor, that means (a) should be less than (H). See Fig. 1. In rooms not often used, the comfort demands are usually lower and the distance between the heaters can be increased. In rooms frequently used, the distance between a sedentary person and heater should be at least between 1.5 to 2 metres (Δh). When these two guide lines are followed, the difference in operative temperature will not exceed the comfort level $\Delta t_{op} = 5\text{ }^\circ\text{C}$. This means that the difference between the real temperature and the temperature that we sense, will not be more than $5\text{ }^\circ\text{C}$.

Mounting

Elztrip is mounted on the ceiling, on armature rails, on wire or suspended. Elztrip should always be mounted horizontally. For minimum mounting distance, see Fig. 2. Standard fittings for mounting are included and are found inside the connection box, see Fig. 3. When mounting on wire, suitable clips that prevent the panel from sliding should be acquired.

Connection

EZ200 is intended for permanent installation. Serial connection is easily made through the plinth (16 mm^2).

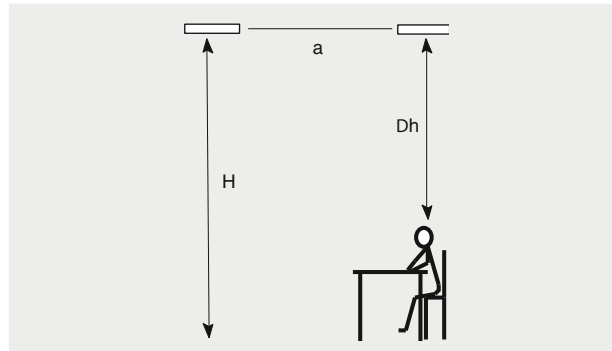
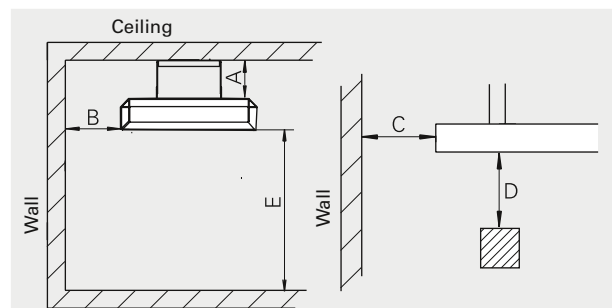


Fig. 1: Positioning vertically.



		Min.distance [mm]
Ceiling	A	80
Wall, long side of the unit	B	150
Wall, short side of the unit	C	150
Flammable material	D	600
Floor	E	1800

Fig. 2: Minimum mounting distance.

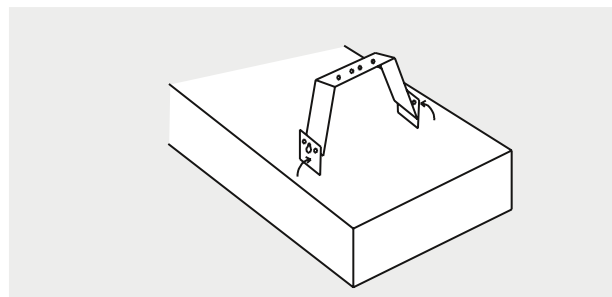


Fig. 3: Standard fitting

Control options

Output control

Stepless control that precisely adapts energy use to the current demand, giving maximal benefit from radiant heating. This results in a soft comfortable heating and lower energy costs.

- ERP, electric heating control
- ERPS, electric heating control (slave)

Control by thermostat and contactor

The choice of thermostat depends on needs and environment. Small loads within the thermostat's setting range do not require a contactor.

- T10, electronic thermostat with concealed knob
- TKS16, electronic thermostat with visible knob, 1-pole switch
- TD10, thermostat with digital display
- KRT1900, capillary room thermostat, IP55

Output control with timer

Stepless control especially suitable for spot and zone heating. The heat contribution is controlled for best comfort. Built-in timer is set to desired time.

- CIRT, stepless output control with timer

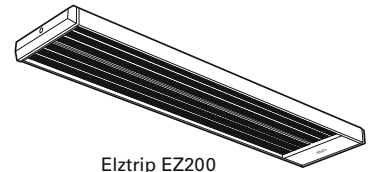
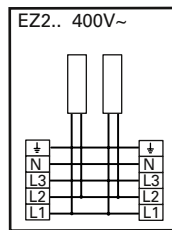
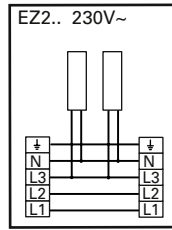
For further options, see section on thermostats and controls or contact Frico.

Controls and other accessories

Type	Description	HxWxD [mm]
ERP	Electric heating control	153x94x43
ERPS	Electric heating control (slave)	153x94x43
T10	Electronic thermostat, knob	80x80x31
TKS16	Electronic thermostat, knob, 1-pole switch	80x80x39
TD10	Electronic thermostat, display	80x80x31
KRT1900	Capillary room thermostat, IP55	165x57x60
CIRT	Stepless control with timer	155x87x43

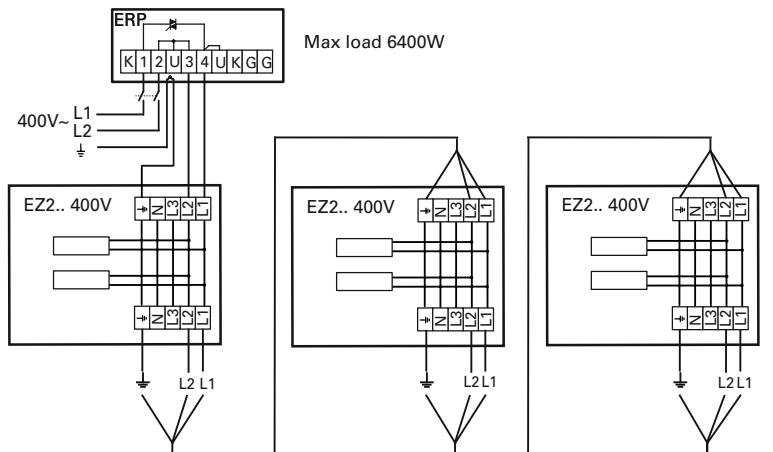
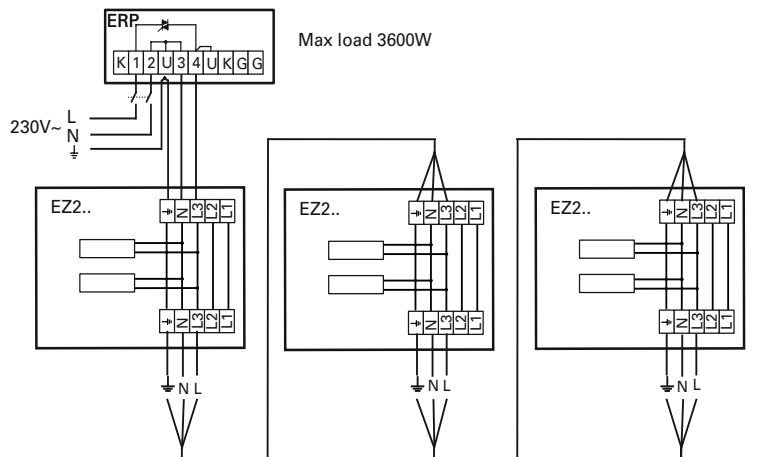
Wiring diagrams

Internal wiring diagram



Elztrip EZ200

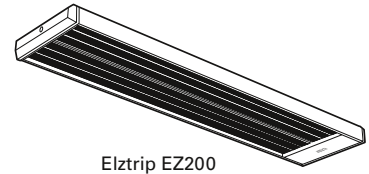
Output control, Elztrip 230 V / 400 V



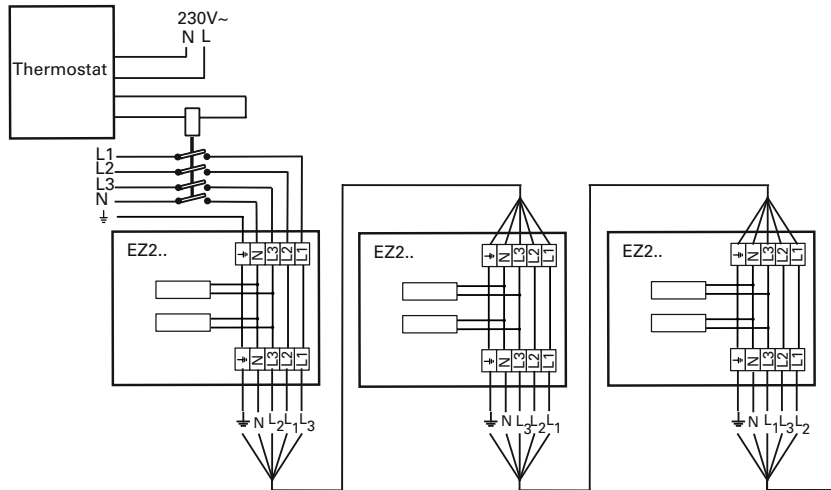
Elztrip EZ200

Wiring diagrams

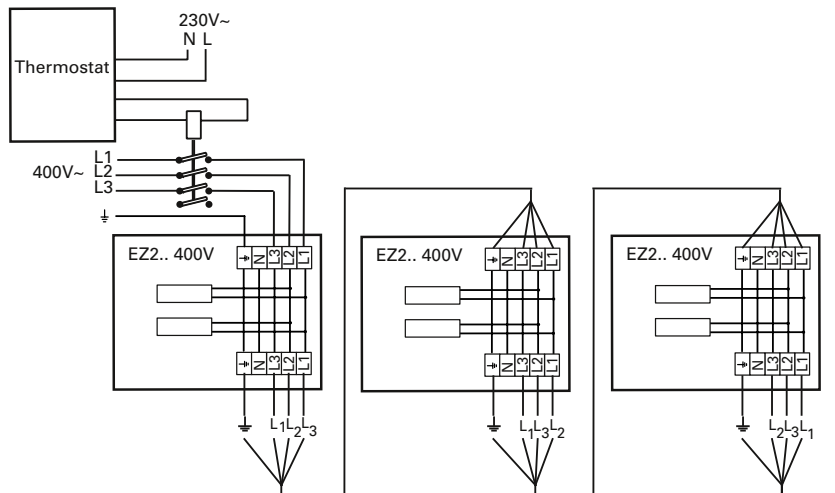
Control by thermostat, Elztrip 230 V



Elztrip EZ200

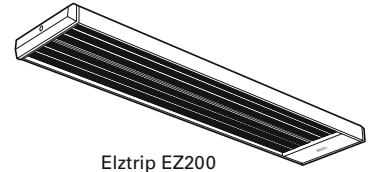


Control by thermostat, Elztrip 400 V

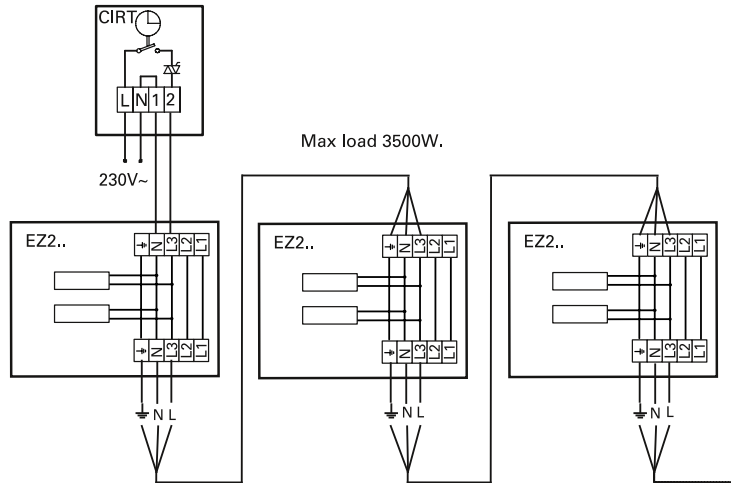


Wiring diagrams

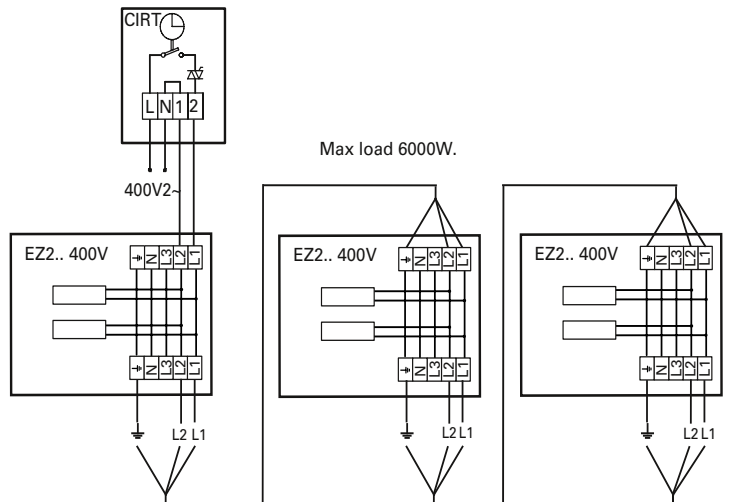
Output control with timer, Elztrip 230 V



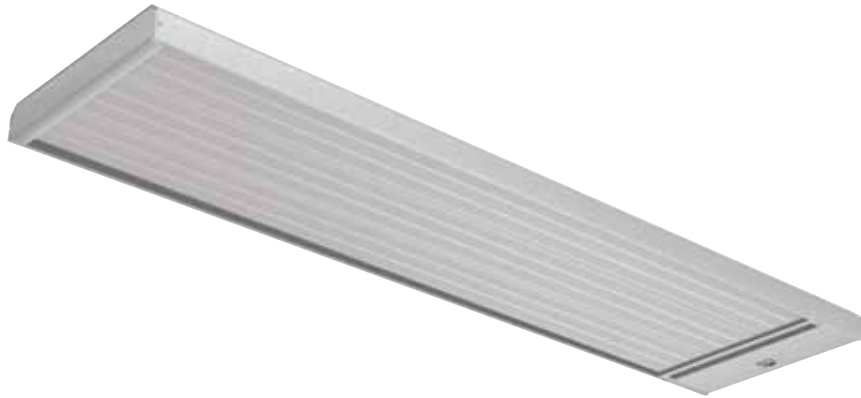
Elztrip EZ200



Output control with timer, Elztrip 400 V



Elztrip EZ300



⚡ 3600 – 4500 W Electrical heat

2 models



Elztrip EZ300

Triple panel radiant heater for warehouses, workshops etc.

Application

EZ300 is intended for total and supplementary heating in industrial environments such as warehouses, workshops etc.

Comfort

Radiant heaters give an efficient and pleasant heat in the dwelling zone and individual comfort can be created with spot and zone heating. No moving parts mean a silent system that does not cause air movements and a hygienic indoor climate is created when the spread of dust, bacteria or odours is reduced.

Operation and economy

Radiant heaters have an easy and flexible installation and require a minimum of maintenance. They give instant heat and no preheating is necessary. Radiant heaters can give cost savings of up to 25 % compared to convector heaters, especially in buildings with high ceilings that are used on an irregular basis.

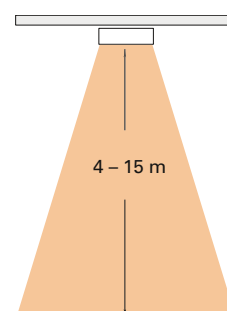
Design

EZ300 is a triple panel radiant heater with discreet and robust design that blends well with electrical fittings.

Product specifications

- Surface structure for best efficiency.
- The heaters are approved for serial connection.
- Fixtures for easy mounting on the ceiling are included.
- Heating panel of naturally anodized aluminium.
- Casing of grey alu-zinc coated steel panels, very resistant against corrosion.

Installation height





The heat is directed to the area where it is needed the most.



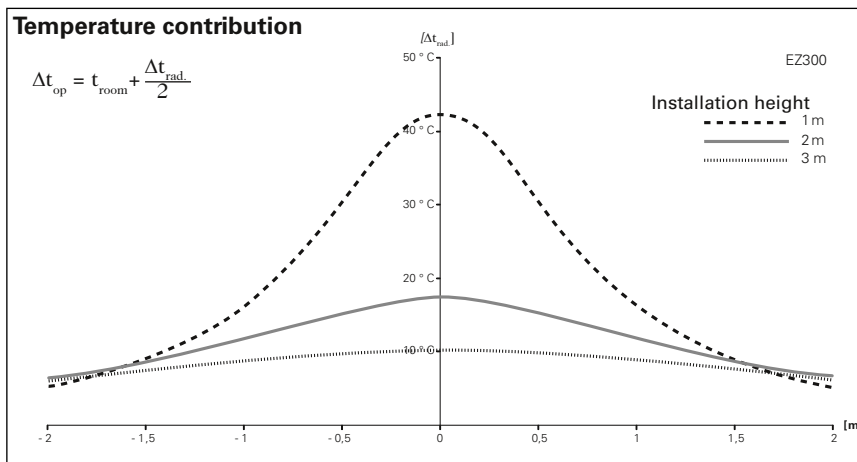
With radiant heaters, the heat is transferred to surfaces such as people, floors and fixtures. This creates comfort even in rooms with large volume.



EZ300 gives instant heat and no preheating is necessary which makes it ideal for buildings that are used on an irregular basis.



Radiant heaters are especially profitable in buildings with high ceilings as no heat losses occur between the heater and the floor.



Elztrip EZ300

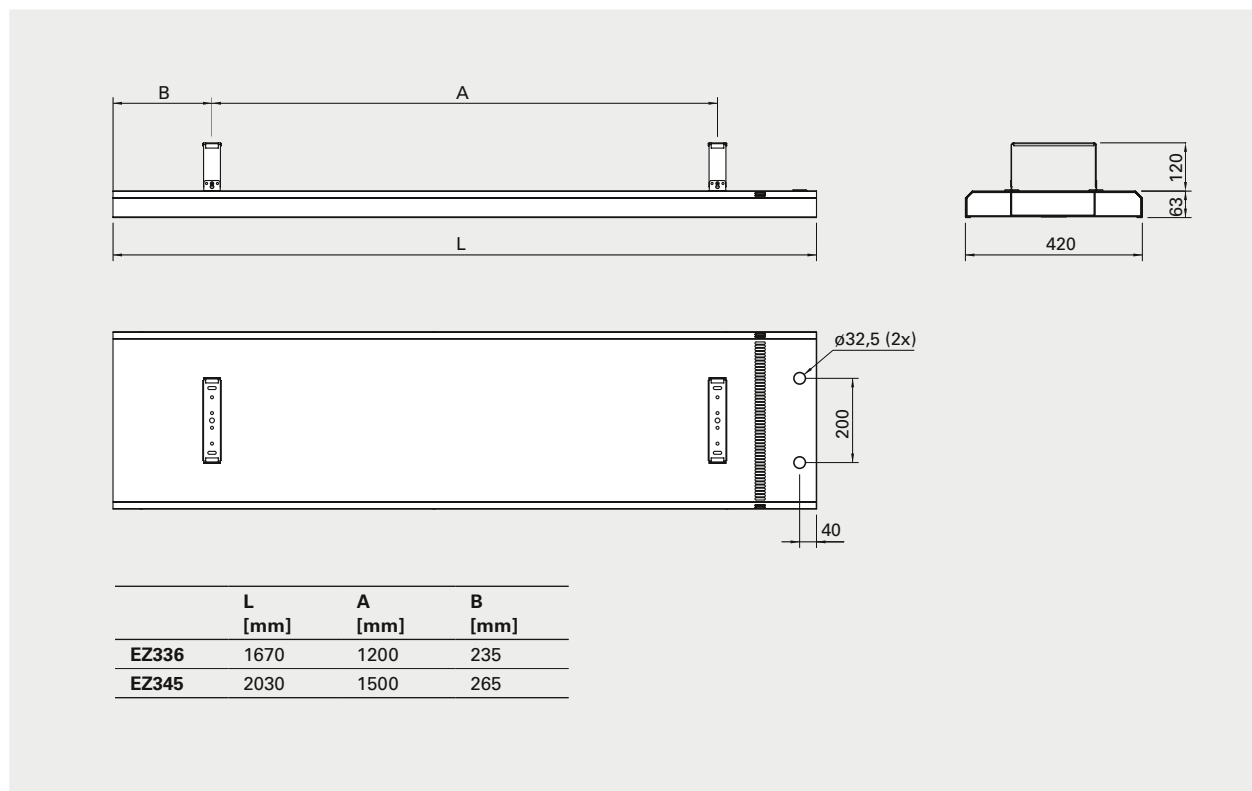
Technical specifications | Elztrip EZ300 ⚡

Type	Heat output [W]	Voltage [V]	Amperage [A]	Max. element temperature [°C]	Dimensions LxHxW [mm]	Weight [kg]
EZ336	3600	230V3~/400V3N~	9,0/5,2	350	1670x63x420	19,8
EZ345	4500	230V3~/400V3N~	11,3/6,5	350	2030x63x420	24,2

Protection class: IP44.

Approved by SEMKO and CE compliant.

Dimensions



Positioning, mounting and installation

Positioning

To estimate approximately how many radiant heaters are needed to cover an area the formula is:

$$\text{Min. number of heaters} = \frac{\text{Area of the premises [m}^2\text{]}}{\text{Installation height [m]} \times \text{Installation height [m]}}$$

This formula is a basic estimation of the minimum number of radiant heaters needed to maintain the comfort. To calculate the right output for each heater, the total heating requirement must be calculated, see the Technical handbook.

When planning an Elztrip installation, the distance between the heaters should not be greater than the height between heater and floor, that means (a) should be less than (H). See Fig. 1. In rooms not often used, the comfort demands are usually lower and the distance between the heaters can be increased. In rooms frequently used, the distance between a sedentary person and heater should be at least between 1.5 to 2 metres (Δh). When these two guide lines are followed, the difference in operative temperature will not exceed the comfort level $\Delta t_{op} = 5\text{ }^{\circ}\text{C}$. This means that the difference between the real temperature and the temperature that we sense, will not be more than $5\text{ }^{\circ}\text{C}$.

Mounting

Elztrip is mounted on the ceiling, on armature rails, on wire or suspended. Elztrip should always be mounted horizontally. For minimum mounting distance, see Fig. 2. Standard fittings for mounting are included and are found inside the connection box, see Fig. 3. When mounting on wire, suitable clips that prevent the panel from sliding should be acquired.

Connection

Elztrip is intended for permanent installation. Serial connection is easily made through the plinth (16 mm^2).

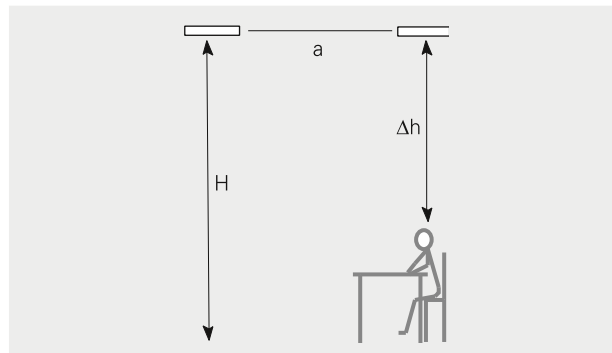
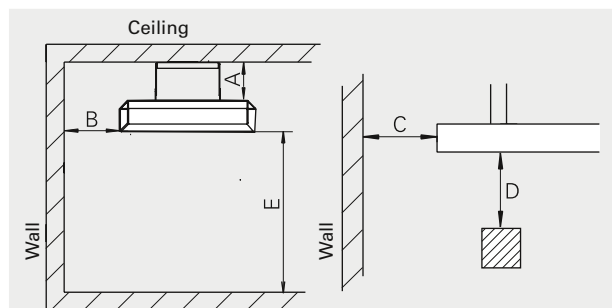


Fig. 1: Positioning vertically.



		Min.distance [mm]
Ceiling	A	115
Wall, long side of the unit	B	250
Wall, short side of the unit	C	250
Flammable material	D	700
Floor	E	1800

Fig. 2: Minimum mounting distance.

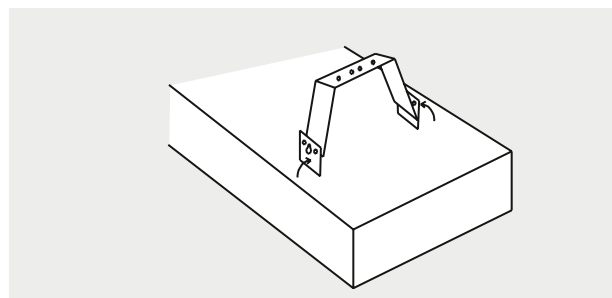


Fig. 3: Standard fitting

Control options

Control with thermostat, contactor and switch

The choice of thermostat depends on needs and environment.

Connection is made by a 3 step switch making it possible to manually connect the elements 1 + 1 + 1.

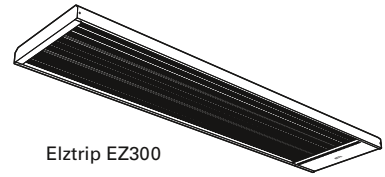
- T10, electronic thermostat with concealed knob
- TK10, external thermostat with visible knob
- KRT1900, capillary tube thermostat, IP55
- S123, manual switch for 1-2-3 output steps

For further options, see section on thermostats and controls or contact Frico.

Controls and other accessories

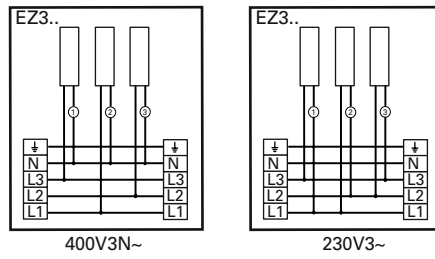
Type	Description	HxWxD [mm]
T10	Electronic thermostat	80x80x31
TK10	Electronic thermostat, knob	80x80x31
KRT1900	Capillary room thermostat, IP55	165x57x60
S123	Manual switch for 1-2-3 output steps	72x64x46

Wiring diagrams

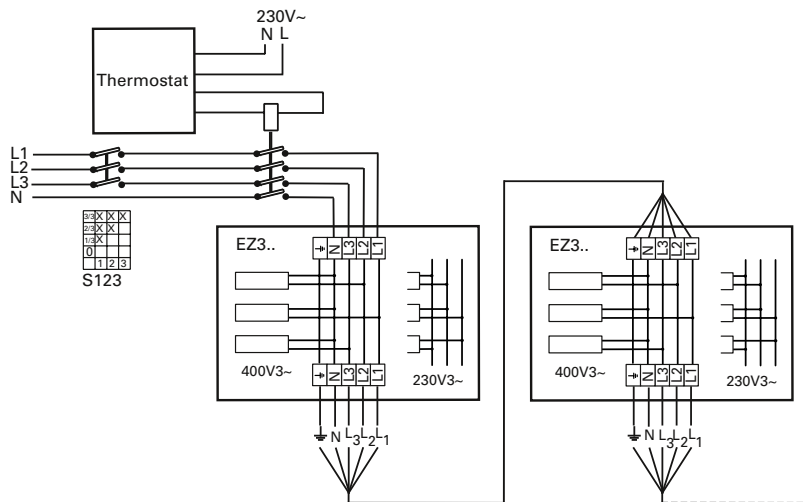


Elztrip EZ300

Internal wiring diagram



Control with thermostat, contactor and switch



Industrial infrared heater IR



⚡ 3000–6000 W Electrical heat

3 models



Industrial infrared heater IR

For premises with large volumes and high ceilings

Application

IR is suitable for total or supplementary heating of premises with large volume and high ceilings. It can also be used outdoors for example on sport arena stands or to keep loading bays dry and frostless.

Comfort

Radiant heaters give an efficient and pleasant heat in the dwelling zone and individual comfort can be created with spot and zone heating. No moving parts mean a silent system that does not cause air movements and a hygienic indoor climate is created when the spread of dust, bacteria or odours is reduced.

Operation and economy

Radiant heaters have an easy and flexible installation and require a minimum of maintenance. They give instant heat and no preheating is necessary. Radiant heaters can give cost savings of up to 25 % compared to convector heaters, especially in buildings with high ceilings that are used on an irregular basis.

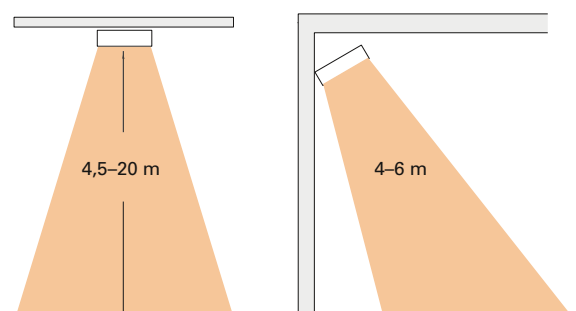
Design

IR has a robust industrial design.

Product specifications

- Reflectors of shiny anodized aluminium for optimal heat distribution.
- The mounting hinges allow the heater to be angled in five different positions.
- Connection plinth which allows for connection of a regulator or for serial connection of several heaters.
- Protection grille is available as an accessory.
- Casing of grey alu-zinc coated steel panels, very resistant against corrosion.

Installation height



Design and specifications are subject to change without notice.



This train station outside Stockholm is heated by IR. A control with timer allow waiting passengers to increase the heat when it is particularly cold.



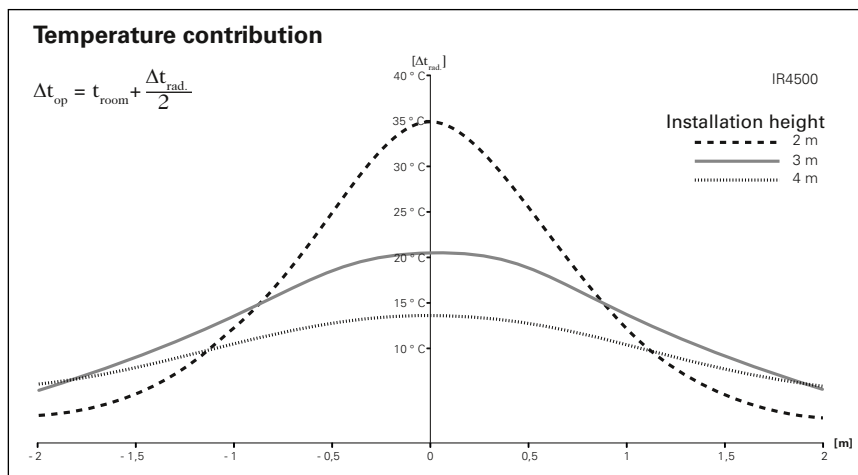
The IR heater can be mounted in an angled position to direct the heating where it is needed. Heaters used outdoors should be placed under a roof. In this installation the working stations are heated by IR heaters in the ceiling and CIR heaters on the wall.



To divide a large hall into different zones is very energy effective especially in buildings where each zone is sporadically used. Protection grille IRG, available as an accessory, can be used to protect the heater in for example sports centres.



The temperature can be adapted perfectly in different areas of a room with IR. Spot heating increases the comfort and lowers the heating costs.



Industrial infrared heater IR

Technical specifications | Industrial infrared heater IR ⚡

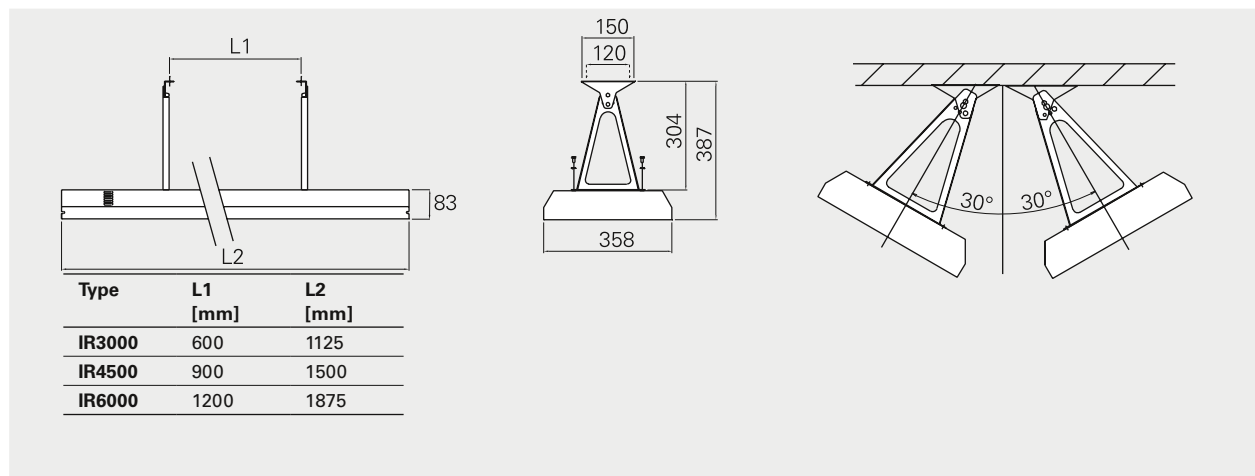
Type	Output stages	Voltage	Amperage	Max. element temperature	Dimensions	Weight
	[kW]	[V]	[A]	[°C]	LxHxW [mm]	[kg]
IR3000	1/2/3	400V3N~*1	4,3	700	1125x83x358	9.0
IR4500	1.5/3/4.5	400V3N~*1	6,5	700	1500x83x358	11.1
IR6000	2/4/6	400V3N~*1	8,7	700	1875x83x358	13.2

*1) Can also be connected 400V3~, but then without output stages. With neutral, one element tube at a time can be connected.

Protection class: IP44.

Approved by SEMKO and CE compliant.

Dimensions



Positioning, mounting and installation

Positioning

For spot heating, the infrared heaters should be positioned so that people get heat from the front and from behind. The distance to the head should not be less than 2 metres. Read more in the Technical handbook.

Mounting

IR is delivered with mounting brackets and can be mounted directly on the ceiling or the wall. The mounting allow the radiation angle to be adjusted 30° in each direction. The heaters can also be suspended from wire (minimum Ø 3 mm). IR should always be mounted with the tube elements in an horizontal position. Protection grille IRG is available as an accessory. For minimum mounting distance, see Fig. 1.

Connection

IR is intended for permanent installation. In the terminal box are double connection plinths for cables of up to 16 mm². This allows for serial connection.

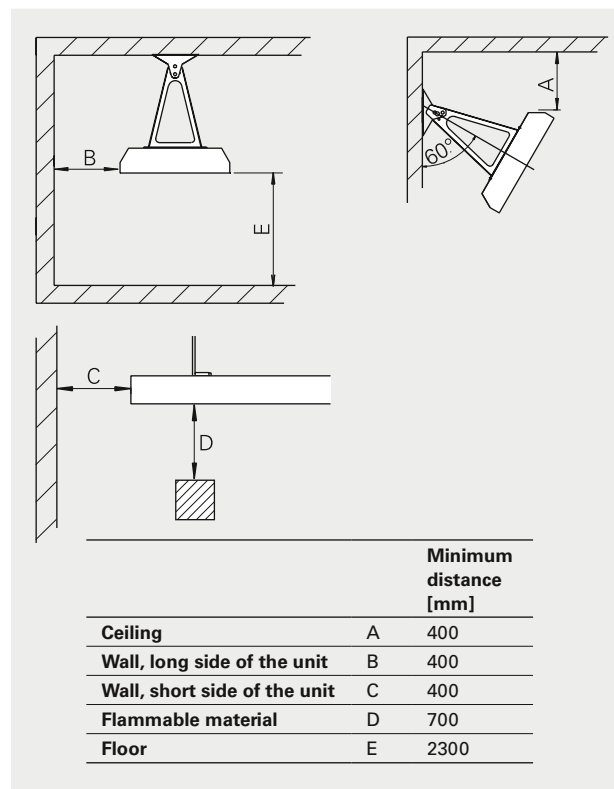


Fig. 1: Minimum distance for fixed installation.

Control options

Control by thermostat, contactor and switch (and timer)

The choice of thermostat depends on needs and environment.

Connection is made by a 3-step switch making it possible to manually connect the elements 1 + 1 + 1.

Timer can be set to desired time.

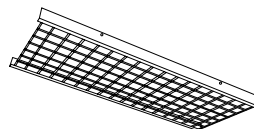
- T10, electronic thermostat with concealed knob
- TK10, electronic thermostat with visible knob
- KRT1900, capillary tube thermostat, IP55
- S123, manual switch for 1-2-3 output steps
- CBT, timer

For further options, see section on thermostats and controls or contact Frico.

Accessories

IRG, protection grille

Can be used to protect the heaters in sport centres. Available in three dimensions to fit each of the IR models.

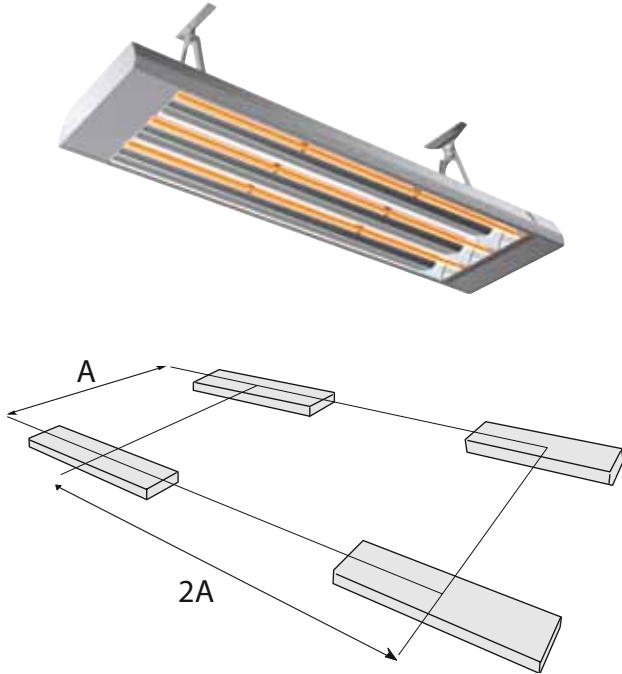


Controls and other accessories

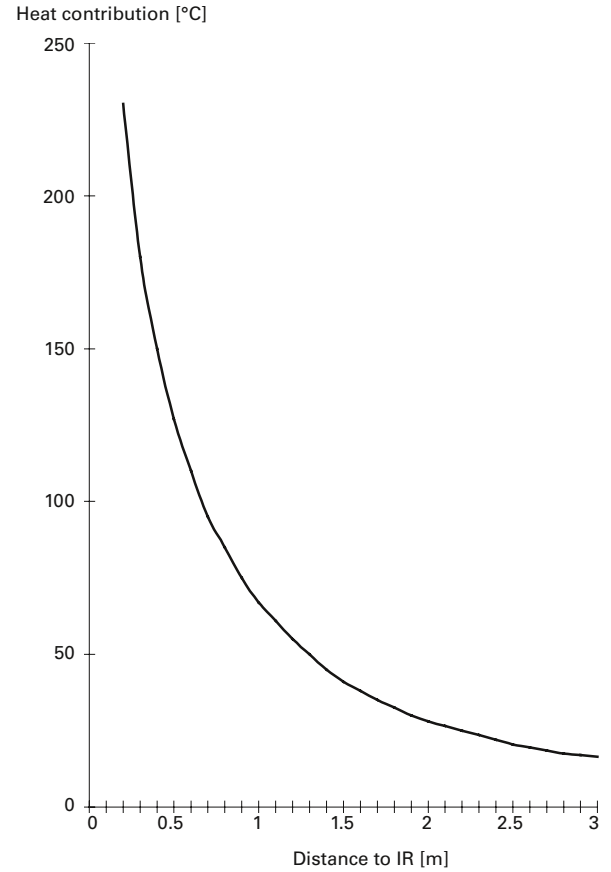
Type	Description	HxWxD [mm]
T10	Electronic thermostat with concealed knob	80x80x31
TK10	Electronic thermostat with visible knob	80x80x31
KRT1900	Capillary room thermostat, IP55	165x57x60
S123	Manual switch for 1-2-3 output steps	72x64x46
CBT	Timer	155x87x43
IRG3000	Protection grille IR3000	869x362x40
IRG4500	Protection grille IR4500	1235x362x40
IRG6000	Protection grille IR6000	1615x362x40

Industrial infrared heater IR

Heat contribution IR

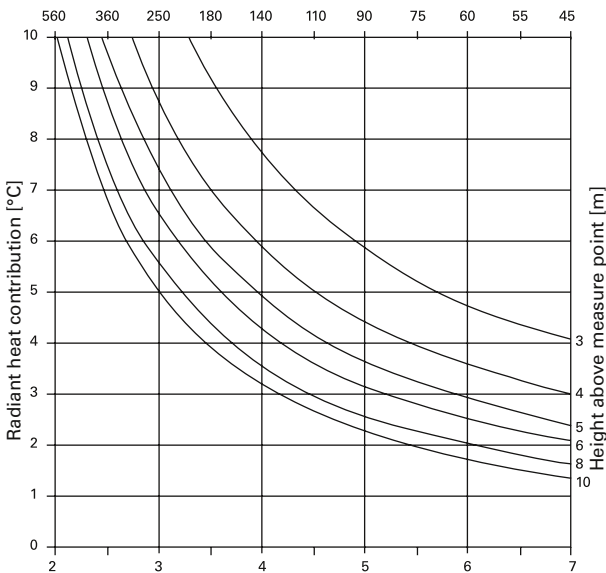


Heat contribution directly below IR 4.5-6 kW



Radiant heat contribution IR 4,5 kW

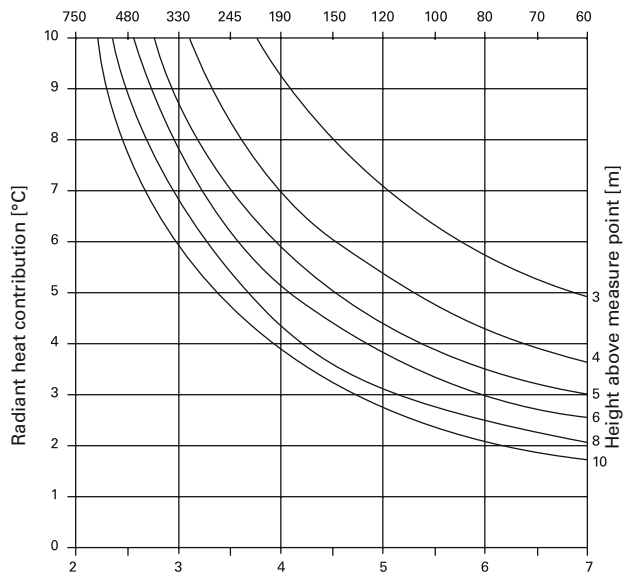
Output [W/m²]



A-distance between the heaters [m]

Radiant heat contribution IR 6 kW

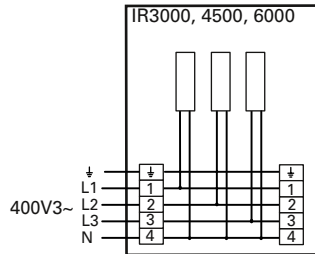
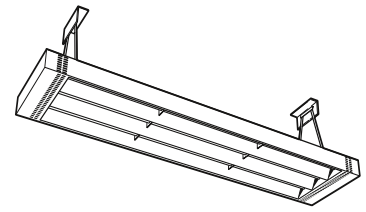
Output [W/m²]



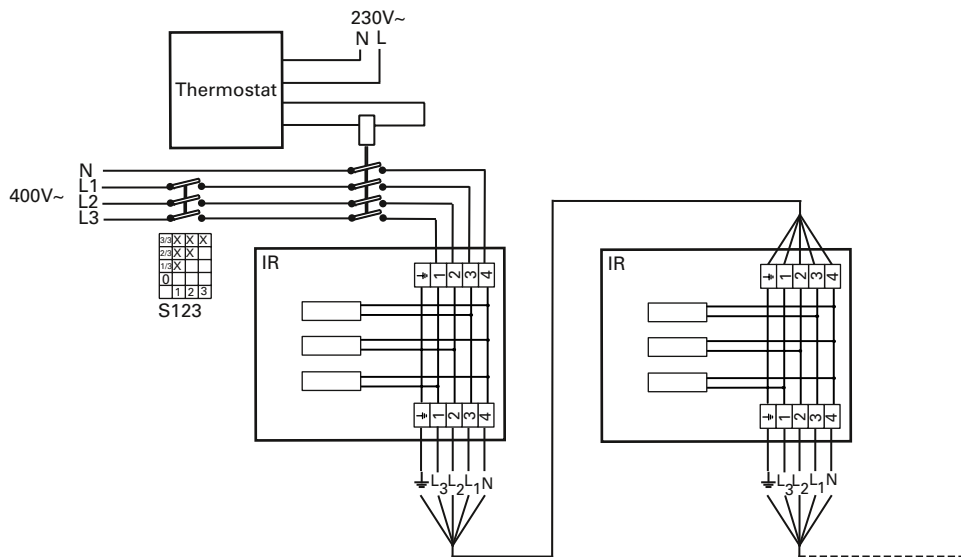
A-distance between the heaters [m]

Wiring diagrams

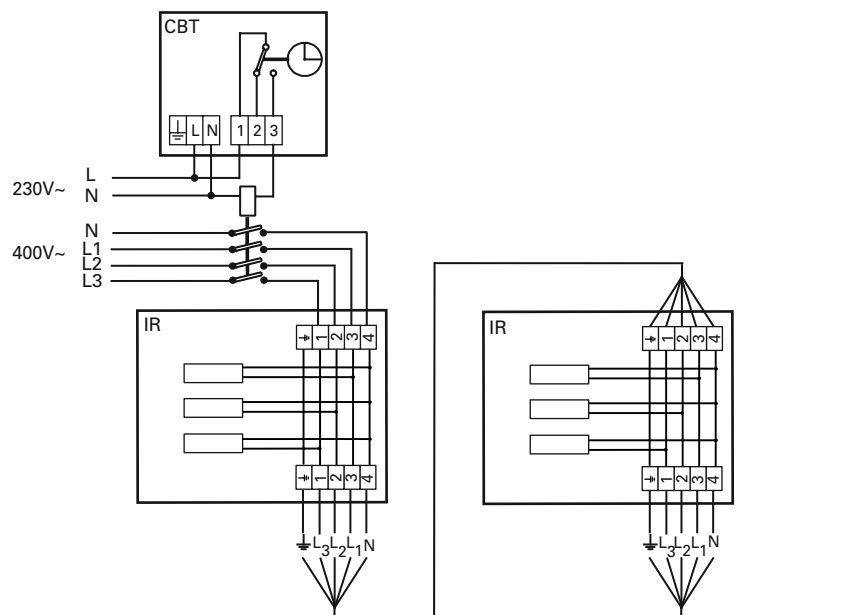
Internal wiring diagram



Control by thermostat, contactor and switch



Control with timer



Halogen infrared heater IRCF



 1500-4500 W Electrical heat

3 models



Halogen infrared heater IRCF

For spot heating of large premises

Application

IRCF is especially designed for spot heating of premises with large air volumes, such as churches, aircraft hangars and marquees. With its high efficiency and compact size it is perfect for many difficult applications.

Comfort

Radiant heaters give an efficient and pleasant heat in the dwelling zone and individual comfort can be created with spot and zone heating. No moving parts mean a silent system that does not cause air movements and a hygienic indoor climate is created when the spread of dust, bacteria or odours is reduced.

Operation and economy

Radiant heaters have an easy and flexible installation and require a minimum of maintenance. They give instant heat and no preheating is necessary. Radiant heaters can give cost savings of up to 25 % compared to convector heaters, especially in buildings with high ceilings that are used on an irregular basis.

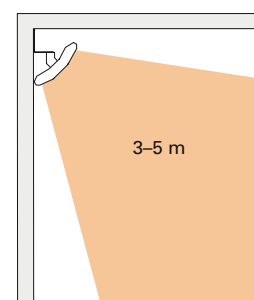
Design

IRCF has a discreet and compact design. Equipped with one to three halogen lamps and with glossy finished reflectors.

Product specifications

- Equipped with one to three halogen lamps and with glossy finished reflectors.
- Easy mounting with mounting bracket on the wall or ceiling. The heater can be angled.
- Protection grille available as an accessory.
- Corrosion proof casing of aluminum.
- Colour: RAL 9006.

Installation height



Halogen infrared heater IRCF



IRCFC can be mounted on the wall or on the ceiling and is suitable in buildings which are used sporadically like this go-cart track starting area.



IRCFC is often installed in large warehouses. They give instant and effective heat which make them profitable quickly.



The smallest model of IRCFC is excellent for difficult applications like churches.



Halogen infrared heater IRCF

Technical specifications | Infrared heater IRCF ⚡

Type	Heat output [W]	Voltage [V]	Dimensions LxHxW [mm]	Number of lamps	Weight [kg]
IRCF1500	1500	230V~	490x230x140	1	1,7
IRCF3000	3000	230V~	490x375x140	2	2,4
IRCF4500	4500	230V~/400V3~	490x515x140	3	3,0

Protection class: Halogen infrared heater IRCF: (IP20), normal design.
CE compliant.

Dimensions

Type	Height [mm]	Length [mm]
IRCF1500	230	490
IRCF3000	375	490
IRCF4500	515	490

IRCF can be angled.

Positioning, mounting and installation

Positioning

To heat a work station, it is suitable to use two units and let the heat flow cross.

Mounting

Delivered with mounting bracket that can be mounted on the wall or ceiling. IRCF must always be mounted horizontally. The unit can be angled. Protection grille IRCG1 is available as an accessory. For minimum mounting distance, see Fig. 1 and 2.

Connection

IRCF is intended for permanent installation.

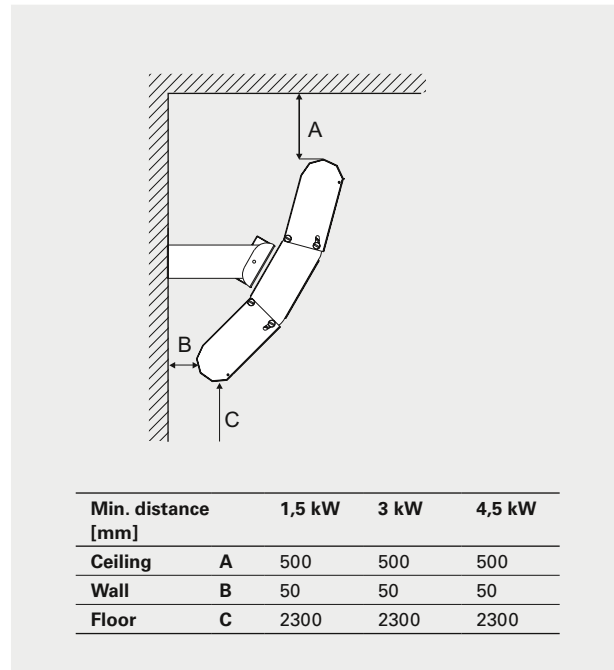


Fig. 1: Minimum mounting distance for wall mounting.

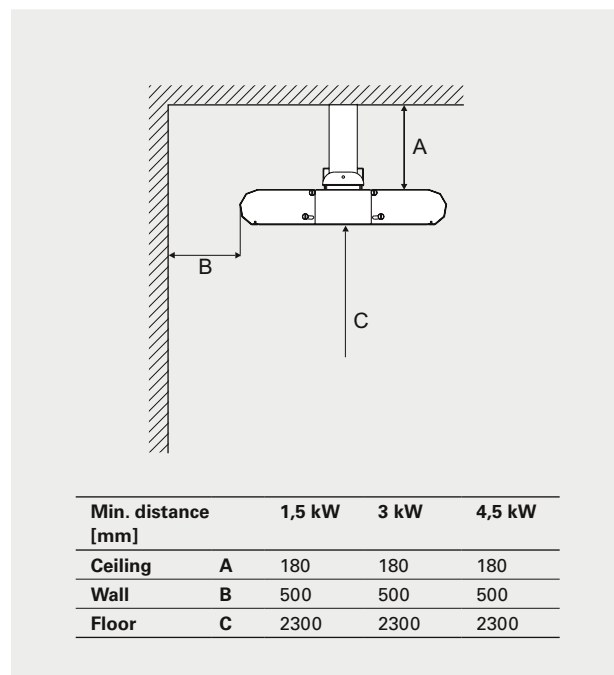


Fig. 2: Minimum mounting distance for ceiling mounting.

Halogen infrared heater IRCF

Control options

Control with timer (monophase)

The timer can be set to a desired time. If the current load exceeds the timer's setting range or if you want to control a larger system, a contactor can be used.

- CBT, electronic timer

Control by timer, contactor and switch (triphase)

Connection is made by a 3-step switch making it possible to manually connect the elements 1 + 1 + 1.

Timer can be set to desired time.

- S123, manual switch for 1-2-3 output steps
- CBT, timer

Control by thermostat, contactor and switch (triphase)

The choice of thermostat depends on needs and environment.

Connection is made by a 3-step switch making it possible to manually connect the elements 1 + 1 + 1.

- T10, electronic thermostat with concealed knob
- TK10, electronic thermostat with visible knob
- KRT1900, capillary tube thermostat, IP55
- S123, manual switch for 1-2-3 output steps

For further options, see section on thermostats and controls or contact Frico.

Accessories

LIRCF, extra lamp

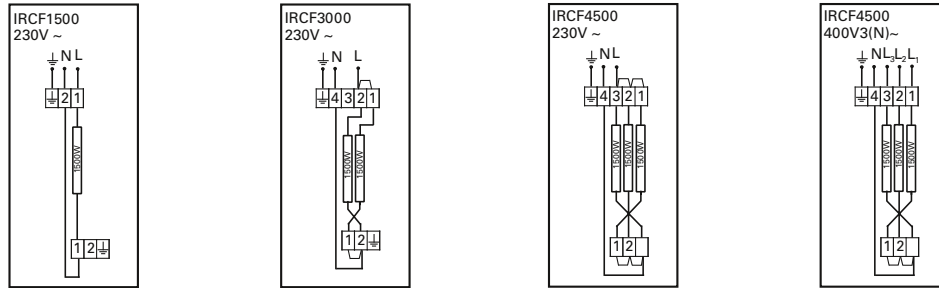
Halogen lamps of 1,5 kW are replaceable and has a life of about 5000 hours with normal usage.

Controls and other accessories

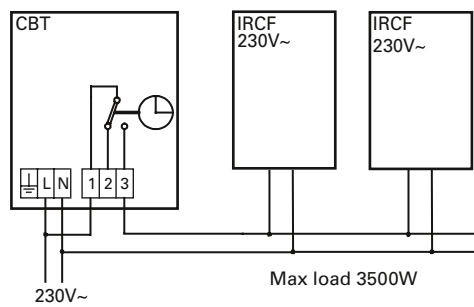
Type	Description	HxWxD [mm]
CBT	Timer	155x87x43
S123	Manual switch for 1-2-3 output steps	72x64x46
T10	Electronic thermostat with concealed knob	80x80x31
TK10	Electronic thermostat with visible knob	80x80x31
KRT1900	Capillary room thermostat, IP55	165x57x60
LIRCF	Extra lamp	
IRCG1	Protection grille for IRCF1500. IRCF3000 require 2 pcs, IRCF4500 require 3 pcs.	

Wiring diagrams

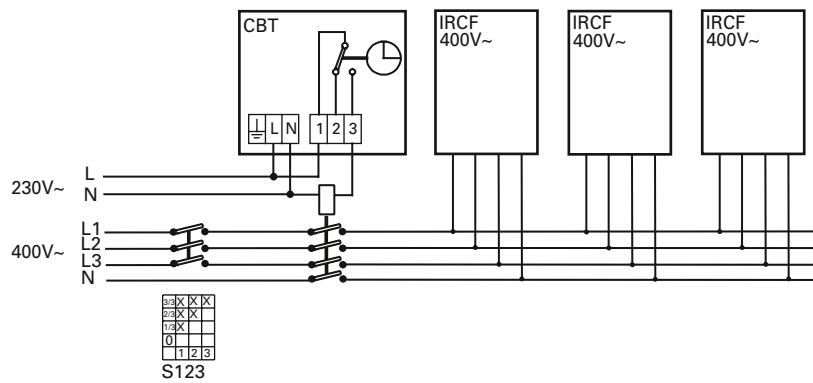
Internal wiring diagram



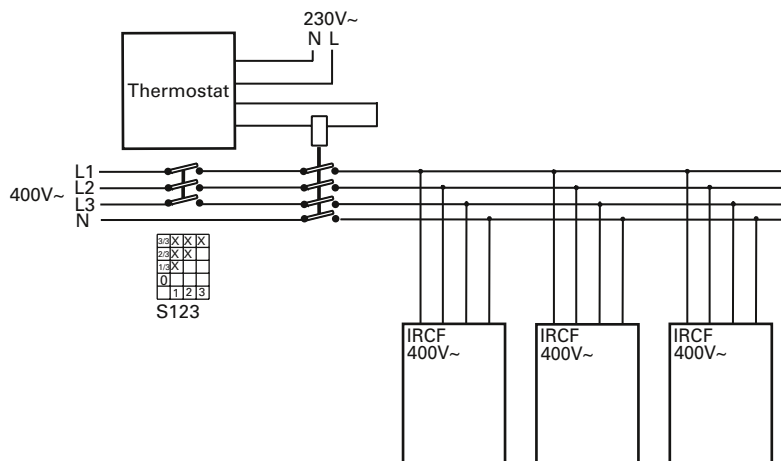
Control with timer (monophase)



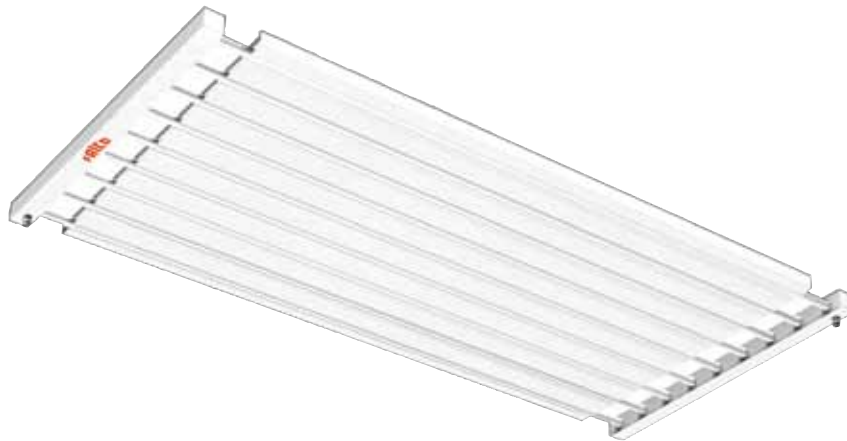
Control by timer, contactor and switch (triphas)



Control by thermostat, contactor and switch (triphas)



Comfort Panel SZ



Water heat

Length: up to 120 metres



Comfort Panel SZ

Water heated radiant heater for high and low installations

Application

Comfort Panel SZ is the ideal system solution for water supplied heating of larger buildings such as industrial buildings, commercial buildings and sports centres. Comfort Panel SZ is suitable for both high and low installation, and extremely high installations are possible with pressurized hot water.

Comfort

Radiant heaters give an efficient and pleasant heat in the dwelling zone and individual comfort can be created with spot and zone heating. No moving parts mean a silent system that does not cause air movements and a hygienic indoor climate is created when the spread of dust, bacteria or odours is reduced.

Operation and economy

The installation cost for Comfort Panel SZ is low compared to other water supplied radiant heating systems since fewer water connections are required. Each panel strip can be up to 120 metres and needs only two connections. Comfort Panel SZ require a minimum of maintenance.

Radiant heaters can give cost savings of up to 25 % compared to convector heaters, especially in buildings that are poorly insulated, have high ceilings and that are used on an irregular basis.

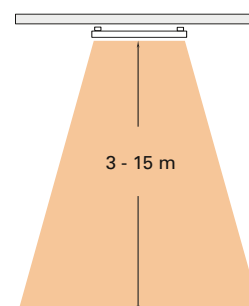
Design

Design in white or grey. Other colours available on request.

Product specifications

- Complies to EN14037 which is based on the EU Construction Product Directives 89/106/CEE. EN14037 is compulsory for a CE mark for water heated radiant heaters.
- Cool formed steel panels wrapped around welded steel pipes for optimum contact and energy distribution.
- For ceiling mounting in panel lengths of 4 meters up to 120 meters.
- Corrosion proof housing of hot zinc-plated and powder coated steel panels. Colours: RAL 9010 (white) and RAL 9002 (light grey), other colours available on request.

Installation height





Comfort Panel SZ can be installed in areas that are difficult to access since the panels do not contain any moving parts that need ongoing maintenance.



Comfort Panel SZ is installed above the areas where heat is needed. The heat loss through the surrounding air is minimal. This lowers the heating costs considerably.



Comfort Panel SZ is the perfect solution in a sports hall. The radiant heating provides heat for the spectators and the athletes.



Comfort Panel SZ can be installed in a an angle.

Technical specifications | Comfort Panel SZ, water heated

Version	Standard					Special*1 (max 200 °C)				
Type*1	Heat output*2 [W/m]	Weight [kg/m]	Max working pressure [bar]	Max water temperature [°C]	Width [mm]	Heat output*3 [W/m]	Weight [kg/m]	Max working pressure [bar]	Max water temperature [°C]	Width [mm]
SZ23	162	4	4	120	300	267	5	16	180	300
SZ26	289	8	4	120	600	477	10	16	180	600
SZ29	406	12	4	120	900	667	15	16	180	900
SZ212	543	16	4	120	1200	870	20	16	180	1200
SZ33	194	6	4	120	300	324	7	16	180	300
SZ36	345	12	4	120	600	574	14	16	180	600
SZ39	501	18	4	120	900	790	21	16	180	900
SZ312	639	24	4	120	1200	1005	28	16	180	1200

*1) References for special versions are SZxxSP

*2) Applicable at water temperature 80/60 °C, air temperature +15 °C

*3) Applicable at water temperature 130/70 °C, air temperature +15 °C

CE compliant according to EN14037.

Construction

Comfort Panel SZ is een zeer efficiënte en concurrerende warmtestraler. Het aansluiten van de panelen is eenvoudig en de verbindingstukken nemen een minimale ruimte in. Zo kan het straaloppervlak zo groot mogelijk zijn. Het paneel wordt rond de pijpen gewikkeld, zodat het contactoppervlak tussen pijp en paneel zo'n 80% is. Hierdoor is het paneel erg zuinig met energie.

Ieder paneel gebruikt meerdere pijpen met een kleinere diameter in plaats van één grote pijp. Zodoende is het paneel efficiënter zonder een grotere stromingsweerstand en energie-input. De stralingstemperatuur is ook gelijkmatiger verdeeld over het straaloppervlak.

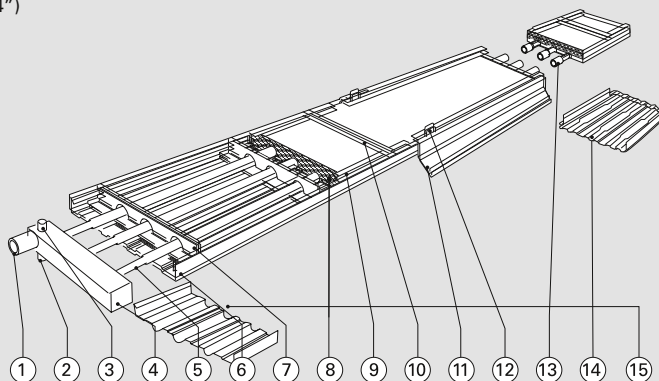
De panelen zijn gemaakt van 0,8 mm stalen panelen die mechanisch koud in het unieke profiel zijn geperst.

De pijpen voor Comfort Panel SZ in de standaardversie (watertemperatuur onder 120 °C) zijn gelast van 1,5 mm stalen pijpen. De panelen zijn ook verkrijgbaar in een speciale versie voor temperaturen onder 180 °C en een werkdruk van 16 bar. Er zijn naadloze pijpen van 2,35 mm staal gebruikt. De pijpen hebben een diameter van 1/2".

Het water wordt aangesloten via de verzamelaars die gelast zijn op de uiteinden van de eerste en laatste secties. De aansluitingen kunnen diameters hebben van 1/2", 3/4", 1" of 1 1/4".

De secties worden hetzij via persfitting (met Mapress o.i.d.) of via lassen aan elkaar bevestigd.

1. Threaded male connection (Ø 1/2" - 3/4" - 1" - 1.1/4")
2. Connection for drain valve Ø 3/8"
3. Connection for air vent. valve Ø 3/8"
4. First or end header
5. Steel pipe Ø 1/2"
6. Radiant panel
7. Suspension bracket
8. Insulation
9. Side edging strip
10. Insulation retaining clip
11. Anti-convective side skirts (accessory)
12. Skirt hook
13. Pipe ends adapted for press fitting or compression fitting or belled end for welding
14. Make-up joint
15. Make-up joint between panel and header (accessory)



Modularity

By connecting a series of intermediate panels, in the standard lengths of 4 or 6 m, and two end panels, again in the standard length, any multiple length of 2 m can be obtained (starting from the minimum length of 4 m).

The following table shows the possible length compositions of the various standard elements.

Length combination of the first, intermediate and end panels (with standard 4 and 6 m panels)

Total length [m]	Combination First section	Combination Intermediate section	Combination Final section
4	1 x 4 m		
6	1 x 6 m		
8	1 x 4 m		1 x 4 m
10	1 x 4 m		1 x 6 m
12	1 x 6 m		1 x 6 m
14	1 x 4 m	1 x 6 m	1 x 4 m
16	1 x 4 m	1 x 6 m	1 x 6 m
18	1 x 6 m	1 x 6 m	1 x 6 m
20	1 x 4 m	2 x 6 m	1 x 4 m
22	1 x 4 m	2 x 6 m	1 x 6 m
24	1 x 6 m	2 x 6 m	1 x 6 m
26	1 x 4 m	3 x 6 m	1 x 4 m
28	1 x 4 m	3 x 6 m	1 x 6 m
30	1 x 6 m	3 x 6 m	1 x 6 m

NB! For a composition of unusual lengths, contact Frico technical support.

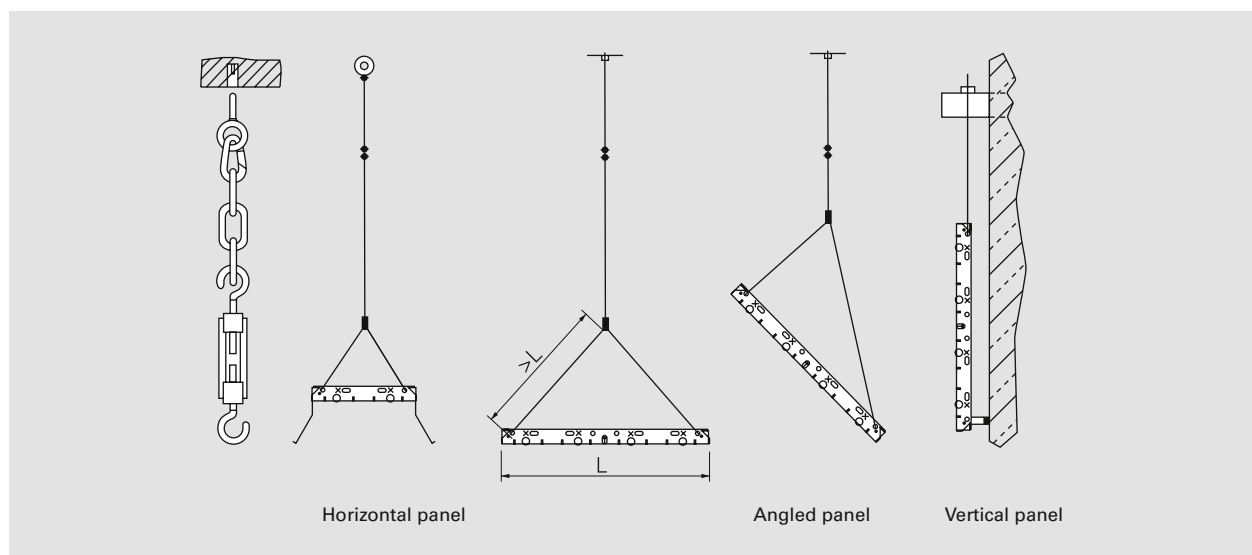
Suspension

The SZ panels can be mounted horizontally, vertically or in an angle. See figures below.

Panels of 6 metres are hung at 5 points and 4 metre panels at 3 points. For other distances between the suspensions, sliding rollers (accessory) must be used. The suspensions are not supplied with the radiant panels, and must be provided by the customer or

ordered separately. These can be made using threaded rods, chains or perforated brackets, and they must be adjustable. The length of the suspensions must be proportional to the total thermal expansion of the radiant panels. See table below.

Max.length, panels	Minimum length, suspension			
	Average temperature, hot water			
	Up to 100 °C	Up to 125 °C	Up to 150 °C	Up to 175 °C
20 m	24 cm	26 cm	28 cm	30 cm
50 m	35 cm	40 cm	50 cm	60 cm
70 m	45 cm	55 cm </td <td>70 cm</td> <td>85 cm</td>	70 cm	85 cm
100 m	60 cm	75 cm	95 cm	120 cm



A Comfort Panel handbook with detailed information is available at www.frico.se. Further information can also be obtained by contacting Frico.

Radiant heaters - Outdoors



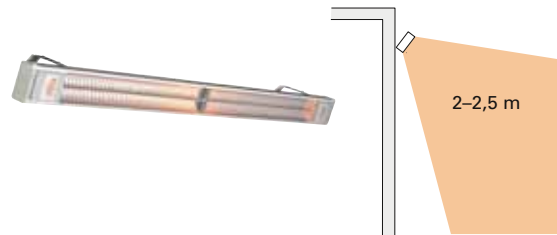
Outdoors

The summer season can be prolonged with the use of radiant heaters for outdoor use. There are different solutions depending on the environment. For open-air restaurants without protective walls a heater with a high surface temperature is required.

The better the area is protected against the wind, the less output you need, which means you are not as dependent on heaters with a high surface temperature.

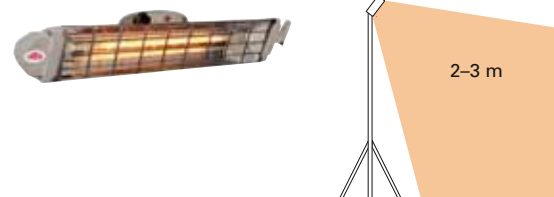
Discreet

CIR provide comfort all year around on terraces, balconies and open-air restaurants. CIR can also be used for spot heating in workshops and warehouses. Requires no protection against bad weather and has five-year corrosion warranty.



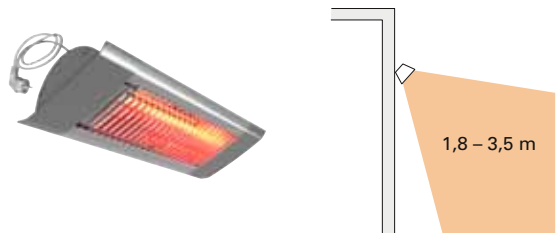
Tough

ELIR gives an intense heat suitable for all outdoor applications and rough industrial premises. While ELIR is light, stable and portable it is also well suited for temporary heating on building sites etc. With its concentrated heat it is a good complement to dehumidifiers for drying in areas damaged by water. High protection class (IP65) makes it possible to install the heater in almost any environment.



Powerful

Halogen infrared heater IH is the perfect choice for exposed outdoor environments where design is important, for example, balconies, pavement cafés, etc. IH can also be used as local heating in large premises such as churches, industries and warehouses. IH is available in two different designs. IHW gives a comfortable heat in the occupied zone from close range and also wider heat distribution. IHF has more direct heat distribution and is designed to be installed higher up.



Infrared heater CIR



⚡ 500-2000 W Electrical heat

12 models



Infrared heater CIR

For applications where discreet design and operation is desired

Application

CIR provide comfort all year around on terraces, balconies and open-air restaurants. CIR can also be used for spot heating in workshops and warehouses. Requires no protection against bad weather and has five-year corrosion warranty.

Comfort

Radiant heaters give an intense, comfortable heat and prolongs the summer season. No moving parts mean a silent system that does not cause air movement or the spreading of dust and other particles.

Operation and economy

Radiant heaters give instant heat, are simple and flexible to install and require minimum maintenance. People and objects are heated but not the surrounding air, which makes radiant heaters very efficient. This is especially effective outdoors. A radiant heater is also more energy efficient, safer and cleaner than a gaspowered heater.

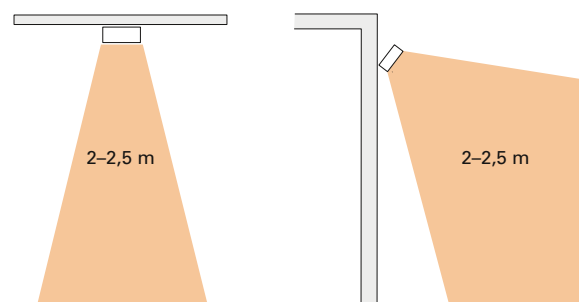
Design

CIR is discreet with its slim design and silent, invisible operation and needs little space to fit in.

Product specifications

- Infrared heater CIR is available in two versions:
 - CIR100 with outputs between 500 and 2000 W.
 - CIR200 with the same outputs and built-in switch.
- Reflectors of high-gloss polished aluminium with maximum resistance against corrosion.
- Grey terminal boxes of heat and weather resistant polycarbonate.
- Adjustable mounting brackets for easy mounting on the wall or ceiling.
- No risk for current leaks and thus no problem with a safety cut-out triggering off.
- IP24. Approved for installation in baths and showers.
- Casing of white lacquered aluminium zinc panels. Colour: RAL 9002, NCS 1502-Y. Protection grille of stainless steel.

Installation height



Design and specifications are subject to change without notice.

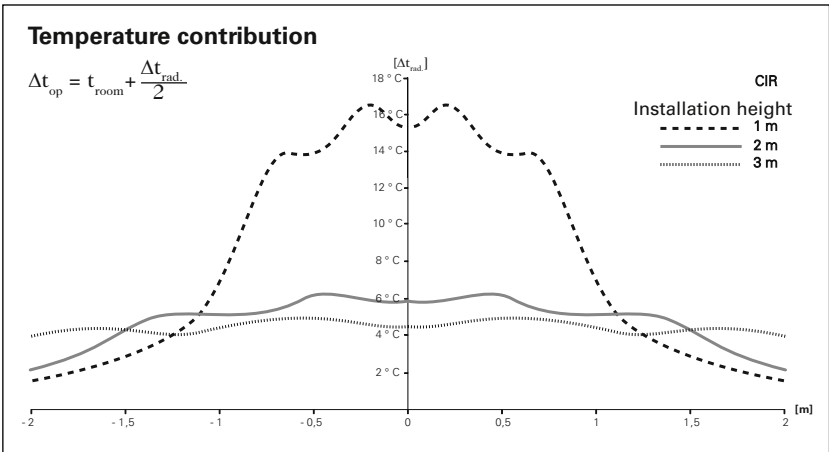


CIR is an ideal solution for giving comfort to customers at outdoor restaurants. The heaters can be mounted on the restaurant’s wall or in line directly above the tables in large terraces.



CIR can also be used for spot heating and extra heat contribution.

CIR is easy to fit in with its slim design. The heaters should heat from at least two directions for an even heating.



Infrared heater CIR

Technical specifications | Infrared heater CIR100 without built-in switch ⚡

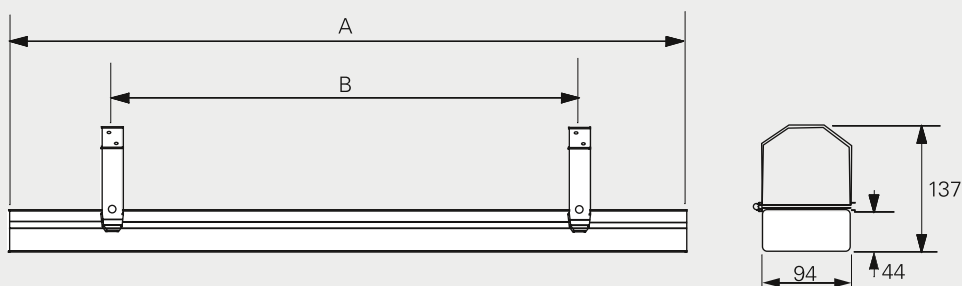
Type	Heat output [W]	Voltage [V]	Amperage [A]	Max. element temperature [°C]	Dimensions LxHxW [mm]	Weight [kg]
CIR10521	500	230V~	2,2	750	710x44x94	1,5
CIR11021	1000	230V~	4,3	750	1250x44x94	2,2
CIR11031	1000	400V2~	2,5	750	1250x44x94	2,2
CIR11521	1500	230V~	6,5	750	1755x44x94	3,0
CIR11531	1500	400V2~	3,8	750	1755x44x94	3,0
CIR12021	2000	230V~	8,7	750	2180x44x94	3,7
CIR12031	2000	400V2~	5,0	750	2180x44x94	3,7

Technical specifications | Infrared heater CIR200 with built-in switch ⚡

Type	Heat output [W]	Voltage [V]	Amperage [A]	Max. element temperature [°C]	Dimensions LxHxW [mm]	Weight [kg]
CIR20521	500	230V~	2,2	750	710x44x94	1,5
CIR21021	1000	230V~	4,3	750	1250x44x94	2,2
CIR21031	1000	400V2~	2,5	750	1250x44x94	2,2
CIR21531	1500	400V2~	3,8	750	1755x44x94	3,0
CIR22031	2000	400V2~	5,0	750	2180x44x94	3,7

Protection class: CIR100 and CIR200: (IP24), splash-proof design.
Approved by SEMKO and CE compliant.

Dimensions



Type	A [mm]	B*1 [mm]	B _{MIN} *2 [mm]
CIR105/205	710	500	300
CIR110/210	1250	900	600
CIR115/215	1755	1200	800
CIR120/220	2180	1500	1000

*1) Recommendation

*2) Minimum distances between brackets

Positioning, mounting and installation

Positioning

The heaters must be placed so that they enclose the area to be heated, see fig. 1 and 2. The normal assembly height is 2–2,5 metres above the ground/floor. A rule of thumb for infrared heaters equipped with metal tubular elements is that 750–1000 W/m² increases the experienced temperature by about 10 °C. The output demand can be reduced if the area to be heated is protected. If the area only has a roof, at least 1000 W/m² should be installed. 750 W/m² is sufficient if the area has three walls. For enclosed areas, the output demand must be calculated. A green house for example requires 250-300 W/m². Optimum comfort is achieved if the heat is distributed from at least two directions.

Mounting

Mounting is very easy using the two brackets (supplied as standard), which can be mounted on the ceiling or wall in different angles. When angle mounting CIR on the ceiling, standard brackets can not be used (the distance to the ceiling will be smaller than the minimum distance 150 mm). The distance between the brackets is adjustable and can be chosen according to the most appropriate place for installation. The infrared heaters are snapped into the brackets and then locked in place. CIR can also be suspended from wires. The units should always be mounted horizontally, but can be angled longitudinally. For minimum mounting distance, see Fig. 3.

Connection

CIR is intended for permanent installation. Connection and serial connection of CIR is done with a maximum cable of 4x2,5 mm² + earth.

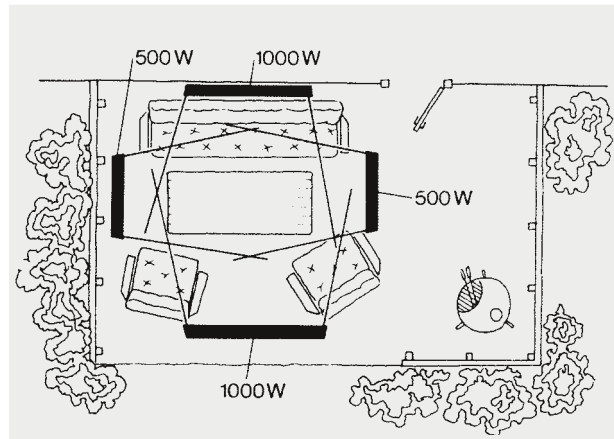


Fig. 1: Good example of positioning, seen from above. Output requirements approx. 1000 W/m².

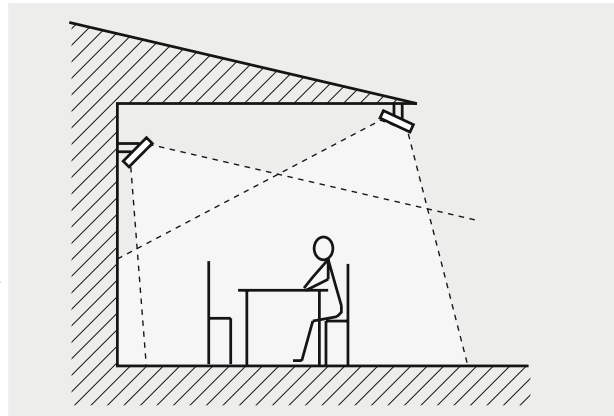


Fig. 2: The heaters should heat from at least two directions for an even heating.

Extra heat contribution

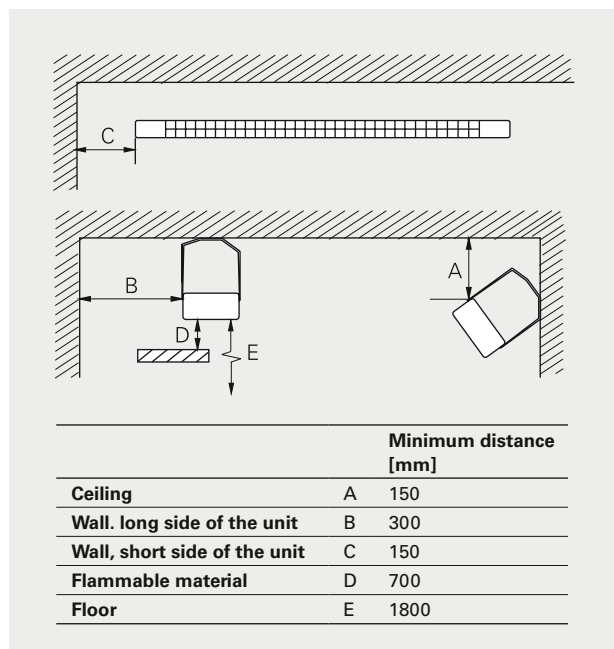
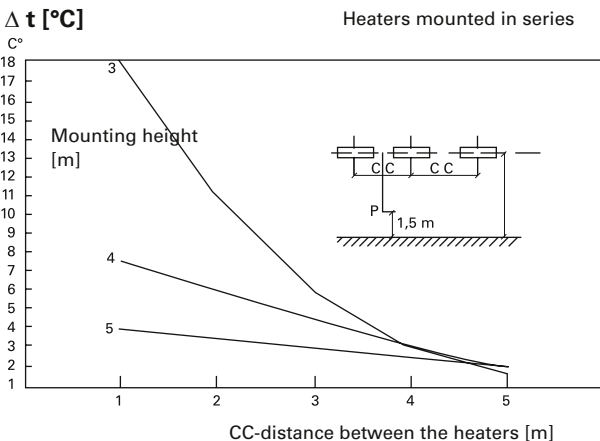


Fig. 3: Minimum mounting distance.

Infrared heater CIR

Control options

Output control with timer

Stepless control especially suitable for spot and zone heating. The heat contribution is controlled for best comfort. Built-in timer is set to desired time.

- CIRT, stepless output control with timer

Control with timer

The timer can be set to desired time. If the load exceeds the timer's setting range or if you want to control a larger system, a contactor can be used.

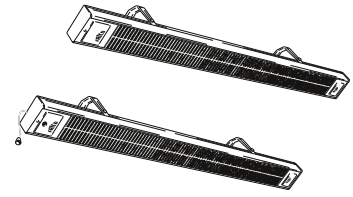
- CBT, electronic timer

Beside these controls, electric heating control ERP can be used to limit the output indoors or in glassed-in areas.

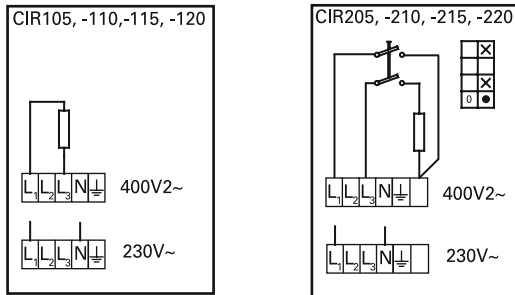
For further options, see section on thermostats and controls or contact Frico.

Type	Description	HxWxD [mm]
CIRT	Stepless output control	155x87x43
CBT	Electronic timer	155x87x43
ERP	Electric heating control	157x93x40

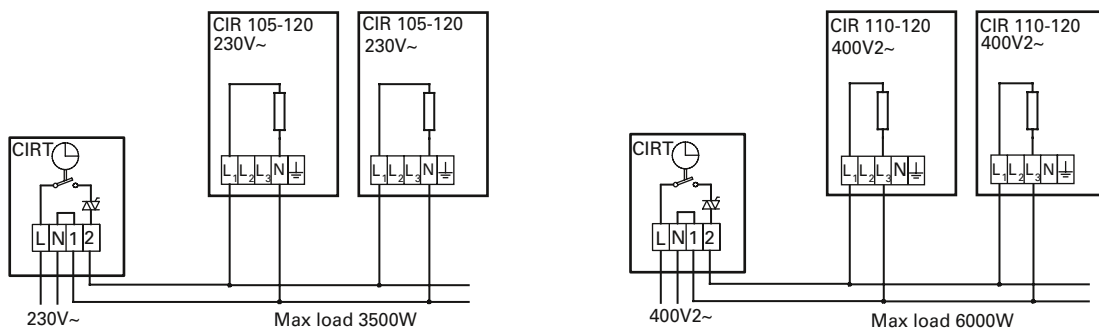
Wiring diagrams



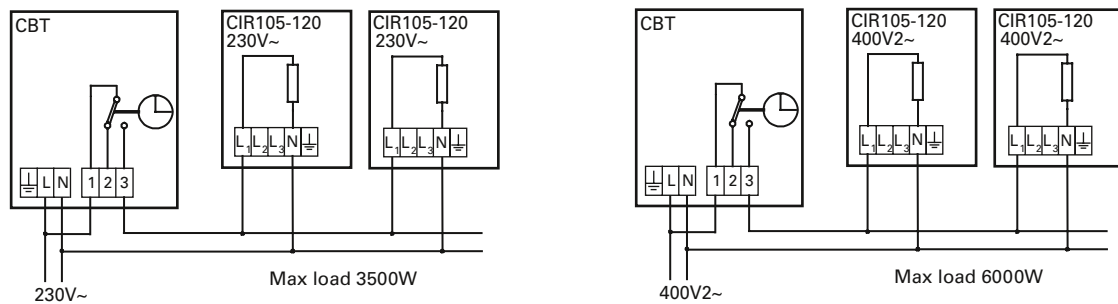
Infrared heater CIR



Output control with timer



Control with timer



Halogen infrared heater ELIR



⚡ 1200 W Electrical heat

1 model



Halogen infrared heater ELIR

For all outdoor applications where a high flexibility is desired

Application

ELIR gives an intense heat suitable for all outdoor applications and rough industrial premises. While ELIR is light, stable and portable it is also well suited for temporary heating on building sites etc. With its concentrated heat it is a good complement to dehumidifiers for drying in areas damaged by water. High protection class (IP65) makes it possible to install the heater in almost any environment.

Comfort

Radiant heaters give an intense, comfortable heat and prolongs the summer season. No moving parts mean a silent system that does not cause air movement or the spreading of dust and other particles.

Operation and economy

Radiant heaters give instant heat, are simple and flexible to install and require minimum maintenance. People and objects are heated but not the surrounding air, which makes radiant heaters very efficient. This is especially effective outdoors. A radiant heater is also more energy efficient, safer and cleaner than a gaspowered heater.

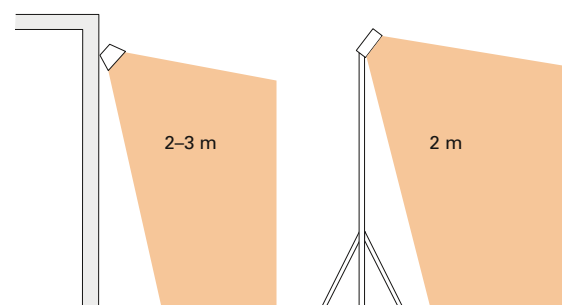
Design

ELIR has a thorough design in a compact format. Simple, robust and light (1 kg). ELIR has no protective glass which means 10–15 % higher efficiency compared to a heater with glass with the same protection class.

Product specifications

- All parts are anti-corrosive.
- Casing/reflectors of high-gloss polished aluminium with maximum resistance against corrosion.
- ELIR is mounted on the wall with the accompanying mounting bracket or suspended from the ceiling. It can also be mounted on a stand for portable use. Suspension details and stand are extra.
- Grey terminal boxes of heat and weather resistant plastic. Colour: RAL 7035.

Installation height



Halogen infrared heater ELIR



ELIR is compact and light. Mounted on a stand ELIR is portable and is well suited for temporary heating.



ELIR gives an intense heat suitable for outdoor applications. The heaters should heat from at least two directions for an even heating.



High protection class (IP65) makes it possible to install the heater in almost any environment.

Halogen infrared heater ELIR

Technical specifications | Infrared heater ELIR ⚡

Type	Heat output [W]	Voltage [V]	Amperage [A]	Max. lamp temperature [°C]	Dimensions LxHxW [mm]	Weight [kg]
ELIR12	1200	230V~	5,2	2000	712x112x83	1,0

Protection class: (IP65), jet-proof design.
CE compliant.

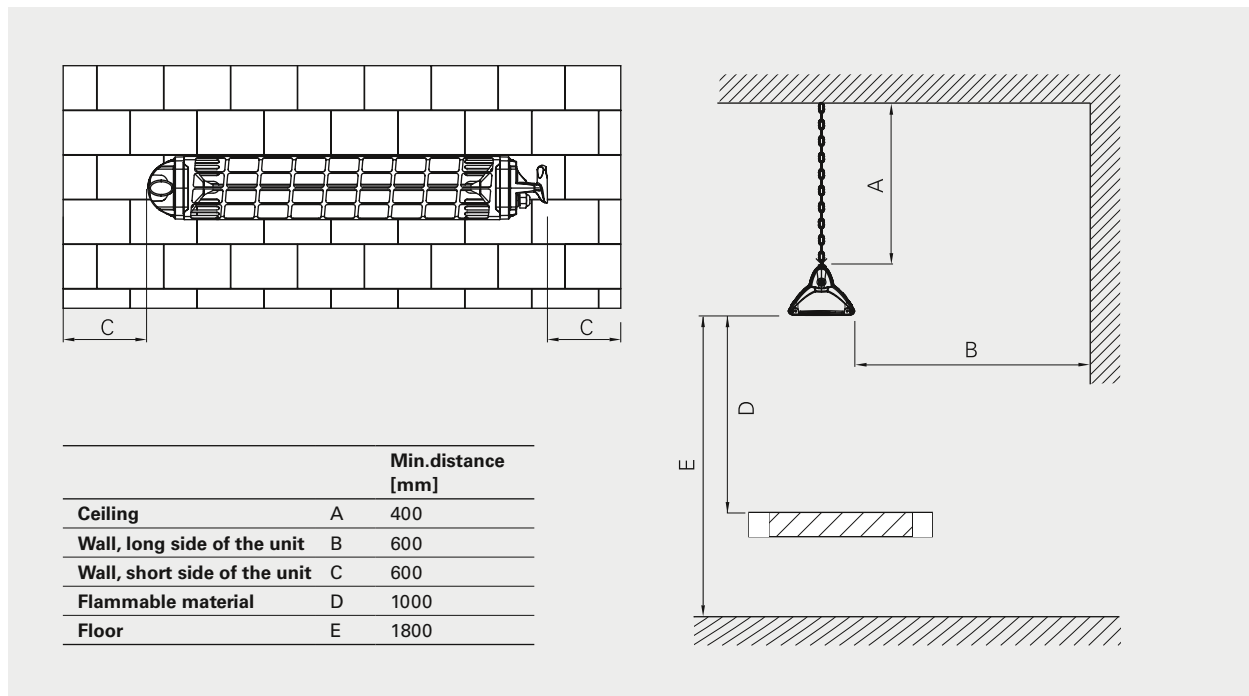


Fig. 2: Minimum mounting distance.

Positioning, mounting and installation

Positioning

The heaters must be placed so that they enclose the area to be heated, see fig. 1. The normal assembly height is 2–3 metres above the ground/floor. A rule of thumb for infrared halogen heaters is that 600–800 W/m² increases the experienced temperature by about 10 °C. The output demand can be reduced if the area to be heated is protected. If the area only has a roof, at least 800 W/m² should be installed. 600 W/m² is sufficient if the area has three walls. For enclosed areas, the output demand must be calculated. Optimum comfort is achieved if the heat is distributed from at least two directions.

Mounting

ELIR should always be mounted horizontally. For minimum mounting distance, see Fig. 2. ELIR can be mounted on the wall, suspended on chains or mounted on stands, see Fig. 3-5. Standard bracket for wall mounting is included. The angle of the heater can be adjusted for optimum comfort, see Fig. 6.

When mounting on chains or stand, suitable fittings are available as accessories.

Connection

ELIR is intended for both permanent installation and portable use. Cable and plug are included in delivery.

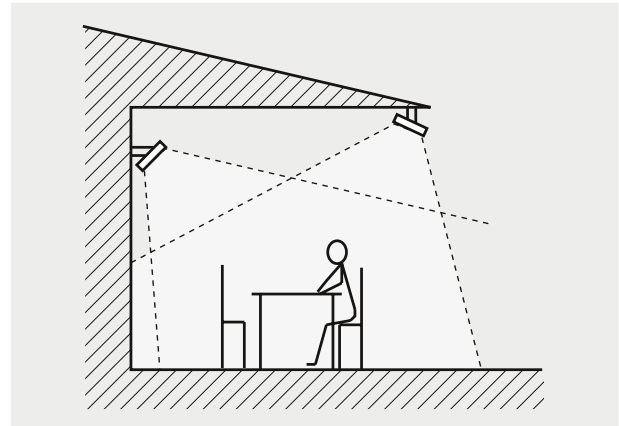


Fig. 1: The heaters should heat from at least two directions for even heating.

Mounting alternatives

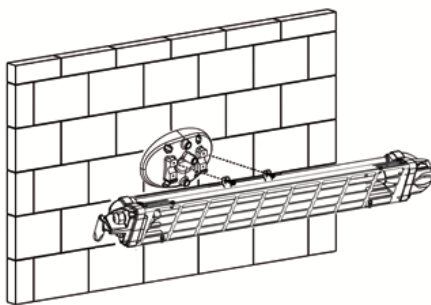


Fig. 3: Standard: Wallmounting (bracket included).

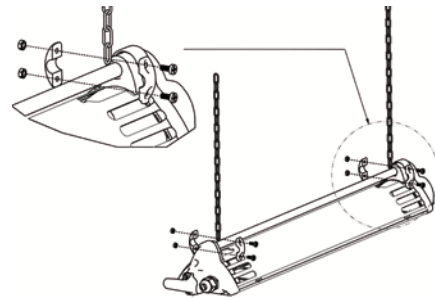


Fig. 4: Chain suspended.

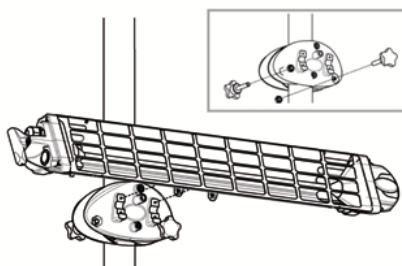


Fig. 5: Mounting on floor stand.

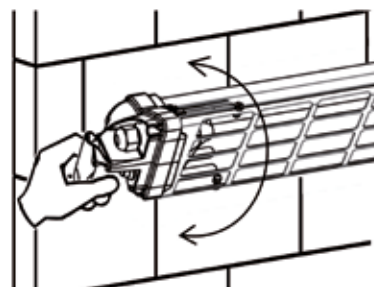


Fig. 6: Adjusting angle

Halogen infrared heater ELIR

Control options

Timer control

The timer can be set to a desired time. If the current load exceeds the timer's setting range or if you want to control a larger system, a contactor can be used.

- CBT, electronic timer

For further options, see section on thermostats and controls or contact Frico.

Accessories

ELIRC, chain for ceiling mounting

See Fig. 4.

ELIRS, floor stand for portable use

Floor stand (tripod) with bracket for ELIR included.

ELIRB, bracket for floor stand

Universal bracket when using any floor stand (i.e. tripod), see Fig. 5.

IREL12, extra lamp

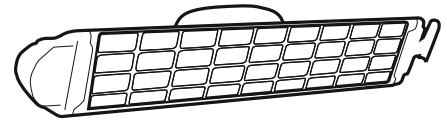
The halogen lamp of 1,2 kW is replaceable. The life of the lamp will depend among other things on surrounding temperature and positioning.

Controls and other accessories

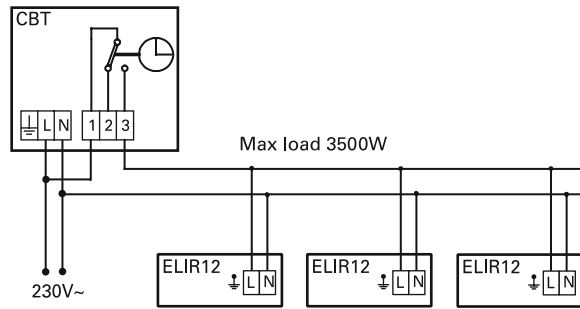
Type	Description	HxWxD [mm]
CBT	Electronic timer	155x87x43
ELIRC	Chain for ceiling mounting	
ELIRS	Floor stand for portable use	
ELIRB	Universal bracket for floor stand	
IREL12	Extra lamp	

Halogen infrared heater ELIR

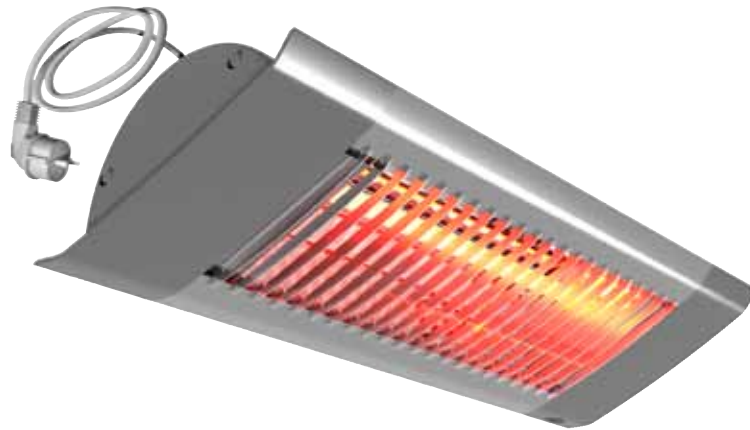
Wiring diagrams



Control with timer



Halogen infrared heater IH



⚡ 1000 – 1500 W Electrical heat

4 models



Halogen infrared heater IH

Suitable for exposed outdoor environments with design demands

Application

Halogen infrared heater IH is the perfect choice for exposed outdoor environments where design is important, for example, balconies, pavement cafés, etc. IH can also be used as local heating in large premises such as churches, industries and warehouses. IH is available in two different designs. IHW gives a comfortable heat in the occupied zone from close range and also wider heat distribution. IHF has more direct heat distribution and is designed to be installed higher up.

Comfort

Radiant heaters give an intense, comfortable heat and prolongs the summer season. No moving parts mean a silent system that does not cause air movement or the spreading of dust and other particles.

Operation and economy

Radiant heaters give instant heat, are simple and flexible to install and require minimum maintenance. People and objects are heated but not the surrounding air, which makes radiant heaters very efficient. This is especially effective outdoors. A radiant heater is also more energy efficient, safer and cleaner than a gaspowered heater.

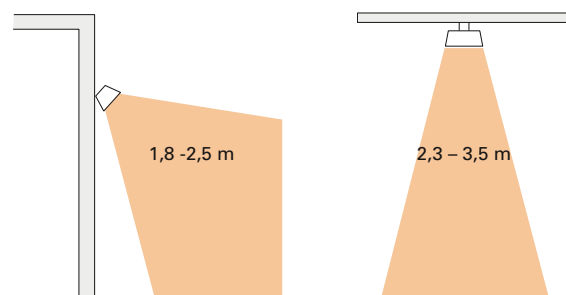
Design

IH is easy to position thanks to its compact design. The discreet and appealing look makes it suitable for outdoor environments with design demands.

Product specifications

- IH is available in two versions:
 - **IHW** provides wide heat distribution, recommended installation height 1.8 – 2.5 m.
 - **IHF** provides directed heat distribution, recommended installation height 2.3 – 3.5 m.
- IH consists of a halogen lamp with a very high intensity and a highly-polished reflector for optimum heat distribution.
- Gives 10-15 % higher efficiency than a glass fronted heater of the same enclosure.
- Bracket for wall mounting. Can also be suspended from the ceiling or mounted on e.g. a parasol or a post. Other mounting alternatives are available as accessories.
- Equipped with a 0.9 metre cord with plug for connection to an earthed outlet socket.
- Casing in anodised aluminium, grille in Nickel/Chrome plating, end caps in powder-coated light-alloy metal. Colour: RAL 9006.

Installation height



Halogen infrared heater IH



Thanks to a high temperature of 2200 °C and the adapted reflector, IH is extremely efficient and provides a comfortable heat.



The IHW10 heater, with the lowest output and a reflector for wide heat distribution, is ideal for mounting under a parasol or an awning.

Halogen infrared heater IH

Technical specifications | Infrared heater IHW with wide heat distribution, installation height 1.8 – 2.5 m ⚡

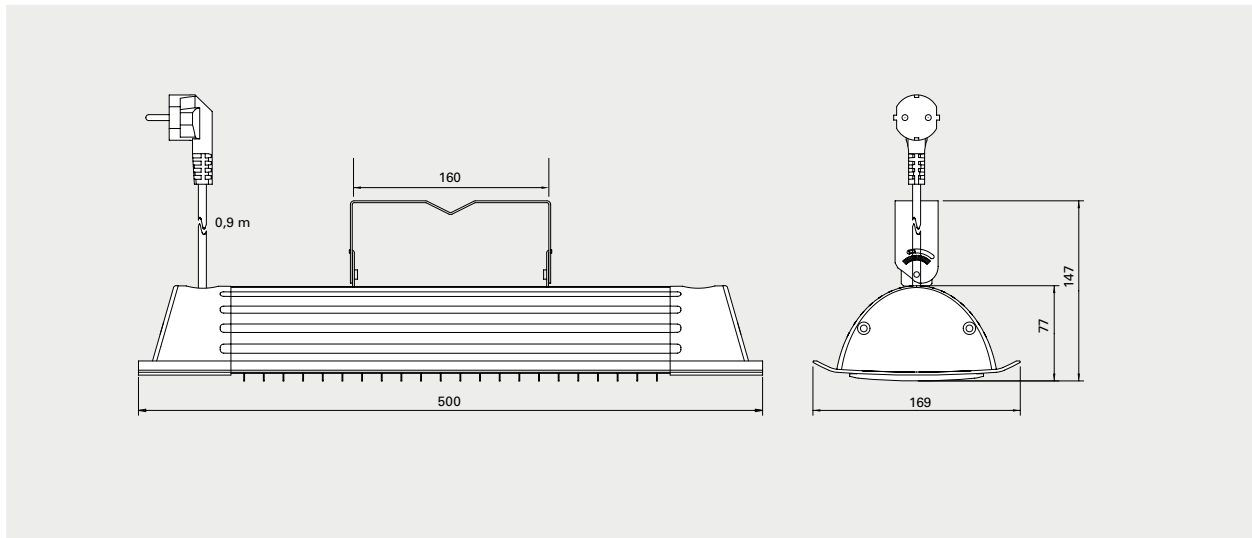
Type	Heat output [W]	Voltage [V]	Amperage [A]	Max. filament temperature [°C]	Dimensions LxHxW [mm]	Weight [kg]
IHW10	1000	230V~	4.3	2200	500x77x169	1.9
IHW15	1500	230V~	6.5	2200	500x77x169	1.9

Technical specifications | Infrared heater IHF with directed heat distribution, installation height 2.3 – 3.5 m ⚡

Type	Heat output [W]	Voltage [V]	Amperage [A]	Max. filament temperature [°C]	Dimensions LxHxW [mm]	Weight [kg]
IHF10	1000	230V~	4.3	2200	500x77x169	1.9
IHF15	1500	230V~	6.5	2200	500x77x169	1.9

Protection class: IPX4.
CE compliant.

Dimensions



Positioning, mounting and installation

Positioning

The heaters must be placed so that they enclose the area to be heated, see fig. 1. The normal assembly height is 2–3 metres above the ground/floor. A rule of thumb for infrared halogen heaters is that 600–800 W/m² increases the experienced temperature by about 10 °C. The output demand can be reduced if the area to be heated is protected. If the area only has a roof, at least 800 W/m² should be installed. 600 W/m² is sufficient if the area has three walls. For enclosed areas, the output demand must be calculated. Optimum comfort is achieved if the heat is distributed from at least two directions.

Mounting

IH is mounted on the wall using the bracket, see fig. 3. The heater can also be mounted on e.g. a parasol or a post, a suitable U-bolt (not included) is used for this together with the supplied console. IH can also be suspended from the ceiling. For other mounting alternatives, see accessories.

The heater must be mounted in a horizontal position in order to keep the lamp horizontal. The heater can be directed straight out from the wall or angled up to 45°. For minimum measurements, see fig. 2.

Connection

IH is equipped with a 0.9 metre cord with plug for connection to an earthed outlet socket.

Control options

Timer control

The timer can be set to a desired time. If the current load exceeds the timer's setting range or if you want to control a larger system, a contactor can be used.

- CBT, electronic timer

For further options, see section on thermostats and controls or contact Frico.

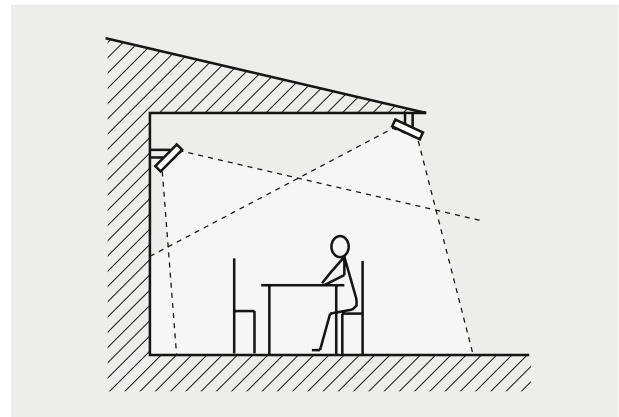


Fig. 1: The heaters should heat from at least two directions for even heating.

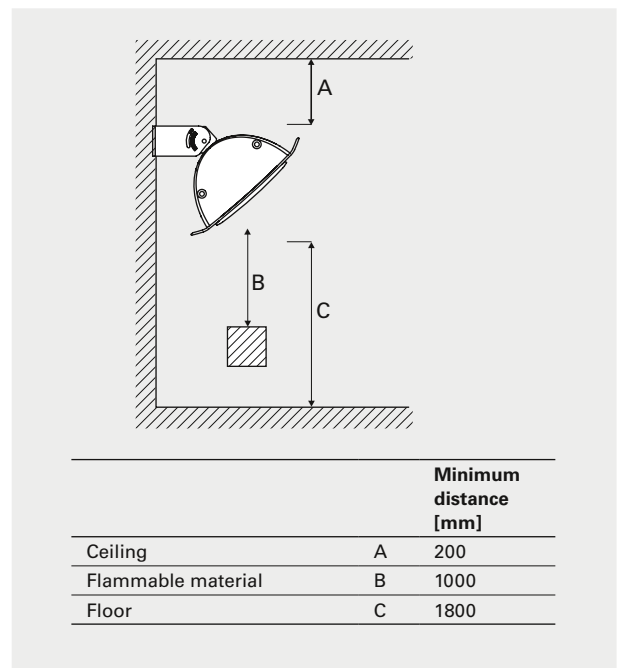


Fig. 2: Minimum distance for fixed installation.

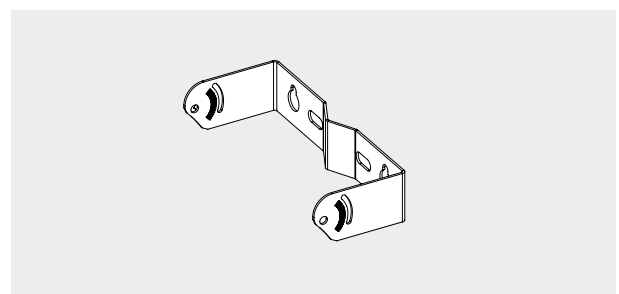


Fig. 3: Wall bracket

Halogen infrared heater IH

Accessories

IHUB, universal bracket

A bracket that makes it easy to even angle IH sideways. The bracket also allows mounting on, for example, a windbreak when the clamping screw is used.

IHXH, drooping extension bracket for high level mounting.

Used to install IH at high level, such as above a window. IHUB universal bracket included.

IHXL, arching extension bracket for low level mounting

Used to install IH at low level, such as on a windbreak. IHUB universal bracket included.

IHT, triple bracket

Three IH units can be mounted on the IHT bracket to provide heat in all directions. Can be suspended from the ceiling by three wires or mounted on an IHP post.

IHTW, wire kit

Set of three bright galvanized wires for easy hanging of IHT.

IHP, post for freestanding installation

Post to stand IH on the floor. IHP has a fixed length of 2.3 m and can be cut to desired length. The IHT triple bracket can be attached to provide heat in all directions. IH can also be mounted directly on the post using a standard bracket and a U-bolt.

IHL, extra lamp

The heat lamp in IH is of the highest quality with a long service life unless it is subjected to unnormal mechanical strains in the form of vibrations and impacts. The life of the lamp will also depend, among other things, on the ambient temperature and its position.

Controls and accessories

Type	Description
CBT	Electronic timer
IHUB	Universal bracket for IH
IHXH	Extension bracket for high level mounting
IHXL	Extension bracket for low level mounting
IHT	Triple bracket
IHTW	Wire kit (3 wires) for IHT
IHP	Post for freestanding installation
IHL1000	Halogen lamp 1000W
IHL1500	Halogen lamp 1500W



Fig. 4: With the IHUB universal bracket IH can also be directed sideways. IH can also be mounted on, for example, a windbreak using the IHUB universal bracket.



Fig. 5: The IHXH and IHXL extension brackets offer flexible installations.



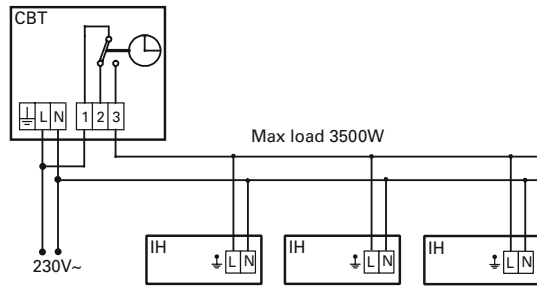
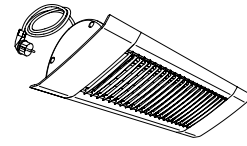
Fig. 6: The IHT triple bracket can be suspended by wires or attached to an IHP post.



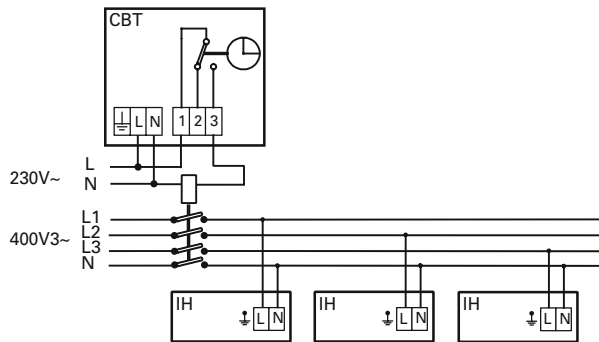
Fig. 7: IHP post secured to the floor.

Wiring diagrams

Timer control



Timer control with contactor



Thermostats





Thermostats

Wide range of thermostats for all environments

Application

Frico's thermostats create great comfort and save energy in public and commercial premises as well as in home environments. They control electrical and water borne floor heating, heat pumps, direct effect electric radiators/convectors and air conditioning. They are also extremely suitable for use with electrically or water heated radiant heaters, fan heaters and air curtains. We offer everything from processor controlled wireless thermostats with advanced functions to the simplest bimetal thermostats.

Comfort

Our precise thermostats create an even temperature and good indoor environment. Processor controlled thermostats also offer many variable functions in the same thermostat. A great advantage is the opportunity to control room and floor heating in integration. By limiting the temperature (min/max) of the floor heating, one has a pleasant floor temperature regardless of the season or selected room temperature.

Operation and economy

The thermostats can be used to control either slow systems such as floor heating or faster systems such as electric radiators/convectors. Correct control gives a longer life of the system and lower energy consumption.

Precise thermostats provide economical heating. With save reduction and weekly program functions one can choose to have lower temperatures, for example at night to give further savings.

Design

Timeless and discreet design, which blends in with all environments.

Product specifications – functions within the range*:

- Digital display for exact setting and reading off.
- Internal and/or external sensors. Possibility of selecting the sensor function and limiting external sensors (min/max).
- Save reduction.
- Possible to control heating or cooling.
- Protection class up to IP55.
- On/off control (for slow systems) or proportional control (for faster systems) in the same thermostat.
- Temperature range down to -35 °C.

*) See following pages for detailed information or separate product sheet/manual.

Thermostats



Thermostats

T,TK,TD, basic offer thermostats

Processor controlled thermostats for room/floor heating. Available with concealed/visible knob or digital display. Model with visible knob also available with switch and in 400 V.

On/off control (for slow systems) or proportional control (for faster systems) in the same thermostat. TD10 has adjustable P-band and time of cycle.

Internal and/or external sensors (external sensor RTS01 available as an accessory) give the possibility of selecting the sensor function e.g limiting external sensors (min/max). Save reduction either by built-in manual switch or via external timer. CE compliant.

RTI, electronic 2-step thermostats

Processor controlled 2-step thermostats for room heating /cooling. Available with concealed or visible knob. Adjustable temperature difference between the steps (1–10 degrees). Save reduction via external connection timer (1–10 degrees). External sensor (RTS01) available as an accessory. High protection class (IP44). CE compliant.

RTS01, external sensor (accessory)

External sensor of NTC-type 10 Kohm. 3 m cable included.



KRT1900/1901

KRT2800

KRTV19

TBK10

TBKS10

ERP

Thermostats

KRT, capillary tube thermostats

Capillary tube thermostats for room heating/cooling. Available with concealed and visible knob, and control in 1 or 2 steps. KRT2800 controls in 2 steps and has adjustable temperature difference between the steps (1–4 degrees). KRT1901 has a temperature range of -35–+10 °C. High protection class (IP44 resp. IP55). CE compliant.

TBK, bimetal thermostats

Mechanical bimetal thermostats with acceleration resistance for room heating/cooling. TBKS10 also has a 1-pole switch. CE compliant.

ERP, electric heating control

Stepless pulse control intended for single phase (3600W/230V) or two phase (6000W/400V2~) electric heaters. Cannot control 3 phase loads. Pulse time 60 secs. Triac control (quiet control). Integrated temperature sensor. External sensors available as an accessory. Save reduction function via external connection timer (1–10 degrees). For larger power outputs a slave unit (ERPS) can be connected. Each ERPS can handle the same power as ERP.

Accessory ERP

Type	Description
ERPRG	Room sensor ERP
ERPGG	Floor/duct sensor ERP
ERPS	Slave unit ERP

Thermostats



CIRT



S123



KUR



CBT

Other controls

CIRT, stepless output control with timer

Stepless output control with timer, primarily intended for infrared heaters and other radiant heaters. Intended for single phase (3600W/230V~) or two phase (6000W/400V2~) electric heaters. Especially suited for spot and zone heating. The heat contribution is regulated for best comfort (25-100 %). The built-in timer can be set for 0.5 to 4 or 4 to 24 hours. High protection class (IP44).

S123, manual switch for 1-2-3 steps

Controls the output in three steps 0-1/3-2/3-3/3.

KUR, digital time switch

Digital weekly timer with 8 different program steps (36 memory places) equipped with a changeover contact. Max. breaking current: 10 A. IP55.

CBT, electronic timer

Electronic timer with alternating contact. Setting range 1/2-1-2-4 or 4-8-16-24 hours respectively. The setting range can be limited down to a maximum time of 1/2 hours. IP44.

Type	Voltage (supply) [V]	Max input [A]	Protection class	Dimensions HxWxD [mm]
CIRT	230/400V2~	16	IP44	155x87x43
S123	230/400V3V~	20	IP42	72x64x46
KUR	230V~	10	IP44	175x85x105
CBT	230V~	16	IP44	155x87x43

Technical specifications | Thermostats

Type	Voltage (supply)	Max input	Setting range	Limit floor heating	Save reduction	Proportional control*1	Static differential	Protection class	Dimensions HxWxD
	[V]	[A]	[°C]	[°C]	[K]	[K/min]	[K]		[mm]
T10	230V~	10	5–30	10–40	-4	2K/10min	0,5	IP30	80x80x31
TK10	230V~	10	5–30	10–40	-4	2K/10min	0,5	IP30	80x80x31
TKS16	230V~	16	5–30	10–40	-4	2K/10min	0,5	IP30	80x80x39
TKS16400	400V2~	16	5–30	10–40	-4	2K/10min	0,5	IP30	80x80x39
TD10	230V~	10	5–37	5–37	Adjustable	Adjustable	0,3	IP30	80x80x31
RTI2	230V~	16/10, 230/400V~	5–35	-	Adjustable	-	0,5	IP44	155x87x43
RTI2V	230V~	16/10, 230/400V~	5–35	-	Adjustable	-	0,5	IP44	155x87x43
KRT1900	-	16/10, 230/400V~	0–40	-	-	-	1,0	IP55	165x57x60
KRT1901	-	16/10, 230/400V~	-35–+10	-	-	-	1,0	IP55	165x57x60
KRTV19	-	16/10, 230/400V~	0–40	-	-	-	1,0	IP44	165x57x60
KRT2800	-	16/10, 230/400V~	0–40	-	-	-	1,0	IP55	165x57x60
TBK10	230V~	10	5–30	-	-	-	0,5	IP30	85x82x39
TBKS10	230V~	10	5–30	-	-	-	0,5	IP30	80x80x43

*1) P-band [K]/time of cycle [min]

*2) Only resistive loads, no contactors.

Products beginning with T can be read as follows: K=knob, S=switch, D= digital display, B=bimetal.

Functions | Thermostats

	Basic offer				Electronic 2-step		Capillary tube			Bimetal	
	T10	TK10	TKS16(400)	TD10	RTI2	RTI2V	KRT1900/1901	KRTV19	KRT2800	TBK10	TBKS10
Internal sensor	X	X	X	X	X	X	X	X	X	X	X
External sensor	X*1	X*1	X*1	X*1	X*1	X*1					
Save reduction	X*2	X*2	X*2	X*2	X*2	X*2					
1-pole switch			X							X	X
Volt free contact	X	X	X	X	X	X	X	X	X		
Contact, 1-pole closing	X	X		X							
Contact, 1-pole alternating			X		X		X	X	X	X	X
Digital display				X							
Advanced extra functions*3				X							
Internal setting	X				X		X		X		
Processor controlled	X	X	X	X	X	X					
Bimetal acc.resistor										X	X
Capillary tube							X	X	X		
Fits wall box system	X	X	X	X						X	X
Heating or cooling function			X	X	X	X	X	X	X	X	X
2-step					X	X			X		
Adjustable temp.diff. between the steps					X	X			X		

*1) External sensor (RTS01) as accessory.

*2) Can be used with an external timer.

*3) See manuals on www.frico.se.

Thermostats

Wiring diagrams

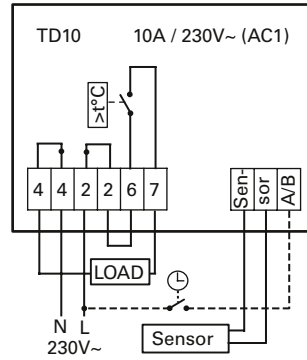
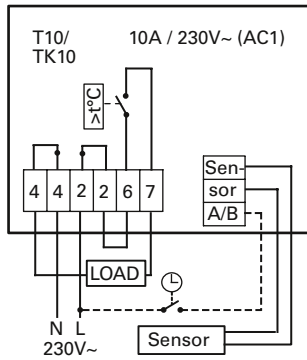
T, TK, TD, basic offer thermostats



T10



TK10



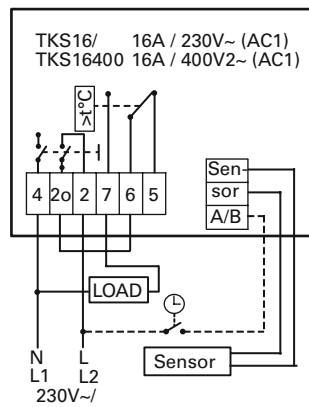
TD10



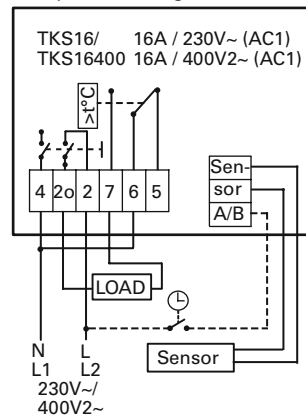
TKS16



TKS16400



2-polig brytning /
2-pole switching



TKS16400

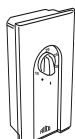


TKS16

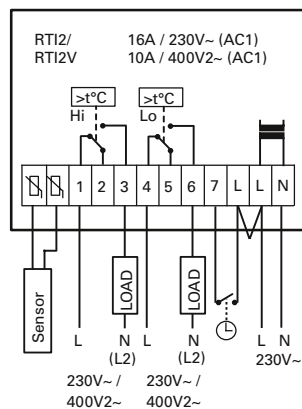
RTI, electronic 2-step thermostats



RTI2

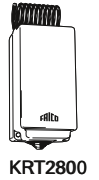
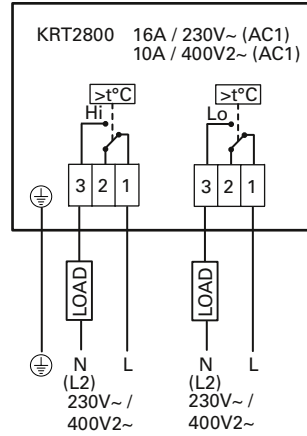
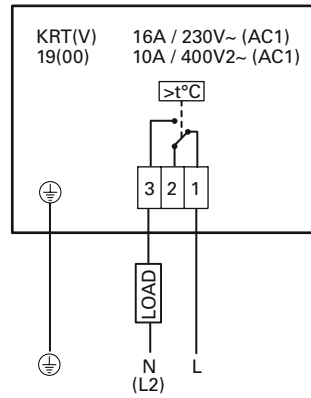


RTI2V

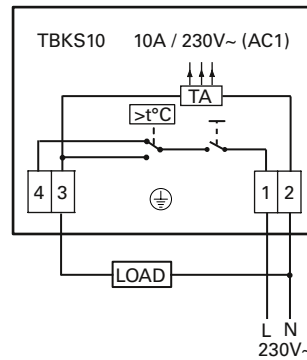
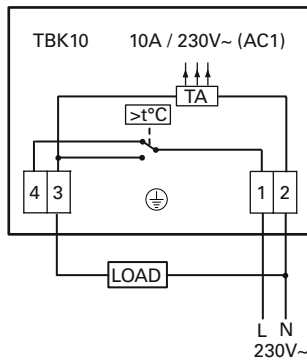


Wiring diagrams

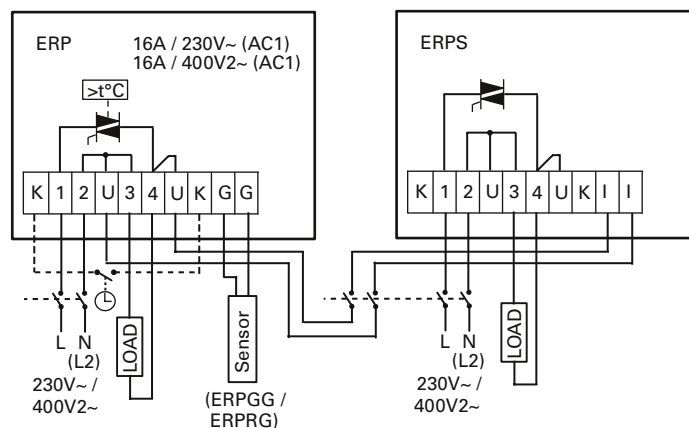
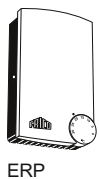
KRT, capillary tube thermostats



TBK, bimetal thermostats



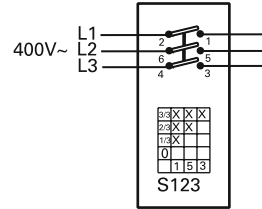
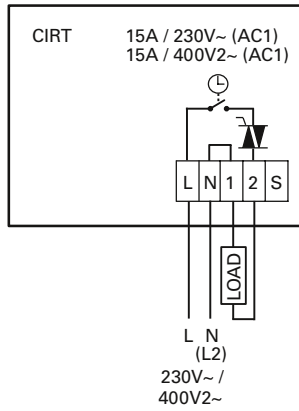
ERP, electric heating control



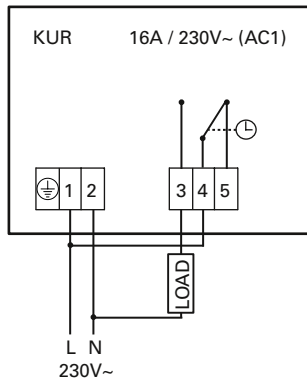
Thermostats

Wiring diagrams

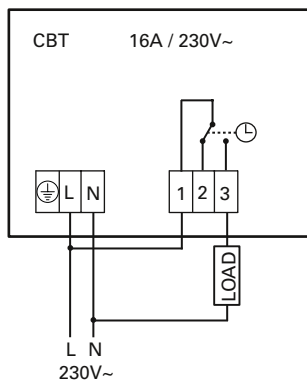
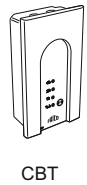
CIRT, stepless output control with timer



KUR, digital time switch



CBT, electronic timer



Contents

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Heating Systems	103
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Heating - Energy

The need to heat a building arises from heat losses that are caused by the temperature differences between indoor air and outdoor air.

Heat losses can be divided into two parts:

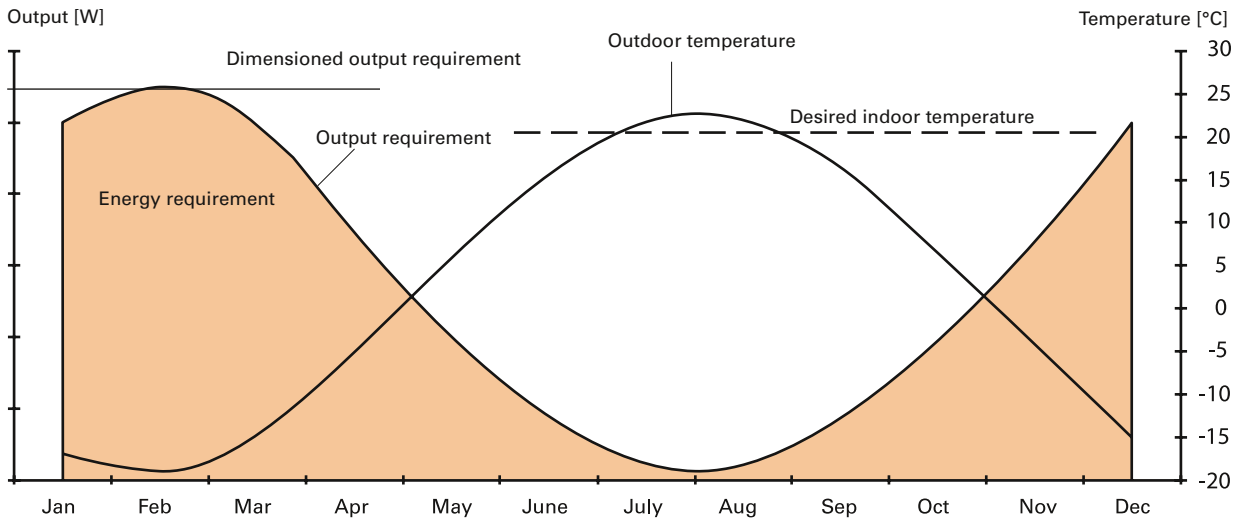
- Transmission losses: Losses via parts of the building (roof, walls, etc.)
- Ventilation losses: Losses through ventilation, unsealed areas and openings.

The outdoor air temperature varies with the season and place but indoor air temperature should remain even and comfortable.

The dimensioned output requirement for a building

is the output necessary to maintain the desired indoor temperature when the outdoor air temperature is at its coldest.

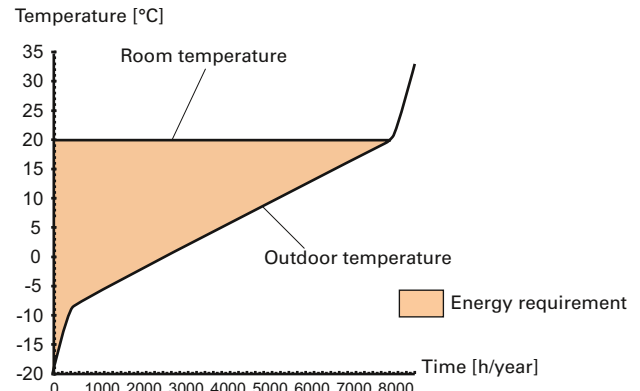
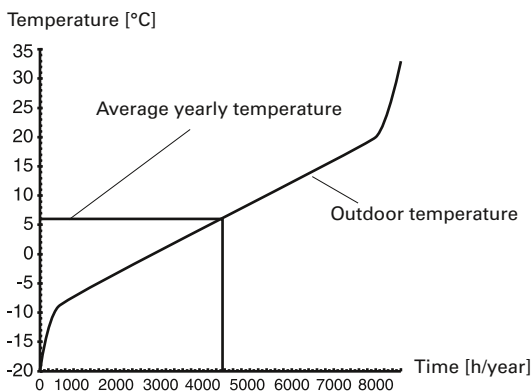
The energy requirement is the total energy requirement of the year for each hour, i.e. the area below the output requirement curve in the diagram.



Duration diagram

A common method of illustrating the energy requirement for heating is to use a Duration diagram. The Duration diagram has two axes. The X axis shows the number of hours in one year, the Y axis the outdoor temperature in °C. One can draw a curve to describe the duration of the outdoor temperature in each place. If the average temperature for the year, is +8 °C, then it is colder than +8 °C for six months or 4380 hours. If a line for desired indoor air temperature is inserted into the diagram, e.g. 20 °C, this line will intersect with

the duration diagram to show the number of degree hours that are needed for heating to 20 °C. The number of degree hours is a measurement that is proportional to the energy requirement for heating. For any particular place, one can either calculate based on such a diagram or consult climate tables, later on in the chapter.



Heating systems

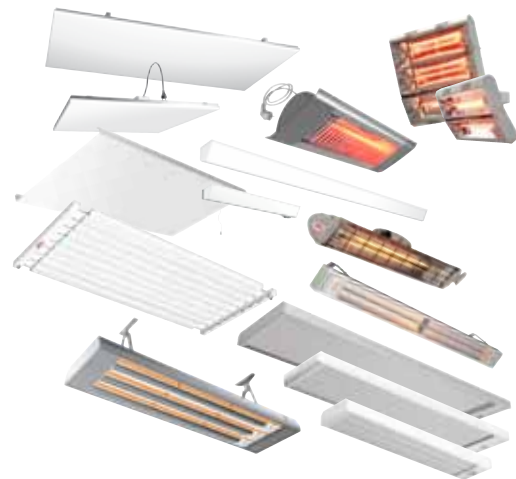
The heating system must cover all heat losses, both from transmission and ventilation. Three main types of heating systems can be outlined:

- Radiant heating
- Air heating
- Convective heating

Radiant heating

Radiant heating transfers heat to surfaces and objects without warming the air on the way. Surfaces are heated and then in turn heat the air within the room. People experience the direct contribution of radiant heat as warmth. The room feels comfortably heated even if the air temperature is relatively low. Radiant heating also prevents overheated air gathering under the ceiling. The equalized distribution of temperature vertically as well as the somewhat lower air temperature contributes to large energy savings.

Radiant heat effectively counteracts cold radiation and cold draughts from large windows, for example.



Air heating

Heating with warm air covers transmission and ventilation losses by supplying heated air to the building. The warm air cools along the outer walls, due to transmission losses. Therefore, the supply air temperature must be higher than the desired room temperature.

Because the heated air is lighter and rises in the room, large temperature differences between the ceiling and the floor can occur. At times, it may be necessary to equalize the differences with e.g. ceiling fans.



Convective heating

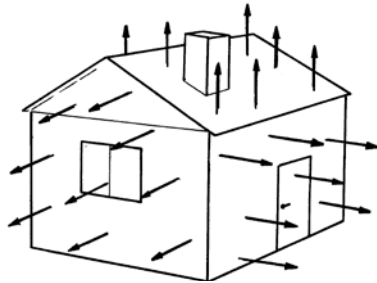
Convective heating transfers heat to the room by warming the air as it passes hot surfaces, radiators, or convectors. The air flow past the radiator or convector is maintained by thermal currents. The warmed air rises and is replaced by colder air. Rotation, or convection, of the air occurs.

Cold draughts from e.g. windows are effectively counteracted by the rising stream of warm air if the heat source is placed under the window.



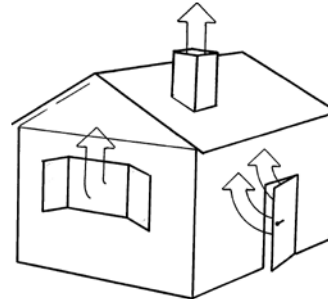
Energy savings

Heat losses



Transmission losses

The size of transmission losses varies according to the areas of the building parts and insulation. The losses are proportional to the temperature differences between indoor air and outdoor air.



Ventilation losses

The ventilation in a building is either mechanical or of the natural type. Mechanical ventilation most often consists of a supply and exhaust air unit that makes heat reclamation possible. Natural and involuntary ventilation consists of thermal currents causing warm air to rise and leak through openings and unsealed areas.

Methods to reduce heat losses

Improved insulation of a building naturally reduces heat losses and increases energy savings, but there are other methods of reducing heating costs as well.

Equalizing temperature differences

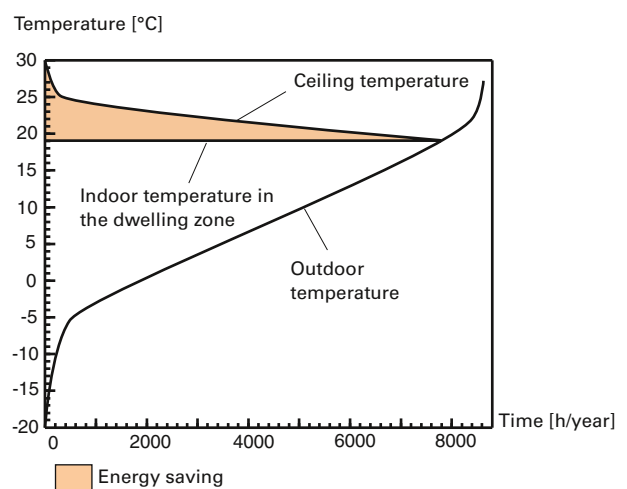
Warm air is lighter than cold air and is gathered in the highest spot inside a building. Vertical temperature differences between floor and ceiling occur. The temperature gradient ($^{\circ}\text{C}/\text{m}$) is a standard of the temperature rise per metre of height and varies depending on the heating system and the season. In rooms with high ceilings, the temperature difference between the dwelling zone and the ceiling is often very big, between 10-15 $^{\circ}\text{C}$. Equalizing the temperature differences can reduce heat losses by as much as 30 % while making optimal use of the heat.

• Radiant Heaters

Heating with a ceiling mounted radiant heater is indirect. The heat develops when heat rays meet surfaces such as floors, walls, machines, etc. The surfaces then heat the air in the dwelling zone. The temperature difference between ceiling and floor thus becomes very small.

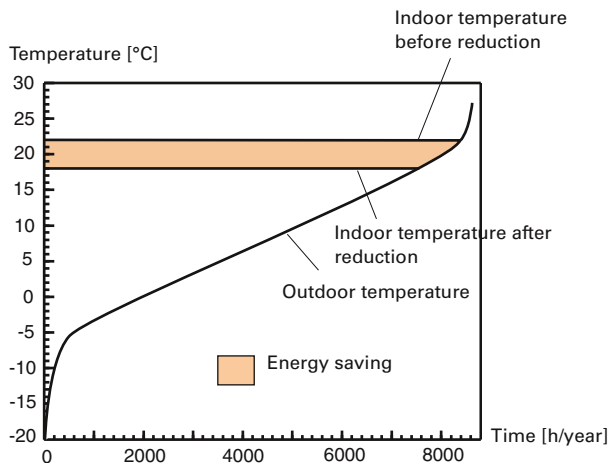
• Ceiling Fans

Heating with e.g. fan heaters or radiators gives relatively high temperature gradients. The installation of ceiling fans is a very simple and inexpensive way to equalize the temperature difference. The heated air is pushed down from the ceiling to the dwelling zone.



Lower indoor temperature

Another method of saving energy is to lower the indoor temperature. However, this must be done without sacrificing the comfort.



• Lower air temperatures

Using radiant heaters, the air temperature in a room can be lowered by a few degrees while still maintaining an experienced high temperature, the so-called operative temperature. A reduction of the temperature by 1 °C results in energy savings of around 5 %. Operative temperatures are those temperatures which human beings feel. They are the sum of the air temperature and radiation temperatures. All objects provide radiant temperature changes. Cold surfaces cause a subtraction and warm surfaces an addition. Operative temperatures can be described thus:

$$t_{op} = \frac{t_{rom} + t_{stråle}}{2} = \frac{t_{rom} + (t_{rom} + \Delta t_{stråle})}{2} = t_{rom} +$$

- der t_{rom} = lufttemperaturen
- $t_{stråle}$ = stråletemperatur (inkl. lufttemperatur)
- $\Delta t_{stråle}$ = stråletemperaturtilskudd (ekskl. lufttemperatur)

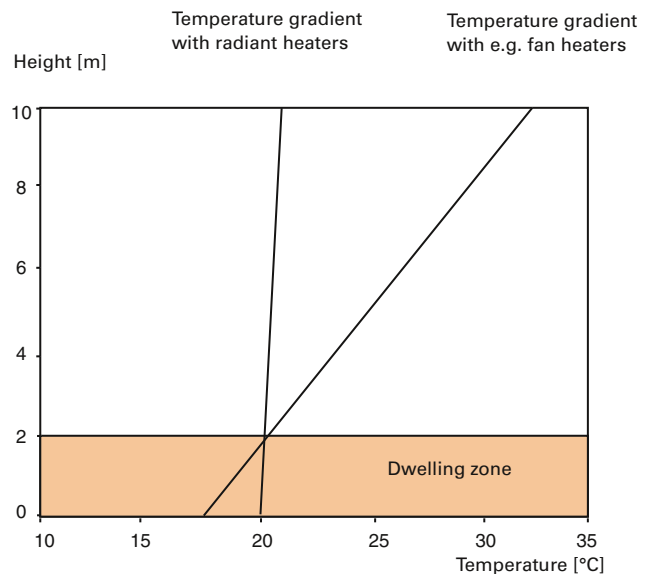
• Zone and spot heating

With radiant heaters, different zones of a building may have varying temperatures. The entire building does not have to have the same high temperature if for example work stations are far apart. Even the comfort aspect means that different work situations require different temperatures. Spot heating can be regarded in the same way as spotlighting. When someone is there, the heating or lighting is increased.

• Low temperature gradient

Heating with radiant heaters provides a highly equalized vertical temperature distribution. The heat develops when the rays meet surfaces such as floors, walls, machines, etc. The surfaces in turn heat the air in the dwelling zone. The temperature differences between the ceiling and the floor become very small and "overheating" minimal. Especially in buildings with high ceilings, great energy savings are obtained compared to conventional heating systems.

The temperature gradient [°C/m], the temperature rise per metre of height, is very low for radiant heaters, approx. 0.3 °C/m. Warm air heating or heating with conventional radiators causes significantly greater temperature differences per metre of height with temperature gradients of 2.5 and 1.7 °C/m respectively, at full output.



• Time control

When there is no-one in the building, e.g. at night and on holidays, the temperature can be lowered.

Reduce leakage

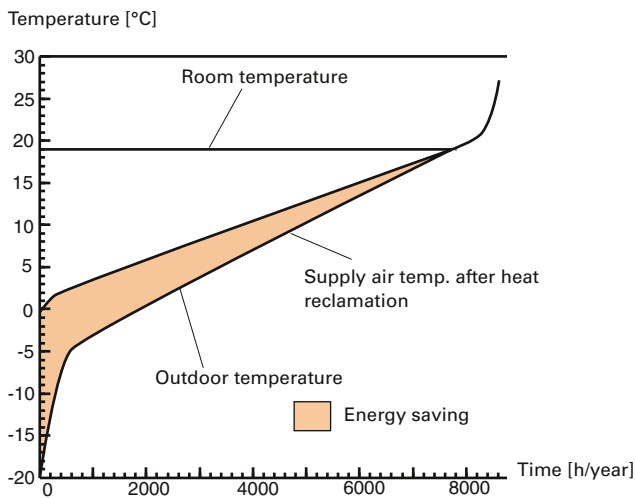
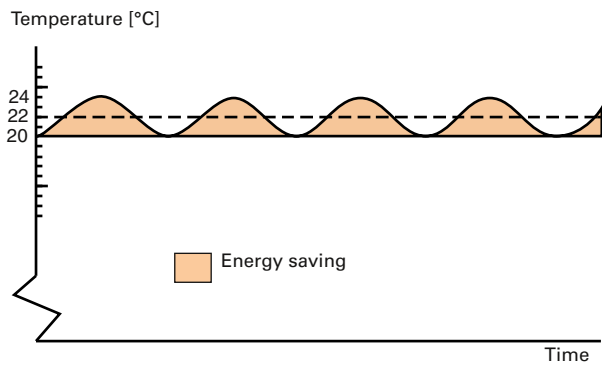
Tremendous energy losses often occur through openings such as doors and gates. Expensive heated or cooled (air-conditioned) air disappears through the opening. This can be prevented by the installation of air curtains. Air curtains create a block between different temperature zones. Balanced ventilation and shorter opening times also contribute to the reduction of energy leakage. Read more about Frico air curtains in Product catalogue Thermozone air curtains.

Greater equalization of temperatures

A standard on/off thermostat can be used to vary the temperature around a set value. If the desired temperature should never be lower than 20 °C, the average temperature is approximately 22 °C. With a triac-controlled output regulator, the room temperature can be set to 20 °C and the temperature won't deviate from the setting. Lowering the temperature by 1 °C gives energy savings of 5 %.

Heat reclamation

To reduce ventilation losses when ventilation is mechanical, a portion of the energy content of the exhausted air can be reclaimed. One simple method is to immediately recycle portions of the warm exhaust air to the supply air unit, so-called return air. Another way is to use a heat exchanger that takes in and returns portions of the heating energy to the building.

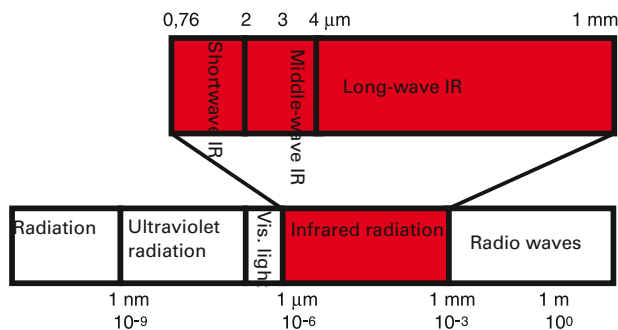


Radiant heaters

What is radiant heating?

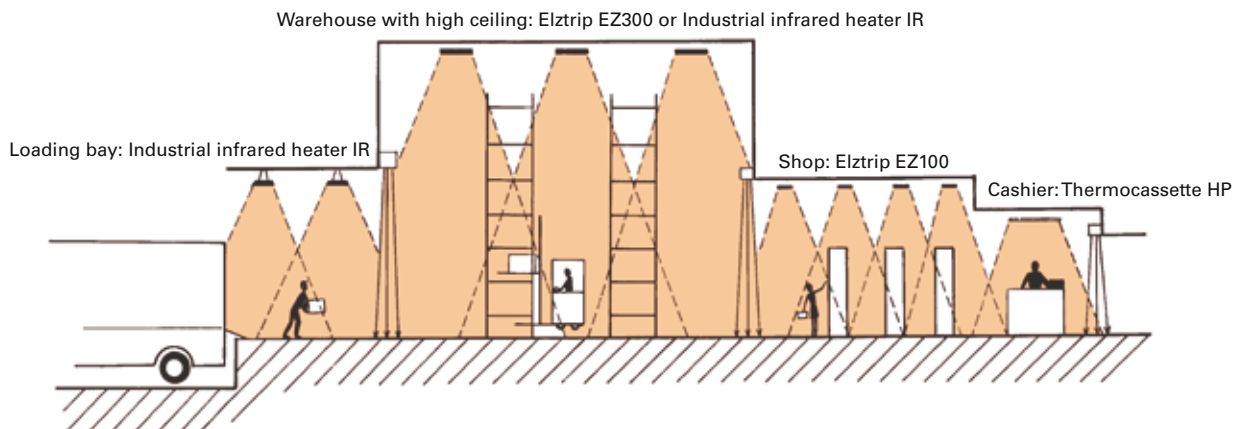
Temperature radiation arises because all bodies emit energy in the form of electromagnetic radiation. Because the radiation comes from a warm body, it is called heat radiation. The figure below shows where temperature radiation is found in the electromagnetic spectrum. Wavelength and radiation intensity from radiant heaters are temperature dependent. The higher the element temperature of the radiant heater, the shorter the wavelength and the higher the radiation intensity.

Two bodies only exchange radiation if there is a temperature difference between them. Human beings constantly exchange heat with their environment. When you lose a lot of heat you are cold. It is necessary to reach a thermal point where there is balance, this point corresponds with the so called comfort temperature. The comfort temperature is defined by the air temperature, wall temperature, air speed and atmospheric humidity. Heating with radiant heating is perfect to maintain a good comfort.



Electromagnetic spectrum

Examples of usage of various radiant heaters



Features

- **Ceiling mounting**

Mounting radiant heaters on the ceiling or on the ceiling line (possibly together with lighting armatures) leaves the walls and floors free, making use of the room more flexible. Thermocassettes set into false ceiling systems and Thermoplus heaters in the ceiling angle are both elegant solutions.

- **Quick heating**

Radiant heaters heat quickly compared to conventional heating of the air. A building may for example have a longer period with reduced night temperatures, which saves energy. However, even in buildings used only sporadically, one most often wants a quick temperature rise.

- **Mechanical ventilation**

Radiant heaters work well in combination with mechanical ventilation. They do not give rise to any air currents that interfere with ventilation.

- **Additional heating**

As additions to other heating systems and when expanding, radiant heaters are often a simple, inexpensive solution.

- **Outdoors**

Outdoors and in poorly insulated buildings, the radiant heat contribution can be used to increase heating comfort or for de-icing. Industrial infrared heater and Comfortinfra heaters can be used on loading bays, sport arena stands, station platforms, and outdoor restaurants, etc.

- **Drying and warming**

Radiant heaters can be used for drying and warming in various industrial processes. There are also many uses on construction sites, e.g. for the curing of concrete, spot and quick drying, paint drying, de-icing, and occasional personal heating.

Comfort

- **Temperature equalization**

Ceiling mounted radiant heaters can be placed where heat is really needed, for example along outer walls where heat deficits arise. Thoughtful positioning provides equalized and comfortable temperatures.

- **Draught-free rooms**

Radiant heaters cause no air movements or thermal currents that cause cold draughts along the floor or similar.

- **Higher surface temperatures**

The surfaces in our surroundings are given a somewhat higher temperature with radiant heaters. The risk for cold radiation is eliminated. Together with a somewhat lower air temperature, this yields excellent heating comfort.

- **Prevents cold draughts**

Cold draughts and cold radiation from e.g. large window surfaces are effectively counteracted with some type of radiant heaters by increasing the temperature of the surfaces.

- **"Soft" long-wave heat radiation**

Radiant heaters for indoor use have relatively low element temperatures that give off less intense heat than e.g. Industrial infrared heaters. By using an electric heating regulator that sends output in pulses, further "softness" can be obtained.

Positioning of radiant heaters

Radiant heaters are used for total heating as well as for zone and spot heating.

• **Total heating**

To estimate approximately how many heaters that are needed to heat a room the formula is:

$$\text{Min. amount of heaters} = \frac{\text{Area of the room [m}^2\text{]}}{(\text{Installation height [m]})^2}$$

This formula is a basic estimation of the minimum amount of heaters needed to maintain the comfort. To calculate the right output for each heater, the total heating requirement must be calculated.

• **Vertical positioning**

When planning the installation, the distance between the heaters should not be bigger than the height between heater and floor, that means (a) should be less than (H). See Fig. 1. In rooms seldom used, the distance can be increased. In rooms frequently used, the distance between a sedentary person and heater should be at least between 1.5 to 2 metres (Δh). When these two guide lines are followed, the difference in operative temperature will not exceed the comfort level $\Delta t_{op} = 5^\circ\text{C}$. This means that the difference between the real temperature and the temperature that man senses, will not be more than 5°C .

• **Zone heating**

Different work situations require different temperatures. With radiant heaters such as Elztrip, it is simple to divide the building into temperature zones or to spot heat individual work stations. This results in lower heating costs and better heating comfort.

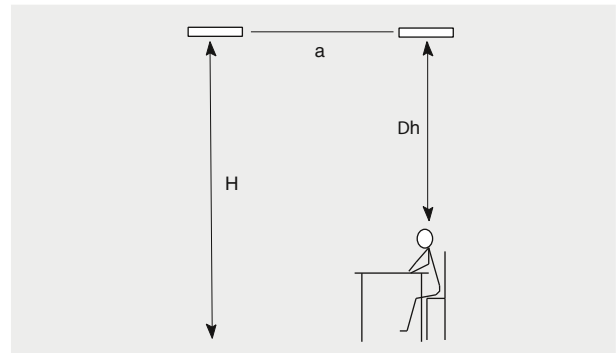
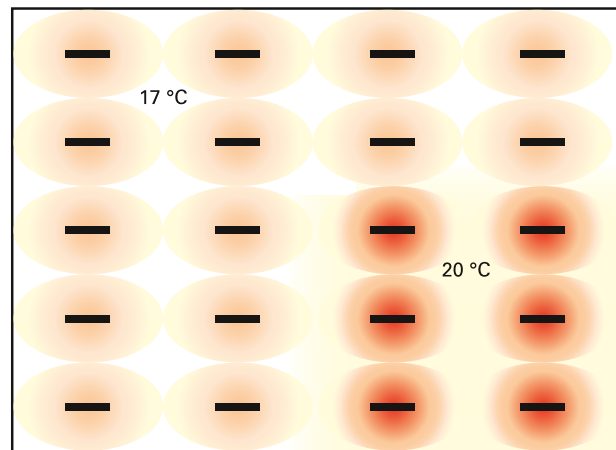
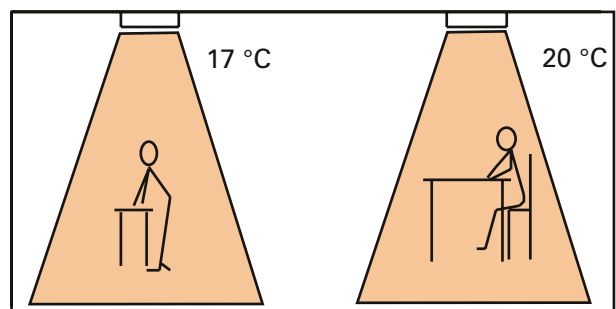


Fig. 1: Vertical positioning.



Plan sketch: Temperature zones with radiant heaters.



Output and energy calculation

Output requirements

Heat losses from a building consist of two parts. Transmission losses through walls, floors, windows, doors and the roof, and ventilation losses.

Transmission losses:

$$P_T = A \times U \times (t_{\text{room}} - \text{DUT})$$

Ventilation losses:

$$P_v = q \times c \times \rho \times (t_{\text{room}} - \text{DUT})$$

or

$$P_v = Q \times (1 - \alpha) \times (t_{\text{room}} - \text{DUT}) \times 0.33$$

where

U = thermal transmittance value [W/m² °C] (=K-value)

A = area of enclosed surfaces [m²]

t_{room} = room temperature [°C]

DUT = lowest dimensioned outdoor temperature of the district [°C]

q = calculated outdoor air flow [m³/s]; forced air flow need not be regarded

c = specific heating capacity [J/kg°C]

ρ = density [kg/m³]

Q = air flow [m³/s]

α = efficiency of heat reclamation, 0 - 1

The thermal transmittance values, U-values, can be read in tables and diagrams or be calculated if the constituent materials are known.

Energy requirement

The energy requirement for heating is determined by the output requirement and the number of degree hours required for heating to the desired temperature. The theoretical energy requirement goes down due to internal heating energy E_i.

Actual energy requirement

$$E = \frac{P_t}{t_{\text{room}} - \text{DOT}} \times \text{°Ch} + \frac{P_v}{t_{\text{room}} - \text{DOT}} \times \text{°Ch} - E_i$$

Internal heat energy

$$E_i = P_i \times A_{\text{floor}} \times \text{Operation} \times 8760$$

°Ch = number of degree hours for heating

E_i = internal heat energy [Wh/year] (depending on room activities, is read off in tables and diagrams)

P_i = internal heat output [W/m²]

Operation = operation time factor for internal heat output

Operation time factor is calculated from the operation time for the activity and is:

$$\text{Operation} = (\text{hours}/24) \times (\text{days}/7)$$

hours = number of hours per day in operation

days = number of days per week in operation

Ventilation systems can also have operation time factors if they are run at half speed or stopped during the night.

Technical support

Frico Technical support offered free of charge :

- Output and energy calculations
- Solutions to heating problems and energy saving advice
- Dimensioning and positioning
- Solutions for heating and comfort

Contact us to discuss heating and energy savings.

On our website www.frico.se you can easily make an output calculation by filling in data about the building and temperatures. The more precise your information is, the more certain will the results of the calculation be.

You can also fill out the calculation form on the next page. Copy it and mail it or fax it to us for calculations and suggestions for savings. Even if all values are not available, we can still do usable calculations. If, for example, the U-values are missing, supply materials, thickness, and insulation information can be given instead. Please attach any explanatory drawings or sketches.



Calculation form

On our website www.frico.se, you have the possibility to easily make your own output calculation. You are also welcome to copy this page, fill out all known details, send by mail or fax to Frico Technical support. We assist you with calculation and dimensioning. This page is also available on our website.

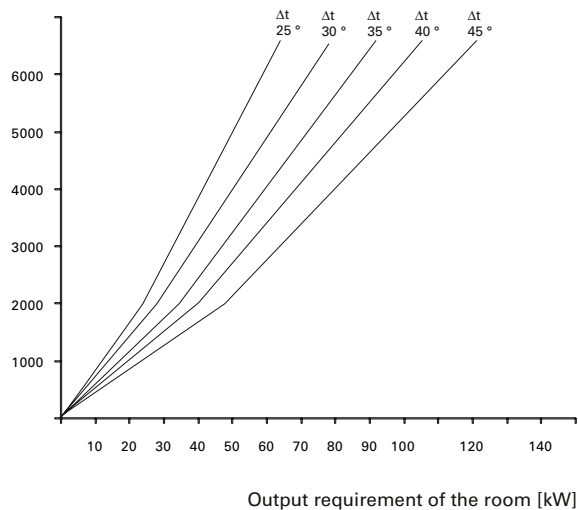
Company:	Contact person:
Address:	Telephone:
	Fax:
	e-mail:
Project:	
Building:	Length:
Location:	Width:
Construction year:	Height:
Flat or irregular ceiling:	
Number of windows:	Window heights:
Mounting height of window:	Window widths:
Number of doors:	Door heights:
	Door widths:
Wall surface of heated space:	
Window type or U-value:	1-,2-,3 pane:
Door type or U-value:	
Number of openings per day:	Duration of each open time:
Outer wall type or U-value:	
Ceiling type or U-value:	
Floor type or U-value:	
Desired temperature (day):	Desired temperature (night):
Internal heat (from lighting, machinery etc):	Activities in the building:
Infiltration (Ventilation air flow and leakage) day time (cha/h):	Infiltration (Ventilation air flow and leakage) night time (cha/h):
Efficiency of reclamation:	Natural ventilation:
Operation time/day, day temperature:	Operation time/day, night temperature:
Present heating system:	
Present energ price and energy form:	

Ready reckoner, output requirement

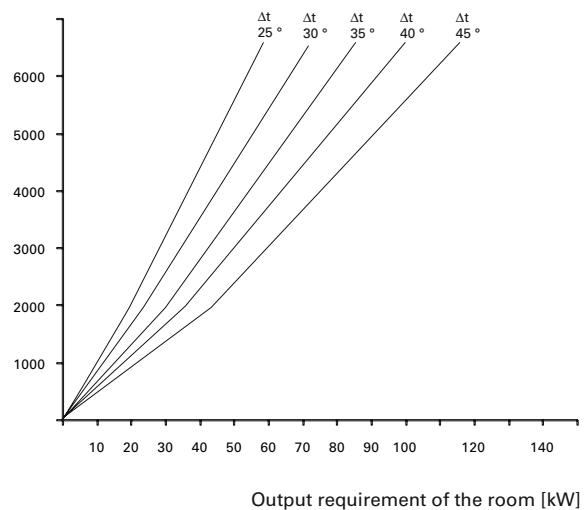
For those who do not know all the facts about the premises an estimation of the output requirement can still be made. If you know the room volume and the desired room temperature you can read off the output requirement in the diagram below. The basis for the diagram is output requirement calculations made according to accepted methods. In the calculations, the air flow is set to one air change in the room or building per hour. It is provided that the four walls are outer walls and the roof above the ceiling is outdoors. In

the output requirement diagram A and B, the average U-value is set at 0,25 and 0,4, which is equivalent to a well insulated building. In diagram C the average U-value is set at 1.0, indicating that the building is less well insulated. The curves Δt in the diagram show the difference between room temperature and the lowest outdoor temperature.

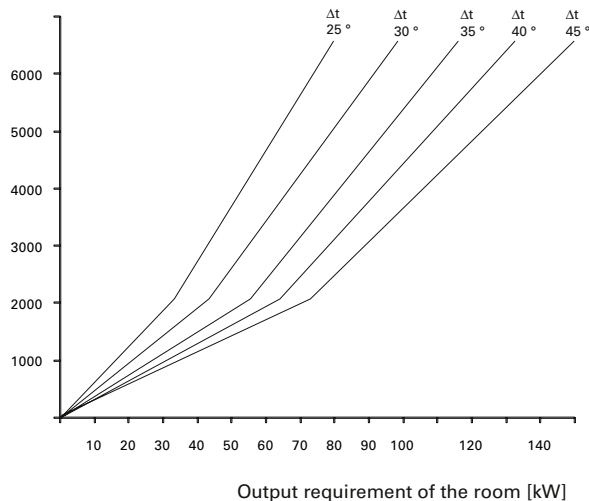
Output requirement diagram A
Average U-value 0.25



Output requirement diagram B
Average U-value 0.4



Output requirement diagram C
Average U-value 1,0



Tables and diagrams for dimensioning

Basic electrical formulas

Amperage

Direct current and 1-phase alternating current at $\cos\varphi=1$	3-phase alternating current Y-connection	3-phase alternating current Δ -connection
$I=U/R=P/U$	$I_f=I$	$I=I_f\sqrt{3}$

Voltage

Direct current and 1-phase alternating current at $\cos\varphi=1$	3-phase alternating current Y-connection	3-phase alternating current Δ -connection
$U=RI$	$U=U_f\sqrt{3}$	$U=U_f$

Output

Direct current and 1-phase alternating current at $\cos\varphi=1$	3-phase alternating current Y-connection	3-phase alternating current Δ -connection
$P=UI$	$P=\sqrt{3} UI \cos\varphi$	$P=\sqrt{3} UI \cos\varphi$

U = operating voltage in volts: with DC and singlephase AC between the two conductors, with 3-phase AC two phases (not between phase and zero).

U_f = voltage between phase and zero in a 3-phase cable. $\sqrt{3} \cong 1.73$

I = amperage in ampere

I_f = amperage in ampere in phase wire

R = resistance in ohm

P = output in watt

Symbols for model types

= normal design (no symbol)

☼ = drip-proof design

☼ = splash-proof design

☼☼☼ = jet-proof design

☼☼☼ = water-tight model

Protection classes for electrical material

IP, first figure	Protection against solid objects
0	No protection
1	Protection against solid objects ≥ 50 mm
2	Protection against solid objects ≥ 12.5 mm
3	Protection against solid objects ≥ 2.5 mm
4	Protection against solid objects ≥ 1.0 mm
5	Protection against dust
6	Dust-tight

IP, second figure	Protection against water
0	No protection
1	Protection against vertically dripping water
2	Protection against dripping water max 15°
3	Protection against sprinkled water
4	Protection against spraying with water
5	Protection against water jets
6	Protection against heavy seas
7	Protection against short immersion in water
8	Protection against the effects of long-term immersion in water

Dimensioning table for cables and wires

Installation wires, open or in conduit		Connection wires		
Area [mm ²]	Fuse [A]	Area [mm ²]	Continuous current [A]	Fuse [A]
1.5	10	0.75	6	10
2.5	16	1	10	10
4	20			
6	25	1.5	16	16
10	35	2.5	25	20
16	63	4	32	25
25	80	6	40	35
35	100	10	63	63
50	125			
70	160			
95	200			
120	250			
150	250			
185	315			
240	315			
300	400			
400	500			

Dimensioning table

Amperage at different outputs and voltages

Output [kW]	Connection wires					
	127/1	230/1	400/1	230/3	400/3	500/3
1.0	7.85	4.34	2.50	2.51	1.46	1.16
1.1	8.65	4.78	2.75	2.76	1.59	1.27
1.2	9.45	5.22	3.00	3.02	1.73	1.39
1.3	10.2	5.65	3.25	3.27	1.88	1.50
1.4	11.0	6.09	3.50	3.52	2.02	1.62
1.5	11.8	6.52	3.75	3.77	2.17	1.73
1.6	12.6	6.96	4.00	4.02	2.31	1.85
1.7	13.4	7.39	4.25	4.27	2.46	1.96
1.7	14.2	7.83	4.50	4.52	2.60	2.08
1.9	15.0	8.26	4.75	4.78	2.75	2.20
2.0	15.8	8.70	5.00	5.03	2.89	2.31
2.2	17.3	9.67	5.50	5.53	3.18	2.54
2.3	18.1	10.0	5.75	5.78	3.32	2.66
2.4	18.9	10.4	6.00	6.03	3.47	2.77
2.6	20.5	11.3	6.50	6.53	3.76	3.01
2.8	22.0	12.2	7.00	7.03	4.05	3.24
3.0	23.6	13.0	7.50	7.54	4.34	3.47
3.2	25.2	13.9	8.00	8.04	4.62	3.70
3.4	26.8	14.8	8.50	8.54	4.91	3.93
3.6	28.4	15.7	9.00	9.05	5.20	4.15
3.8	29.9	16.5	9.50	9.55	5.49	4.39
4.0	31.5	17.4	10.0	10.05	5.78	4.62
4.5	35.4	19.6	11.25	11.31	6.50	5.20
5.0	39.4	21.7	12.50	12.57	7.23	5.78
5.5	43.3	23.9	13.75	13.82	7.95	6.36
6.0	47.3	26.1	15.0	15.1	8.67	6.94
6.5	51.2	28.3	16.25	16.3	9.39	7.51
7.0	55.0	30.4	17.50	17.6	10.1	8.09
7.5	59.0	32.6	18.75	18.8	10.8	8.67
8.0	63.0	34.8	20.0	20.1	11.6	9.25
8.5	67.0	37.0	21.25	21.4	12.3	9.83
9.0	71.0	39.1	22.5	22.6	13.0	10.4
9.5	75.0	41.3	23.75	23.9	13.7	11.0
10.0	78.5	43.5	25.0	25.1	14.5	11.6

For outputs between 0,1 and 1 kW, the amperage read is multiplied by 0.1. For outputs between 10 and 100 kW, the amperage read is multiplied by 10.

Climate data

Place	Av. daily temp [°C]	Extremes in Dec. [°C]	Av. wind speed [m/s]
Scandinavia			
Tromsö	2.9	-14.9	3.0
Karesoando	-1.5	-30.2	1.5
Sodankyle	-0.4	-43.1	3.0
Trondheim	4.9	-20.2	3.2
Vaasa	3.5	-30.2	3.8
Bergen	7.8	-8.4	3.2
Oslo	5.9	-20.2	2.2
Stockholm	6.6	-16.3	3.8
Göteborg	7.6	-15.8	4.0
Copenhagen	8.5	-11.4	2.3
British isles, France, Belgium, The Netherlands, Luxemburg			
London	10.4	(-12)	-
Eelde	8.7	-14.6	5.3
De Bilt	9.3	-20.8	3.3
Ostend	9.9	-13.5	6.5
Brussels	9.9	-16.0	3.8
Lille	9.7	-14.0	4.5
Luxemburg-City	8.8	-15.2	-
Le Havre	10.6	-7.8	-
Paris	10.9	-13.2	3.9
Strasbourg	9.7	-21.0	2.2
Brest	10.8	-5.0	5.0
Tours	11.2	-18.0	3.7
Nantes	11.7	-10.8	3.6
Lyon	11.4	-24.6	3.0
Bordeaux	12.3	-13.4	3.1
Toulouse	12.5	-10.5	3.6
Marseilles	14.2	-12.8	4.4
Ajaccio, Corsica	14.7	-3.6	2.6
Iberian Peninsula			
Santander	13.9	-0.2	3.6
Barcelona	16.4	-2.5	2.2
Oporto	14.4	-3.7	5.1
Madrid	13.9	-6.5	2.7
Palma de Mallorca	16.8	-1.5	2.8
Losbon	16.6	0.0	4.1
Sevilla	18.8	-2.8	1.7
Malaga	18.5	2.0	2.1
Poland, Czech Republic, Slovakia, Hungary			
Gdynia	7.9	-14.8	3.6
Warsaw	8.1	-18.9	4.1
Cracow	8.6	-17.1	2.7
Prague	7.9	-20.4	-
Ostrava	8.1	-27.9	-
Bratislava	9.6	-22.8	3.4
Budapest	11.2	-19.1	2.3
Pecs	11.5	-	3.3

Place	Av. daily temp [°C]	Extremes in Dec. [°C]	Av. wind speed [m/s]
Central Europe			
List auf Sylt	8.4	-8.0	6,7
Greifswald	8.3	-17.4	5,3
Hamburg	8.4	-16.4	4,2
Dresden-Wahnsdorf	8.6	-20.3	4,9
Aschen	9.7	-16.5	3,0
Karlsruhe	10.1	-21.5	2,3
Vienna	9.8	-15.3	3,0
Salzburg	8.1	-27.7	2,0
Garmisch-Partenkirchen	6.3	-22.7	1,3
Zurich	8.5	-19.3	2,8
Innsbruck	8.6	-24.8	1,3
Graz	8.3	-19.0	1,4
Geneva	10.3	-	-
Italy			
Milan	3.8	-7.0	-
Genoa	9.2	-2.8	-
Florence	14.4	-8.0	-
Rome	15.6	-5.0	-
Naples	16.8	-1.6	-
Mesina	17.9	-0.2	-
Southeast Europe			
Zagreb	11.6	-26.3	-
Belgrado	11.8	-19.3	-
Bucharest	11.1	-19.9	2,0
Sarajevo	9.8	-22.4	1,4
Sofia	10.4	-20.3	2,0
Skopje	12.4	-21.8	-
Tirana	16.0	-8.0	1,5
Thessalonki	16.1	-	-
Athens	17.8	-	2,0
Eastern Europe and Russia			
Murmansk region	-0.6	-	4,2
Arkhangelsk region	-1.0	-	-
Moscow	4.9	-	-
St Petersburg region	4.4	-	3,6
Baltic Countries	6.2	-	5,0
Belarussia	6.3	-	3,4
Kiev	7.6	-	-
Novosibirsk	1.0	-	-

Värmeisolering, U-värde

U = värmeegenomgångstalet [$W/m^2 \text{ } ^\circ C$]

U -värdet anger den värmeisolerande egenskapen hos en byggnadsdel. För att beräkna U -värdet kan följande ekvation användas:

$$1/U = R_{si} + R + d_1/\lambda_1 + d_2/\lambda_2 + \dots + d_n/\lambda_n + R_{se}$$

R = värmemotstånd [$m^2 \text{ } ^\circ C/W$]

R -värdet anger den värmeisolerande egenskapen hos en produkt eller byggnadsdel.

R_{si} = värmeövergångsmotstånd vid övergång från inneluft till vägggryta [$m^2 \text{ } ^\circ C/W$].

R_{se} = värmeövergångsmotstånd vid övergång från uteluft till vägggryta [$m^2 \text{ } ^\circ C/W$].

d_1, d_2, \dots, d_n = tjocklek för respektive material [m].

$\lambda_1, \lambda_2, \dots, \lambda_n$ = värmekonduktivitet [$W/m \text{ } ^\circ C$].

Material	U-värde [$W/m^2 \text{ } ^\circ C$]
Väggar	
1-stenstegel 12 cm	1,8
1 + 1/2 stenstegel 18 cm	1,1
Lättbetongblock 20 cm	0,8
Lättbetongblock 30 cm	0,6
Betong 15 cm	2,8
Betong med 5 cm isolering	0,8
Betong med 10 cm isolering	0,4
Regelvägg 5 cm isolering	0,8
Regelvägg 10 cm isolering	0,4
Regelvägg 15 cm isolering	0,3
Nybyggnad	0,3
Tak	
Betongbjälklag 15 cm	2,8
Betongbjälklag med 5 cm isolering	0,8
Betongbjälklag med 10 cm isolering	0,4
Lättbetong 20 cm	0,8
Lättbetong 30 cm	0,6
Plåttak utan isolering	4,0
Plåttak med 5 cm isolering	0,8
Plåttak med 10 cm isolering	0,6
Plåttak med 25 cm isolering	0,2
Nybyggnad	0,2
Fönster	
1-glasfönster	5,0
2-glasfönster	3,0
3-glasfönster	2,0
3-glasfönster isolerruta	1,8

Energiekvivalenter

Mängd och ämne	Energimängd [MWh]
1 m ³ olja	8,000
1 Nm ³ gasolpropan	0,022
1 Nm ³ naturgas	0,009
1 Nm ³ stadsgas	0,004
1 kg gasolpropan	0,087
1 kg naturgas	0,007
1 kg stadsgas	0,003

Värmekonduktivitet

Material	λ -värdet [$W/m \text{ } ^\circ C$]
Natursten	2,4-3,6
Kalksandsten	1,0
Betong	1,7
Lättklinkerbetong	0,6
Tegel och betonghålblock	0,6
Cementbruk	1,0
Trä, spånskivor	0,14
Gipsskivor	0,22
Plywood	0,13
Träfiberskivor	0,08
Mineralull	0,045
Cellplast	0,04

Värmemotstånd R

Material	R värmemotstånd [$m^2 \text{ } ^\circ C/W$]
Inre + yttre övergångsmotstånd $R_{si} + R_{se}$	0,17
Källarvägg under mark 1-2 meter	1,0
Under golv på mark Yttre randzon	0,7
Under golv på mark Inre randzon	2,0

Ventilationsluftflöden

För beräkning av ventilationsluftflödet kan följande ekvation användas:

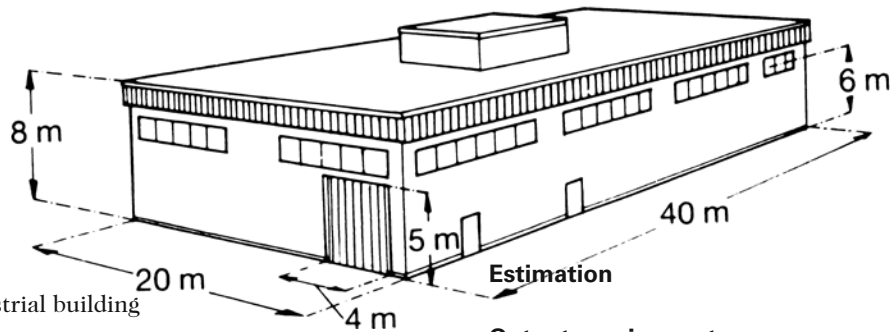
$$Q = q \times A_{\text{golv}} \times 3,6 \text{ eller } Q = n \times V_{\text{byggn}}$$

där q = luftflöde [$l/s m^2$]
 n = antal omsättning per timma
 A_{golv} = golvyta för byggnaden [m^2]
 V_{byggn} = byggnadens volym [m^3]

Luftflöden nedan är endast rekommendationer, se även BBR99 (Boverkets byggregler) alternativt AFS (Arbetskyddsstyrelsens författningssamling).

Lokaltyp	l/s per m ²	l/s per person	Luftomsättning per timme
Butik	2,1	7	4-5
Kafeteria	5	7	6,0
Offentliga lokaler	0,35	+7	3,0
Kontor	0,35	+7	1-2
Skola	0,35	+7	4-5
Sporthall	2,1	7	2,0
Bageri	6		6,0
Stålverk	40,0		10-15
Bilverkstad	30		3,0
Mekanisk verkstad	0,35	+7	5,0
Plåtslageri/svetsverkstad	5,0		5,0
Samlingslokal rökare		20	8,0
Samlingslokal icke-rökare	7	7	6,0
Minimikrav	0,35		ca 0,5

Calculation example



Input

Object: Industrial building

Building dimensions

Length: 40 m
 Width: 20 m
 Height: 8 m
 Window area: 130 m²
 Doors: 25 m²

Construction materials

Walls: Light concrete block 30 cm U = 0.6
 Roof: Light concrete block 30 cm U = 0.6
 Windows: 2-pane, 6 m above floor U = 3.0
 Doors: Ins. sheet metal, folding door U = 1.0

Time in operation: 12 hrs/day, 5 days a week

Ventilation

Natural ventilation, day: 0.4 ch./h
 Natural ventilation, night: 0.3 ch./h
 Internal heat output: 5 W/m²

Indoor temperature

Desired day temperature: +18 °C
 Desired night temperature: +15 °C

District data

Dimensioned outdoor temperature DOT: -18 °C
 Annual average temperature: 5 °C
 Average wind velocity: 4,0 m/s

Estimation

Output requirement

Transmission losses: $P_T = A \times U \times \Delta t$

	Area [m ²]	U-value	Δt [°C]	Output [W]
Outer wall	805	0.6	36	17388
Roof	800	0.6	36	17280
Floor	800	0.3	36/2	4320
Window	130	3.0	36	14040
Doors	25	1.0	36	900

Total transmission losses: 53 928 W

Ventilation losses: $P_V = V_{\text{building}} \times n \times \Delta t \times 0,33$

	Bldg. air volume [m ³]	Air changes [ch./h]	Δt [°C]	Output [W]
Day	6400	0.4	36	30413
Night	6400	0.3	33	20909

The maximum ventilation losses are during the day.

Dimensioned output requirement:

$$53\,928 + 30\,413 = 85\,341 \text{ kW}$$

Energy requirement

Transmission energy: $E_T = P_T / \Delta t \times \text{°Ch}$

$$E_T = 53\,928 / 36 \times 97\,330 = 146 \text{ MWh/yr}$$

Ventilation energy: $E_V = P_V / \Delta t \times \text{°Ch}$

$$\text{Day: } 30413 / 36 \times 97330 \times 12/24 \times 5/7 = 29 \text{ MWh/yr}$$

$$\text{Night: } 20909 / 33 \times 97330 \times (1 - 12/24 \times 5/7) = 40 \text{ MWh/yr}$$

Internal heat: $E_I = P_I \times A_{\text{floor}} \times 8760$

$$E_I = 5 \times 800 \times 8760 \times 12/24 = 12,5 \text{ MWh/yr}$$

Total energy requirement: $E_T + E_V - E_I = 202,5 \text{ MWh/yr}$

Calculation example

Assume that the industrial building in the example is to be heated either with radiant heaters, e.g. industrial infrared heater IR or fan heaters. Based on that, we make a computer calculation of output and energy requirements especially for these heating methods.

The calculation program also takes the temperature gradient °C/m (temperature rise per metre of height) into consideration which is of great importance with reference to the height of the building and the method of heating.

Area and height

Bldg. ground area	800 m ²
Roof area	800 m ²
Building height	8 m
Window area	130 m ²
Mounting height, window	6 m
Door area	25 m ²
Outer walls area	805 m ²

Infiltration

Air changes, day	0.4 ch./h
Air changes, night	0.3 ch./h

U-value

Window U-value	3.0 W/m ² °C
Door U-value	1.0 W/m ² °C
Outer wall U-value	0.6 W/m ² °C
Roof U-value	0.6 W/m ² °C
Floor U-value	0.3 W/m ² °C

Extra heat sources

Internal heat	5 W/m ²
---------------	--------------------

Energy price

Energy price, electricity	0.50 SEK/kWh
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	Radiant heaters	Fan heaters	Fan heaters with ceiling fans	
Temperature				
Dim. indoor temperature	17	18	18	°C
Dim. outdoor temperature	-18	-18	-18	°C
Annual average temp.	5	5	5	°C
Temperature gradient	0,3	2,5	0,3	°C/m
Night temperature	14	15	15	°C
Time in operation				
TIO day temperature	11	12	12	h/day
TIO night temperature	13	12	12	h/day
Days/week in operation	5	5	5	days

RESULTS

Output

Transmission losses	54 201	68 684	55 699	W
Ventilation losses	+ 30 202	+ 35 693	+ 31 046	W
Total losses	84 402	104 377	86 745	W
Internal heat	- 4 000	- 4 000	- 4 000	W
Total net output req.	80 402	100 377	82 745	W
Output req./m ²	101	125	103	W/m ²
Output req./m ³	13	16	13	W/m ³

Energy kWh/yr

Energy req. daytime	88 075	130 340	103 787	kWh/yr
Energy req. nighttime	+ 70 252	+ 88 309	+ 71 975	kWh/yr
Total gross energy req.	158 327	218 649	175 761	kWh/yr
Internal heat	- 12 514	- 12 514	- 12 514	kWh/yr
Total net energy req.	145 813	206 135	163 247	kWh/yr
Annual operation cost	72 906	103 067	81 623	SEK/yr

Energy saving

A comparison of the energy requirement results from the calculations:

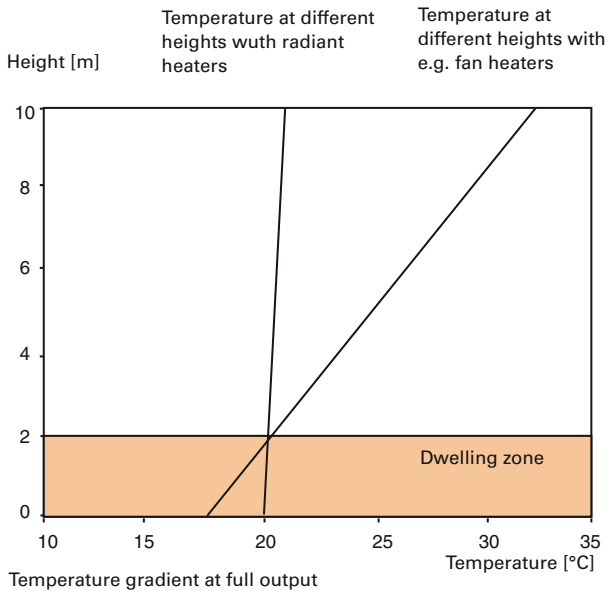
- Industrial infrared heater IR: 146 MWh/yr
- Fan heaters: 206 MWh/yr
- Fan heaters and ceiling fans ICF: 163 MWh/yr
- Energy savings with radiant heaters: 60 MWh/yr

Radiant heater IR result in approx. 30 % lower energy consumption when compared to fan heaters. If ceiling fans are used with the fan heaters, the difference is 20 %.

Savings factors

• Low Temperature Gradient
 Radiant heaters have a relatively low temperature gradient (approx. 0.3 °C/m) compared to fan heaters (approx. 2.5 °C/m). Vertical temperature is better equalized, which means lower heat losses and better use of supplied heating output in the dwelling zone.

• Radiant temperature contribution
 Industrial infrared heaters also supply a radiant

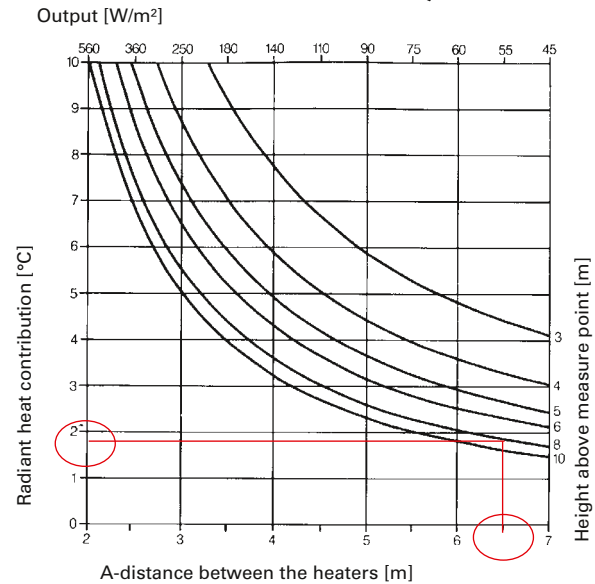
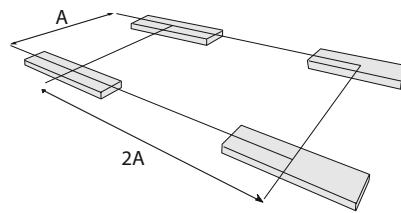


temperature contribution "free of charge". The air temperature in the room can be lowered somewhat with a maintained operative (experienced) temperature. The diagram below shows how large the radiant temperature contribution is with the IR 4500. The heaters are ceiling mounted at a height of 8 metres above the floor. Measurement is done 1.5 metres above the floor. (Height above point of measure = 6.5 m.)

The diagram for radiant temperature contribution shows:
 $\Delta t_{rad} = 2 \text{ }^\circ\text{C}$, A-distance 6.5 metres between the units.

$$\Delta t = t_{room} + \Delta t_{rad}/2 \Rightarrow t_{room} = t_{op} - \Delta t_{rad}/2$$

In our example: $t_{room} = 18 - 2/2 = 17 \text{ }^\circ\text{C}$



Radiant heat contribution IR 4500

• Fast heating
 Heating with radiant heaters is faster than airborne heat. If we have a lower temperature at night as in the example we can lengthen the night time temperature.

Recommendation and positioning

The output requirement for the industrial building heated with infrared heater IR is just over 80 kW. Recommendation: 18 Industrial infrared heaters IR at 4.5 kW each.

Lined writing area with horizontal ruling lines.



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