



Wall Heating System

Wall heating: cosy comfort with drywall or plaster construction

Wall heating systems operate on the same principle as floor heating systems, with very low water temperatures and short response times. The wall becomes a draught-free low-temperature radiator, which emits warmth as gentle radiant heat and provides a pleasant living environment. Enhanced temperature uniformity of the wall surfaces and direct heat emission by radiation allow the air temperature in the room to be lowered by 2 to 3 degrees without reducing comfort. The lower room temperature allows higher relative humidity, which is beneficial for the respiratory tract because it reduces dehydration.

Danfoss wall heating systems can be installed as embedded elements in interior plaster, including clay plaster. Installation in drywall construction is even faster with the prefabricated insulated heating elements of the SpeedUp and SpeedUp Eco installation options. The type of installation used depends on the individual building, but the result is the same: comfortable warmth with a difference.

Installation options

The Danfoss wall heating system offers a variety of installation options. It can be installed on rough walls or integrated into metal stud walls. Various options are available, depending on the type of application:

SpeedUp / SpeedUp Eco in drywall construction with thermal insulation

A wall heating system for interior and exterior walls with drywall construction. Comfortable, energy saving and healthful. Suitable for single-family and multi-family dwellings, office and commercial premises, and retrofitting in all types of renovation projects.

Basic Rail with plaster finishing

A well-conceived system for integrating comfortable, energy-saving and healthy wall heating systems in interior and exterior walls. Suitable for single-family and multi-family dwellings, office and commercial premises, and all types of renovation projects.

SpeedUp / SpeedUp Eco in drywall construction

Danfoss SpeedUp and SpeedUp Eco vertical systems can be installed in interior or exterior walls with drywall construction. With this option, fully oxygen-tight grey Danfoss FH system pipes are installed in the wall in the form of industrially prefabricated system panels with an integrated 0.5 mm aluminium thermal conduction layer. With its high thermal conductivity, the aluminium layer provides uniform, full-surface heat emission to the drywall finishing panels (either fibre-reinforced gypsum or wood) fitted on top of the heating panels. This ensures rapid room heating. All that is needed to achieve a comfortable room temperature is hot water at a relatively low temperature. This makes Danfoss drywall wall heating systems a good choice for use with energy-saving heat generation systems such as condensing boilers, solar energy systems and heat pumps.

The response time of the heating elements is very short because they are only covered by thin drywall panels or wood panels. Wall heating systems heat the room uniformly without draughts, thereby fulfilling comfort, hygiene and health requirements.

Advantages:

- Space-saving.
- Economical system technology.
- Low supply temperature.
- Especially suitable for condensing boilers, solar energy systems and heat pumps.
- For new or existing structures.
- Healthy, hygienic heat.
- Rapid heat emission.
- Maintenance-free heating surface.

BasicRail with plaster finishing

Danfoss Basic Rail wall heating systems can be installed on interior and exterior walls. Depending on the structural conditions, Danfoss FH system pipes are fitted using bracket rails (on interior walls or well insulated exterior walls) or attached to prefabricated, thermally insulated system panels with metal heat-conduction sheets. The water circulating through the FH system pipes transfers its warmth to the wall surface (plaster), which in turn transfers it to the room. The average surface temperature in operation is around 25°C, and the maximum wall temperature is never higher than 35°C, even on very cold days. All that is needed to achieve a comfortable room temperature is hot water at a relatively low temperature. This makes the various Danfoss wall heating systems a good choice for use with energy-saving heat generation systems such as condensing boilers, solar energy systems and heat pumps.

Wall heating systems have very short response times because the wall layers are thin. They warm the room uniformly without draughts, thereby fulfilling comfort, hygiene and health requirements. Wall heating systems are invisible and provide more freedom for arranging room furnishings. With the Basic Rail installation option, a thin protective metal layer is fitted on top of the heating coil to absorb the stress in the plaster and prevent crack formation.

Advantages:

- Space saving.
- Economical system technology.
- Low supply temperature.
- Healthy, hygienic heat.
- Rapid heat emission.
- Maintenance-free heating surface.

Heating plasters

In principle all types of plaster with gypsum, calcium or cement as binder can be used. Good thermal conductivity and a low coefficient of thermal expansion are important. Plasters vary in terms of heat conductivity and other thermal characteristics, depending on the binder. They also differ in terms of the maximum usable supply temperature. Light plasters are not suitable for use as heating plasters.

Gypsum plasters (such as Knauf MP 75 G/F) are recommended for wall heating plasters because they cure quickly without residual stress and conduct heat well. In addition, gypsum plasters can be sprayed on top of the Danfoss structures in a single coat. Cement-lime plasters and clay plasters can also be used in accordance with their application guidelines.

Suitable heating plasters	Gypsum plaster	Clay plaster	Cement-lime plaster
Product	Knauf MP 75F or MP 75 G/F	Claytec Clay Finish Coat Plaster 05.010, 05.012 or 1001205.012 oder 10012	Marmorit Rotkalk or Marmorit biorit 110
Maximum supply temperature	50 °C	50 °C	65–70 °C
Thermal conductivity	0.58 W/mK	0.65 W/mK	0.75–0.87 W/mK

Thermal decoupling

If especially short response times are desired or the wall heaters must be integrated in a wall adjoining a room that is rarely heated, construction with thermal decoupling is recommended. If the substrate does not provide adequate adhesion for the plaster or the thermal insulation of the wall must anyhow be improved, construc-

tion with integrated insulation is recommended. If this construction is used on exterior walls (with additional insulation on the interior side), the dew point location should be checked.

Composite construction

With composite construction, the plaster is bonded to the masonry. This type of construction is used with interior walls when the adjoining rooms are normally heated or with exterior walls that have good exterior insulation and low storage capacity (such as porous concrete block –Ytong or hollow blocks). It is used in the renovation of existing buildings when the thickness of the layer applied to the load-bearing wall is limited (mortar thickness 35 mm).

Due to direct contact with the rough wall, the wall heating system must also heat the rough wall, which has a somewhat adverse effect on the control characteristics (due to the large mass).

In combination with floor heating

The ratio of wall surface to floor surface is very unbalanced in small rooms. In bathrooms, the floor heating area is also reduced by the bathtub and shower areas. A floor heating system is sometimes too small to heat a bathroom on its own. A wall heating system produces an optimal room climate thanks to its advantageous vertical orientation, which allows its radiated heat to reach our bodies (the directly irradiated surface) much better.

A combination of floor heating and wall heating is also ideal in other situations. Especially during transition periods, this combination offers attractive advantages: the floor heating system

does not need to be used at all, while the wall heating system quickly brings the room to a comfortable temperature. In “normal” winter operation, the floor heating supplies approximately half of the heat demand, while the fast-acting wall heating provides the variable remainder of the heat demand. Even in extremely cold weather, the floor temperature (especially in older buildings) never becomes too high, since it only has to provide part of the heat.

Thermal insulation

Pursuant to energy savings regulations, exterior wall structures in new buildings must be designed to comply with the maximum allowable primary energy demand characteristic. However, at the same time the insulation of the building component must be designed such that the maximum allowable transmission heat loss is not exceeded.

If insulation is desirable or necessary and this insulation is to be applied as interior insulation, it is necessary to check whether the resulting shift of the dew point in the wall is permissible.

Standards and guidelines

In addition to local regulations, the standards applicable to the various materials and structures must be observed in the planning and execution phases.

- EN 1264 Surface Embedded Heating and Cooling Systems
- EN 15316 Heating systems in buildings

Maximum surface and supply temperatures

As people do not come in direct contact with the wall heating elements, the surface temperature can be higher than with floor heating elements. Nevertheless, for physiological reasons the average surface temperature should not exceed 40 °C.

The topmost layer usually has a decisive effect on the maximum heat output of the wall heating elements. This imposes the primary restriction on the heat output due to the maximum allowable supply temperature.

Material	Maximum supply temperature
Gypsum plaster	50 °C
Clay plaster	50 °C
Cement-lime plaster	70 °C
Plasterboard drywall	50 °C
Fibre-reinforced gypsum drywall	50 °C

Output

As with floor heating, the heat output of the wall heating elements depends on the following parameters:

- Supply temperature.
- Heating pipe spacing.
- Construction: Depth of coverage of the heating pipes by plaster or drywall boards.

- Thermal conductivity of the plaster or drywall boards.

Due to the thin plaster layers or drywall boards, the wall heating system responds quickly. Both materials provide little storage mass, warm up quickly, and cool down quickly.

Control

Each wall heating system must be controlled by a room thermostat. In the same way as with floor heating, individual room temperatures are controlled by room thermostats and servo drives or by wireless remote control units (Danfoss CF 2).

**Planning and execution:
Application areas and
preliminary planning**

To avoid impairment of the heating capacity of the Vertical system by subsequently installed fixtures or furnishings, certain aspects must be clarified with the owner in advance, such as

- Determining which walls are available for wall heating and which walls are storage areas. Storage areas cannot be used as heating surfaces.
- The wall structure and the available structural depth must be specified.
- The structural strength of the wall with integrated wall heating must be verified.
- The fittings for attachment to the rough wall must be checked.
- The design temperature must be determined: For integration of alternative energy sources such as heat pumps or solar energy systems, it is reasonable to specify a supply temperature of 35–40 °C.

If the supply lines are also supposed to heat the floor, they should be planned into the screed to provide room heating; otherwise the heating pipes in the floor should be insulated in accordance with energy saving regulations. A horizontal arrangement of the pipe grid is always preferable, with the heating circuits beginning at the bottom. This ensures proper air bleeding when the system is put into service. If the heating circuits are designed with sufficient flow rates and generously flushed, a supplementary air bleeder is not necessary; otherwise it is recommended to place an air bleed at the highest point.

With relatively large wall areas, expansion joints must be provided in accordance with the plaster or drywall boards used (see the manufacturer's instructions). Intersection of the expansion joints must be avoided.

Installation type	Heating pipe length / m ²	Pipe spacing
Basic Rail EZ 2	8.33 m	12 cm
Basic Rail EZ 3	7.00 m	15 cm
Basic Rail CZ 1	5.00 m	20 cm
SpeedUp / Speed Up Eco EZ	8.00 m	12.5 cm
SpeedUp / SpeedUp Eco CZ	4.00 m	25 cm
Maximum heating pipe length: 80 m		

Locating the installed heating pipes later on (for hanging pictures) is easy with thermo foil. The foil is placed on the finished wall and the supply temperature is raised briefly (by starting a

heating cycle or intentionally setting the temperature higher). The film changes colour in the immediate vicinity of the heating pipes.

Example material requirements calculation* and cost estimate for SpeedUp™ wall heating system, 1 m ² Installation options with comfort zone (CZ with 250 mm PS), edge zone (EZ with 125 mm PS), or mixed zones (¼ EZ + ¾ CZ) without additional insulation				
Code no.	Description	Requirement per m ² Mixed	Requirement per m ² CZ	Requirement per m ² EZ
088X0100	SpeedUp heat panel CZ, 0.5 m ²	1.26 unit	1.46 unit	/
088X0101	SpeedUp heat panel EZ, 0.5 m ²	0.30 unit		1.46 unit
088X0102	SpeedUp header panel CZ, 4 pcs.		0.24 unit	/
008X0103	SpeedUp header panel EZ, 4 pcs.	0.05 unit	/	0.24 unit
008X0104	SpeedUp header panel cross-over CO	0.03 unit	/	/
008X0105	SpeedUp blank panel BP, 0.5 m ²	0.15 unit	0.25 unit	0.25 unit
008X0107	SpeedUp supply/return panel EZ, 0.5 m ²	0.05 unit	0.05 unit	0.05 unit
088X0001	Composite pipe 16 x 2.00 mm, 200 m	5.00 m	4.00 m	8.00 m
088X0003	Composite pipe 16 x 2.00 mm, 500 m	5.00 m	4.00 m	8.00 m
088X0122	SpeedUp perimeter insulation, 50 m	1.00 m	1.00 m	1.00 m
088X0135	Threshold support batten, 0.25 m	0.14 unit	0.14 unit	0.14 unit
Installation time (minutes per m ²)		10	8	12

* The stated values are based on experience. The stated quantities and times can be used as guidelines for generating estimates for buildings with floor areas of 100 m² or more, including 10% unheated area for (e.g) edge zones or header panels.

Example material requirements calculation* and cost estimate for SpeedUp™ wall heating system, 1 m ² Installation options with comfort zone (CZ with 250 mm PS), edge zone (EZ with 125 mm PS), or mixed zones (¼ EZ + ¾ CZ) without additional insulation				
Code no.	Model	Requirement per m ² Mixed	Requirement per m ² CZ	Requirement per m ² EZ
088X0201	SpeedUp Eco heat panel CZ, 0.5 m ²	1.26 unit	1.46 unit	/
088X0202	SpeedUp Eco heat panel EZ, 0.5 m ²	0.30 unit	/	1.46 unit
088x0203	SpeedUp Eco header panel CZ, 1 pc.	0.76 unit	0.96 unit	/
008x0204	SpeedUp Eco header panel EZ, 1pc.	0.20 unit	/	0.96 unit
008x0208	SpeedUp Eco corner 90° panel	0.40 unit	0.20 unit	0.10 unit
008x0205	SpeedUp Eco header panel cross-over CO	0.03 unit	/	/
008x0206	SpeedUp Eco blank panel BP, 0.5 m ²	0.15 unit	0.25 unit	0.25 unit
008x0210	SpeedUp Eco supply/return panel EZ, 0.5 m ²	0.02 unit	0.02 unit	0.02 unit
088X0001	Composite pipe 16 x 2.00 mm, 200 m	5.00 m	4.00 m	8.00 m
088X0003	Composite pipe 16 x 2.00 mm, 500 m	5.00 m	4.00 m	8.00 m
088x0123	SpeedUp Eco perimeter insulation, 25 m	1.00 m	1.00 m	1.00 m
088X0135	Threshold support batten, 0.25 m	0.14 unit	0.14 unit	0.14 unit
Installation time (minutes per m ²)		10	8	12

* The stated values are based on experience. The stated quantities and times can be used as guidelines for generating estimates for buildings with floor areas of 100 m² or more, including 10% unheated area for (e.g) edge zones or header panels.

Example material requirements calculation* and cost estimate for Basic Rail wall heating, 1 m²
Installation options with comfort zone (CZ with 250 mm PS), edge zone (EZ with 125 mm PS), or mixed zones (1/4 EZ + 3/4 CZ) without additional insulation

Code no.	Description	Requirement per m ²					
		Mixed	CZ 3	CZ 2	CZ 1	EZ 2	EZ 1
088X0065	Perimeter insulation	1.00 m	1.00 m	1.00 m	1.00 m	1.00 m	1.00 m
088X0040	BasicRail 16 mm, 2 m	2.00 m	2.00 m	2.00 m	2.00 m	2.00 m	2.00 m
088X0250	Wallheating metalgrid, 25 m ²	1.00 m ²	1.00 m ²	1.00 m ²	1.00 m ²	1.00 m ²	1.00 m ²
088X0251	Wallheating Dowel, 500 pcs	8 pcs.	8 pcs.	8 pcs.	8 pcs.	8 pcs.	8 pcs.
088X0001	FH Composite pipe 16 mm, 200 m	5.50 lfdm	3.50 lfdm	4.00 lfdm	5.00 lfdm	8.40 lfdm	11.30 lfdm
088X0003	FH Composite pipe 16 mm, 500 m	5.50 lfdm	3.50 lfdm	4.00 lfdm	5.00 lfdm	8.40 lfdm	11.30 lfdm
Installation time (minutes per m ²)		8.5	6.5	7	8	11.5	14.5

* The stated values are based on experience. The stated quantities and times can be used as guidelines for generating estimates for buildings with floor areas of 100 m² or more, including 10% unheated area for (e.g) edge zones or header panels.

Preparation for installation of the wall heating system

All work on the basic building structure must be fully completed before the wall heating system is installed. Electricity and water connections must be present, storage space must be available for the material, and provisions must be made for waste material disposal. The rough wall must be dry and free from irregularities and contamination. The installation site must be draught-free and protected against strong temperature variations, which means that the windows and outside doors must be installed and sealing work must have been completed on exterior walls bordering on the ground. The rough wall must fulfil the requirements of the Danfoss wall heating system. The individual room thermostat controller with 230 V / 50 Hz power supply connection is installed in the distribution box. With hardwired control

systems, the necessary electrical wiring for the room thermostat and the recessed boxes must be planned and installed. This is not necessary with wireless control.

For coordination with subsequent trade work, it is essential to ensure that construction joints are straight and flush and the joint widths are equal. The wall heating elements must not overlap structural construction joints.







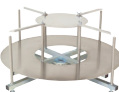

If a plaster substrate is used, ensure that it is dust-free, clean, free from materials that impair adhesion, and able to bear loads.

Storage and installation conditions for Danfoss systems

To avoid damage to Danfoss FH system pipes, fittings, associated system components and tools during storage, the following points should be observed for long-term storage. These guidelines also apply to finished system components during installation. In addition to these guidelines, the general installation instructions and the individual operating instructions of all equipment and components must be observed. The storage temperature of all electrical tools and equipment should not drop below 0°C. The minimum installation temperature for the pipe system is -10°C. However, the operating temperature of the presses must never drop below freezing and should not exceed 40°C. The optimal working temperature range for the pipes, fittings and tools is 5 to 25°C.

If the pipes are stored below -10°C, they should be provided with external protection against impact, pinching, and other forms of mechanical stress. The storage and installation areas should be dry and free from excessive dust loads in order to ensure proper operation of the fittings and tools. The original packaging of the fittings and pipes provides optimal protection during storage until the time of assembly on site. Tools should always be transported in suitable boxes or cases. Do not stack pipe boxes higher than ten boxes. Do not throw pipes, fittings or tools during transport or installation.

Tools

	Code no.	Description
	088X0601	The Danfoss Pipe Cutter is a simple tool for cutting composite pipe. The Pipe Cutter is as easy to use as a normal scissor, just place the Cutter around the pipe and press the handles.
	088X0602	The Danfoss Pipe Cutter is a simple tool for cutting composite pipe. The Pipe Cutter is as easy to use as a normal scissor, just place the Cutter around the pipe and press the handles.
	088X0603	The Danfoss Pipe Bevelling tool is used to remove sharp edges from a cut composite pipe. The Pipe Bevelling tool ensures that the O-ring in the fittings is not damaged when sliding over the edge. The Bevelling tools work both on the inside and the outside of the pipe and is available for 16 mm and 20 mm pipes.
	088X0605 088X0607	The Danfoss bending spring is used to ensure that the composite pipes are not flattened when making a sharp bend. For example when connecting the composite pipes to the manifolds in the cabinet a sharp bend is needed. The spring is placed around the pipe to ensure the pipe is not able to deform and is simply removed when the bend has been made.
	088X0609	The Danfoss Press tool is a simple to use tool for fast installation of press fittings. The tool can be used for 16 mm and 20 mm fittings by replacing the pressing jaw. The Pressing Tool ensures a tight seal without the use of electricity.
	088X0612	The Danfoss Hot Wire Cutter is designed for use with the SpeedUp system. The Hot Wire Cutter is used for cutting new channels for pipes in the SpeedUp blank panels. The Hot Wire Cutter works simply by turning on the cutter and pressing it through the panel in the desired pattern leaving a new channel for the pipe.
	088X0600	The Pipe Dispensing wheel allows for one man installation of the Danfoss floor heating. The Pipe Dispensing wheel is used by placing the whole coil of composite pipe on the wheel and securing it. The Dispensing wheel is placed in the next room to the one you are installing floor heating and then it is as simple as pulling the pipe as you progress through the installation.
	088X0613	The Ball Nose Routing Bit is designed for use with the SpeedUp Eco system. The Ball Nose Routing Bit is mounted on a slot cutter to cut the right dimension and pattern for the 16mm composite pipe.

Installation times

Installation times for Danfoss wall heating systems		
Item/unit	Minutes per unit	Unit
Installation of storey manifold without cabinet	45	item
Installation of storey manifold with cabinet	75	item
PS = 150 mm; installation type: Basic Rail; plaster system	12.5	m ²
PS = 200 mm; installation type: Basic Rail; plaster system	7.5	m ²
PS = 125/250 mm; installation type: SpeedUp / SpeedUp Eco; plaster system	15	m ²
PS = 125/250 mm; installation type: SpeedUp / SpeedUp Eco; plaster system	18	m ²
Metal reinforcement for plaster systems	8	m ²
PS = 125/250 mm; installation type: SpeedUp / SpeedUp Eco; drywall	15	m ²
PS = 125/250 mm; installation type: SpeedUp / SpeedUp Eco; drywall	18	m ²

The stated values are based on experience. The stated quantities and times can be used to generate estimates for buildings with floor areas of 100 m² or more, including 10% unheated area (edge zones, header panels, etc).

Output table, Danfoss SpeedUp™ wall heating system

Spread (δK) 5.
Heat output based on EN 1264.

Drywall and plaster

Mean hot water temp.	Room temperature	EZ PS 12.5 cm Fermacell 12.5 mm	Surface temperature	CZ PS 25 cm Fermacell 12.5 mm	Surface temperature	EZ PS 12.5 cm gypsum plaster 15 mm	Surface temperature	CZ PS 25 cm gypsum plaster 15 mm	Surface temperature	EZ PS 12.5 cm cement plaster 15 mm	Surface temperature	CZ PS 25 cm cement plaster 15 mm	Surface temperature
$t_{h,m}$	t_i		TFB		TFB		TFB		TFB		TFB		TFB
°C	°C	W/m ²	°C	W/m ²	°C	W/m ²	°C	W/m ²	°C	W/m ²	°C	W/m ²	°C
30	15	69.2	23.7	52.8	21.6	74.6	24.3	56.5	22.1	78.8	24.8	59.4	22.4
30	18	55.1	24.9	42.0	23.2	59.4	25.4	44.9	23.6	62.7	25.8	47.3	23.9
30	20	45.6	25.7	34.7	24.3	49.1	26.1	37.2	24.6	51.9	26.5	39.2	24.9
30	22	36.0	26.5	27.5	25.4	38.8	26.9	29.4	25.7	41.0	27.1	30.9	25.9
30	24	26.3	27.3	20.0	26.5	28.3	27.5	21.4	26.7	29.9	27.7	22.5	26.8
35	15	92.7	26.6	70.6	23.8	99.9	27.5	75.6	24.5	105.4	28.2	79.6	24.9
35	18	78.6	27.8	59.9	25.5	84.7	28.6	64.1	26.0	89.4	29.2	67.5	26.4
35	20	69.2	28.7	52.8	26.6	74.6	29.3	56.5	27.1	78.8	29.8	59.4	27.4
35	22	59.8	29.5	45.6	27.7	64.4	30.1	48.8	28.1	68.0	30.5	51.4	28.4
35	24	50.4	30.3	38.4	28.8	54.3	30.8	41.1	29.1	57.3	31.2	43.2	29.4
40	15	116.1	29.5	88.5	26.1	125.1	30.6	94.7	26.8	132.1	31.5	99.7	27.5
40	18	102.1	30.8	77.8	27.7	110.0	31.7	83.2	28.4	116.1	32.5	87.6	29.0
40	20	92.7	31.6	70.6	28.8	99.9	32.5	75.6	29.5	105.4	33.2	79.6	29.9
40	22	83.3	32.4	63.5	29.9	89.8	33.2	68.0	30.5	94.8	33.8	71.5	30.9
40	24	73.9	33.2	56.3	31.0	79.7	34.0	60.3	31.5	84.1	34.5	63.5	31.9
45	15	139.5	32.4	106.3	28.3	150.3	33.8	113.7	29.2	158.6	34.8	119.7	30.0
45	18	125.5	33.7	95.6	29.9	135.2	34.9	102.3	30.8	142.7	35.8	107.7	31.5
45	20	116.1	34.5	88.5	31.1	125.1	35.6	94.7	31.8	132.1	36.5	99.7	32.5
45	22	106.8	35.3	81.3	32.2	115.0	36.4	87.1	32.9	121.4	37.2	91.6	33.5
45	24	97.4	36.2	74.2	33.3	104.9	37.1	79.4	33.9	110.8	37.8	83.6	34.5
50	15	162.8	35.4	124.0	30.5	175.4	36.9	132.8	31.6	185.2	38.1	139.8	32.5
50	18	148.8	36.6	113.4	32.2	160.3	38.0	121.4	33.2	169.3	39.2	127.7	34.0
50	20	139.5	37.4	106.3	33.3	150.3	38.8	113.7	34.2	158.6	39.8	119.7	35.0
50	22	130.1	38.3	99.1	34.4	140.2	39.5	106.1	35.3	148.0	40.5	111.7	36.0
50	24	120.8	39.1	92.0	35.5	130.1	40.3	98.5	36.3	137.4	41.2	103.7	37.0
55	15	186.2	38.3	141.8	32.7	200.5	40.1	151.8	34.0	211.7	41.5	159.8	35.0
55	18	172.2	39.5	131.1	34.4	185.5	41.2	140.4	35.5	195.8	42.5	147.8	36.5
55	20	162.8	40.4	124.0	35.5	175.4	41.9	132.8	36.6	185.2	43.1	139.8	37.5
55	22	153.5	41.2	116.9	36.6	165.3	42.7	125.2	37.6	174.6	43.8	131.7	38.5
55	24	144.1	42.0	109.8	37.7	155.3	43.4	117.5	38.7	163.9	44.5	123.7	39.5
60	15	209.5	41.2	159.6	34.9	225.7	43.2	170.8	36.4	238.3	44.8	179.8	37.5
60	18	195.5	42.4	148.9	36.6	210.6	44.3	159.4	37.9	222.3	45.8	167.8	39.0
60	20	186.2	43.3	141.8	37.7	200.5	45.1	151.8	39.0	211.7	46.5	159.8	40.0
60	22	176.8	44.1	134.7	38.8	190.5	45.8	144.2	40.0	201.1	47.1	151.8	41.0
60	24	167.5	44.9	127.6	39.9	180.4	46.6	136.6	41.1	190.5	47.8	143.8	42.0

**Output table,
BasicRail
wall heating system**

Spread (δK) 5.
Heat output based on EN 1264.

Plaster

Mean hot water temp.	Room temperature	EZ gypsum plaster PS 12 cm $\lambda = 0.58 - 35$ mm	Surface temperature	CZ gypsum plaster PS 15 cm $\lambda = 0.58 - 35$ mm	Surface temperature	EZ gypsum plaster PS 20 cm $\lambda = 0.58 - 35$ mm	Surface temperature	CZ cement-lime PS 12 cm $\lambda = 0.75$	Surface temperature	EZ cement-lime PS 15 cm $\lambda = 0.75$	Surface temperature	CZ cement-lime PS 20 cm $\lambda = 0.75$	Surface temperature
$t_{h,m}$	t_i		t_o		t_o		t_o		t_o		t_o		t_o
°C	°C	W/m ²	°C	W/m ²	°C	W/m ²	°C	W/m ²	°C	W/m ²	°C	W/m ²	°C
30	15	60.6	22.6	55.0	21.9	47.0	20.9	67.6	23.5	61.4	22.7	52.5	21.6
30	18	48.2	24.0	43.8	23.5	37.4	22.7	53.8	24.7	48.8	24.1	41.7	23.2
30	20	39.9	25.0	36.2	24.5	30.9	23.9	44.5	25.6	40.4	25.1	34.6	24.3
30	22	31.5	25.9	28.6	25.6	24.4	25.1	35.2	26.4	31.9	26.0	27.3	25.4
30	24	23.0	26.9	20.8	26.6	17.8	26.2	25.6	27.2	23.3	26.9	19.9	26.5
35	15	81.2	25.1	73.6	24.2	62.9	22.9	90.5	26.3	82.2	25.3	70.2	23.8
35	18	68.9	26.6	62.4	25.8	53.3	24.7	76.8	27.6	69.7	26.7	59.6	25.4
35	20	60.6	27.6	55.0	26.9	47.0	25.9	67.6	28.5	61.4	27.7	52.5	26.6
35	22	52.4	28.5	47.5	27.9	40.6	27.1	58.4	29.3	53.0	28.6	45.3	27.7
35	24	44.1	29.5	40.0	29.0	34.2	28.3	49.2	30.1	44.6	29.6	38.2	28.8
40	15	101.7	27.7	92.2	26.5	78.7	24.8	113.4	29.2	102.9	27.9	88.0	26.0
40	18	89.4	29.2	81.0	28.1	69.2	26.7	99.7	30.5	90.5	29.3	77.3	27.7
40	20	81.2	30.1	73.6	29.2	62.9	27.9	90.5	31.3	82.2	30.3	70.2	28.8
40	22	73.0	31.1	66.2	30.3	56.5	29.1	81.4	32.2	73.9	31.2	63.1	29.9
40	24	64.7	32.1	58.7	31.3	50.1	30.3	72.2	33.0	65.5	32.2	56.0	31.0
45	15	122.1	30.3	110.7	28.8	94.6	26.8	136.2	32.0	123.6	30.5	105.7	28.2
45	18	109.8	31.7	99.6	30.5	85.1	28.6	122.5	33.3	111.2	31.9	95.0	29.9
45	20	101.7	32.7	92.2	31.5	78.7	29.8	113.4	34.2	102.9	32.9	88.0	31.0
45	22	93.5	33.7	84.8	32.6	72.4	31.0	104.2	35.0	94.6	33.8	80.9	32.1
45	24	85.3	34.7	77.3	33.7	66.0	32.3	95.1	35.9	86.3	34.8	73.8	33.2
50	15	142.6	32.8	129.3	31.2	110.4	28.8	159.0	34.9	144.3	33.0	123.3	30.4
50	18	130.3	34.3	118.2	32.8	100.9	30.6	145.3	36.2	131.9	34.5	112.7	32.1
50	20	122.1	35.3	110.7	33.8	94.6	31.8	136.2	37.0	123.6	35.5	105.7	33.2
50	22	113.9	36.2	103.3	34.9	88.2	33.0	127.1	37.9	115.3	36.4	98.6	34.3
50	24	105.8	37.2	95.9	36.0	81.9	34.2	117.9	38.7	107.0	37.4	91.5	35.4
55	15	163.0	35.4	147.8	33.5	126.2	30.8	181.8	37.7	165.0	35.6	141.0	32.6
55	18	150.7	36.8	136.7	35.1	116.7	32.6	168.1	39.0	152.6	37.1	130.4	34.3
55	20	142.6	37.8	129.3	36.2	110.4	33.8	159.0	39.9	144.3	38.0	123.3	35.4
55	22	134.4	38.8	121.9	37.2	104.1	35.0	149.9	40.7	136.0	39.0	116.3	36.5
55	24	126.2	39.8	114.5	38.3	97.7	36.2	140.7	41.6	127.8	40.0	109.2	37.6
60	15	183.4	37.9	166.3	35.8	142.1	32.8	204.5	40.6	185.7	38.2	158.7	34.8
60	18	171.2	39.4	155.2	37.4	132.6	34.6	190.9	41.9	173.3	39.7	148.1	36.5
60	20	163.0	40.4	147.8	38.5	126.2	35.8	181.8	42.7	165.0	40.6	141.0	37.6
60	22	154.8	41.4	140.4	39.5	119.9	37.0	172.7	43.6	156.7	41.6	133.9	38.7
60	24	146.6	42.3	133.0	40.6	113.6	38.2	163.5	44.4	148.4	42.6	126.9	39.9

