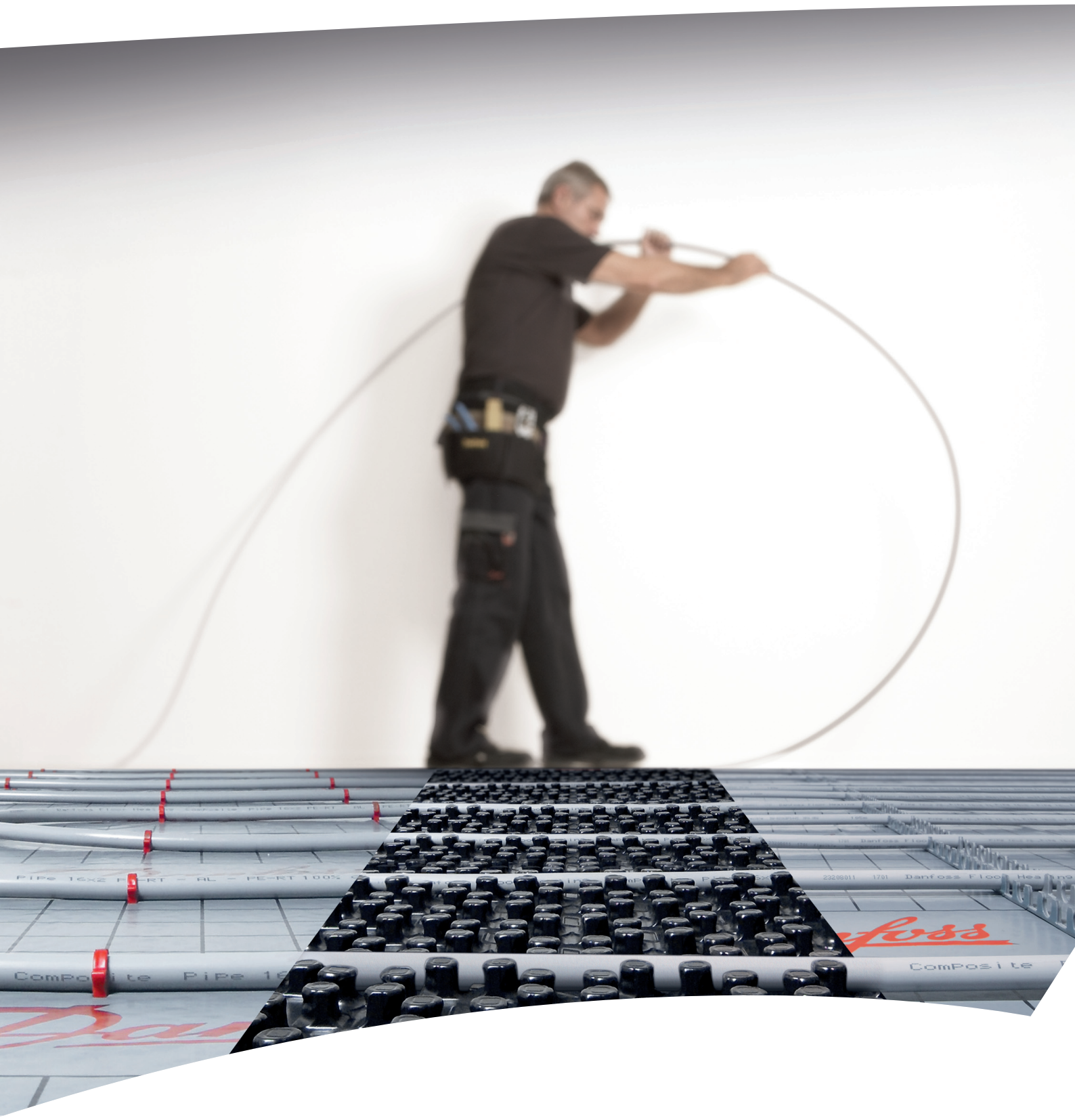
MAKING MODERN LIVING POSSIBLE



Basic™ Heating Systems

DANFOSS HEATING SOLUTIONS

Handbook

Index

Underfloor heating with heated screed as liquid or cement screed

Underfloor heating, with its low supply temperature, has many advantages. It runs maintenance-free, is energy saving and ensures comfortable room temperatures.
Rooms with underfloor heating allow greater freedom for interior design. The Danfoss FH pipes enclosed in cement or liquid screed give off comfortable warmth without any drafts, - creating a dustfree, hygenic environment.

Basic heating systems

The Danfoss underfloor heating systems with heated screed - Basic heating systems - are low temperature underfloor heating systems suitable for all new buildings. They can be installed in all rooms and floors of blocks of flats or in business premises.
The grey Danfoss composite pipes are installed, according to worked out distances, using BasicClip, BasicGrip or BasicRail on insulation panels giving the pipe lay-out. The water flowing though the composite or PE-RT pipes gently warms the screed which works as heating element. It is possible to lay all common floor coverings on top of Danfoss underfloor heating, except perhaps heavy exotic carpets or special engineered wood flooring which would need extra calculations when planning the system.
Since low water temperatures are required to achieve the required room temperatures, Danfoss underfloor heating systems are ideal for use with boilers, solar energy and heat pumps. This means that producers of energy saving heat will find an ideal partner in underfloor heating.

Advantages

- Low energy saving temperature
- Cost effective, no additional costs
- 100% impervious to air, no heat exchanger necessary
- Comfortable, clean and healthy air
- Greater freedom of interior design, more living space for whole family
- Maintenance-free

Relevant standards for underfloor heating

The following regulations and EN Standards should be observed when planning and installing floor heating:

EN 1991	Action on structures
EN 1264	Underfloor Heating, Systems and Components
DIN 4109	Sound Insulation in the Building Industry
ISO EN 140-8	Measurement of sound insulation in buildings and building elements
EN 13813	Screed Material and Floor Screeds
	Local building regulations.

Professional information on interface co-ordination when planning heated underfloor construction (ref: BVF).

For underfloor heating the EN 1264, part 4 standards are applicable.
Three Danfoss basic constructions are possible: A, B and C.
They meet the minimum insulation requirements in relation to use and position in the house.

Minimum thermal resistance of insulation under floor heating systems from EN 1264, part4

Construction	A	B	C		
	Heated room below	Unheated or occasionally heated room below or room on ground floor*	Outside air temperature below construction		
			Design outside temperature $T_d > 0°$ C	Design outside temperature $0° C > T_d \geq -5° C$	Design outside temperature $-5° C > T_d \geq -15° C$
Thermal resistance (m^2 K/W)	0.75	1.25	1.25	1.5	2

** When groundwater table is < 5 m this value should be raised!*

BasicRail

The composite pipes are clipped onto the BasicRail self-adhesive clip rails at regular distances.

The maximum of 2 m between the clip rails should only be applied when using cement screed. When using liquid screed a maximum distance of 1m should be observed. Because of the fluid consistency of liquid screed it could run under the pipes and can push them upwards.

In accordance with EN 1264 Danfoss FH pipes should be laid more than

- 50 mm away from vertical construction, such as walls
- 200 mm from chimneys and open fire places, open and walled-up shafts, as well as lift shafts

BasicClip

The BasicClip System is a tacker system where the pipes are tacked onto the insulation with u-shaped tacker pins. The insulation overlap panels are supplied as 2 x 1 m pre-folded panels. The foil clad panels give a perfect grip for the barbs in the EPS and under the foil.

The grid pattern on the panel foil is 50 mm which allows the different laying distances to be kept : 100 and 150 mm for Edge Zones, and 200, 250 and 300 mm for Comfort Zones.

Any additional insulation should be laid under the BasicClip overlap panels.

BasicClip insulation overlap panels are available in 2 variations:

- with 35 mm thermal and impact sound insulation EPS
- with 20 mm thermal and impact sound insulation EPS

For optimum installation of the system an expansion profile is available to overcome expansion gaps and door thresholds.

The system is suitable for liquid (CAF) and cement screeds (CT).

BasicGrip

The BasicGrip panel system consists of deeply drawn foil with studs that allow perfect laying of pipes.

With their size of 1 x 1 m, the panels are easy to lay and can be installed by just one person.

The panels can be cut with the usual cutter knife. The studded panels facilitate correct pipe distances. Laying the pipes diagonally is possible without additional grips. It is safe to walk on the strong foam studded panels.

When using the BasicGrip panel without thermal insulation the deeply drawn foil is correspondingly thicker.

The laying distance is calculated in multiples of 50 mm, so that possible pipe distances in the Edge Zone are 100 and 150 mm and in the Comfort Zone 200, 250 and 300 mm are achieved.

Any additional insulation should be laid under the BasicGrip panels.

BasicGrip panels are available in 3 variations:

- with 35 mm thermal and impact sound insulation EPS
- with 11 mm thermal insulation EPS
- without insulation

For optimum installation of the system, the following additional products are on offer:

- An expansion profile to overcome expansion gaps and door thresholds
- Door and manifold panels with varying insulation thickness
- PE –String to seal perimeter insulation when using liquid screed

The system is suitable for liquid (CAF) and cement screeds (CT).

Basic insulation overlap panels

The individual components of the overlap insulation panels are bonded and consist of the following layers:

- Bonded multi-layer foil with 5 cm grids to facilitate exact pipe laying
- A thermal and impact sound insulation layer made of polystyrene

What type of insulation is used, depends on the type of floor and the building. If the concrete is even and free of other installations, a single layer of insulation is sufficient. In 90% of all new buildings heating, sanitation and electrical services are installed which require double layer insulation.

Continuous sound impact insulation also has to be installed.

For height adjustment, thermal insulation, e.g. EPS 035 DEO 20 mm is laid between the pipe channels and gaps around the pipes are filled with Danfoss Dry Levelling Compound.

Finally, the Basic insulation overlap panels are installed. The surface of these 2 m^2 (1 + 1 m^2 foldable) insulation panels are very strong, safe to walk on, and form a very good surface for BasicClip and BasicRail heating systems.
The strong foil is a technically perfect base for cement and liquid screeds.

Floor constructions

A: Floor construction above rooms of equal use/ temperature; Minimum thermal resistance R_{min} = 0.75 m^2K/W

Construction with insulation panels 20/35 mm plus additional insulation:									
Insulation panels 20/35 mm R = 0.44 m^2K/W; R = 0.77 m^2K/W	20	20	20	20	35	35	35	35	mm
	+	+	+	+	+	+	+	+	
EPS DEO λ =0.040 W/mK	20				-				mm
EPS DEO λ=0.035 W/mK		20				-			mm
PUR λ=0.030 W/mK			20				-		mm
PUR λ =0.025 W/mK				20				-	mm
Total thermal resistance R	0.94	1.01	1.11	1.27	0.77	0.77	0.77	0.77	m^2 K/W
Total insulation thickness	40	40	40	40	35	35	35	35	mm

B: Floor construction above occasionally or permanently unheated rooms, cellars or ground-floor (ground water table > 5 m); minimum thermal resistance R_{min} = 1.25 m^2 K/W

Construction with insulation panels 20/35 mm plus additional insulation :									
Insulation 20/35 mm R = 0.44 m^2K/W; R = 0.77 m^2K/W	20	20	20	20	35	35	35	35	mm
	+	+	+	+	+	+	+	+	
EPS DEO λ = 0.040 W/mK	40				20				mm
EPS DEO λ = 0.035 W/mK		30				20			mm
PUR λ = 0 .030 W/mK			30				20		mm
PUR λ = 0.025 W/mK				30				20	mm
Total thermal resistance R	1.44	1.30	1.44	1.64	1.27	1.34	1.43	1.57	m^2 K/W
Total insulation thickness	60	50	50	50	55	55	55	55	mm

C: Construction for floors against outside air; minimum thermal resistance R_{min} = 2.0 m^2 K/W

Construction with insulation panels 20/35 mm plus additional insulation:									
Insulation 20/35 mm R = 0.44 m^2K/W; R = 0.77 m^2K/W	20	20	20	20	35	35	35	35	mm
	+	+	+	+	+	+	+	+	
EPS DEO λ = 0.040 W/mK	70				50				mm
EPS DEO λ = 0.035 W/mK		60				50			mm
PUR λ = 0 .030 W/mK			50				40		mm
PUR λ = 0.025 W/mK				40				40	mm
Total thermal resistance R	2.19	2.16	2.11	2.04	2.02	2.2	2.1	2.37	m^2 K/W
Total insulation thickness	90	80	70	60	85	85	75	75	mm

λ = Thermal conductivity in W/mK.

Thermal resistance

Other combinations are possible to achieve certain built-up heights. The following table indicates the thermal resistance of the different insulations, dependent on their thickness.

The final layer should always be the Basic insulation overlap panels 20/35 mm to guarantee a stable base for further installation.

$$R_{Insulation} = \frac{d}{\lambda}$$

$$\left[\frac{\text{Insulation thickness in (mm)}}{\text{Thermal resistance in (W/mK)}}\right]$$

EPS 045 DES		EPS 040 DEO		EPS 035 DEO		PUR λ = 0.03 W/mK		PUR λ = 0.025 W/mK	
Thickness [mm]	$R_{insulation}$ [m² K/W]	Thickness [mm]	$R_{insulation}$ [m² K/W]	Thickness [mm]	$R_{insulation}$ [m² K/W]	Thickness [mm]	$R_{insulation}$ [m² K/W]	Thickness [mm]	$R_{insulation}$ [m² K/W]
10	0.22	10	0.25	10	0.29	10	0.33	10	0.40
15	0.33	15	0.38	15	0.43	15	0.50	15	0.60
20	0.44	20	0.50	20	0.57	20	0.67	20	0.80
25	0.56	25	0.63	25	0.71	25	0.83	25	1.00
30	0.67	30	0.75	30	0.86	30	1.00	30	1.20
35	0.78	35	0.88	35	1.00	35	1.17	35	1.40
40	0.89	40	1.00	40	1.14	40	1.33	40	1.60
45	1.00	45	1.13	45	1.29	45	1.50	45	1.80
50	1.11	50	1.25	50	1.43	50	1.67	50	2.00
55	1.22	55	1.38	55	1.57	55	1.83	55	2.20
60	1.33	60	1.50	60	1.71	60	2.00	60	2.40
65	1.44	65	1.63	65	1.86	65	2.17	65	2.60
70	1.56	70	1.75	70	2.00	70	2.33	70	2.80
75	1.67	75	1.88	75	2.14	75	2.50	75	3.00
80	1.78	80	2.00	80	2.29	80	2.67	80	3.20
85	1.89	85	2.13	85	2.43	85	2.83	85	3.40
90	2.00	90	2.25	90	2.57	90	3.00	90	3.60
95	2.11	95	2.38	95	2.71	95	3.17	95	3.80
100	2.22	100	2.50	100	2.86	100	3.33	100	4.00
105	2.33	105	2.63	105	3.00	105	3.50	105	4.20
110	2.44	110	2.75	110	3.14	110	3.67	110	4.40
115	2.56	115	2.88	115	3.29	115	3.83	115	4.60
120	2.67	120	3.00	120	3.43	120	4.00	120	4.80
125	2.78	125	3.13	125	3.57	125	4.17	125	5.00
130	2.89	130	3.25	130	3.71	130	4.33	130	5.20
135	3.00	135	3.38	135	3.86	135	4.50	135	5.40
140	3.11	140	3.50	140	4.00	140	4.67	140	5.60
145	3.22	145	3.63	145	4.14	145	4.83	145	5.80
150	3.33	150	3.75	150	4.29	150	5.00	150	6.00
155	3.44	155	3.88	155	4.43	155	5.17	155	6.20
160	3.56	160	4.00	160	4.57	160	5.33	160	6.40
165	3.67	165	4.13	165	4.71	165	5.50	165	6.60
170	3.78	170	4.25	170	4.86	170	5.67	170	6.80
175	3.89	175	4.38	175	5.00	175	5.83	175	7.00
180	4.00	180	4.50	180	5.14	180	6.00	180	7.20
185	4.11	185	4.63	185	5.29	185	6.17	185	7.40
190	4.22	190	4.75	190	5.43	190	6.33	190	7.60
195	4.33	195	4.88	195	5.57	195	6.50	195	7.80
200	4.44	200	5.00	200	5.71	200	6.67	200	8.00

Basic perimeter insulation

The Basic Perimeter insulation 150 mm consists of 8 mm PE-Foam. The double-sided adhesive tape on the back allows it to be easily attached to the wall. The adhesive tape on the room side of the foil attaches the perimeter insulation to the insulation panels.
In accordance with EN 1264 the perimeter insulation can be compressed by 5 mm and thus, together with the insulation panels, forms the required tank for the screed as well as thermal and sound bridges.
When using a double layer of insulation, the additional insulation should be laid first. Should their thickness exceed 5 cm, the perimeter insulation is installed on top of the additional insulation.

Tanking for liquid screed

When using liquid screed the insulation joints should be taped over to accept screed with a very thin consistency.

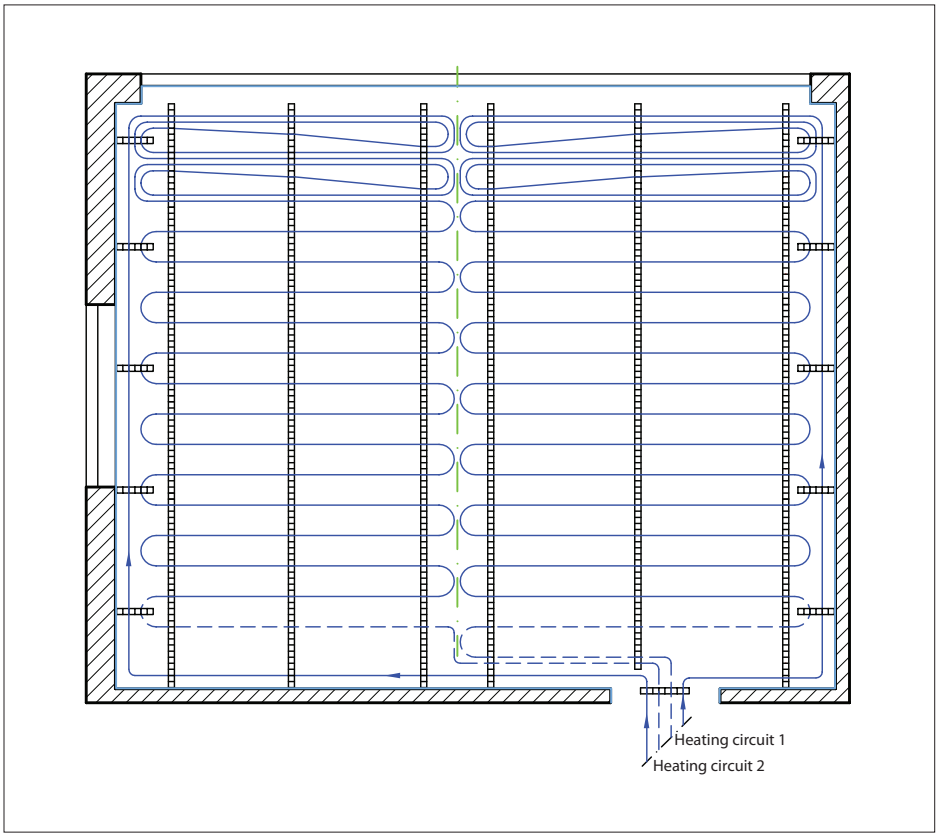
BasicRail - types of installation

The heating circuits are laid in meander form, which is an advantage when first installing the pipes in the edge zones of the room (Edge Zone) and then taking them to the centre of the room (Comfort Zone): the warmer temperatures of the heating circuit arrive at the outer zones (higher floor temperature), and the cooled down water heats the central zone (lower floor temperature).

To achieve higher output around the edges or in front of windows, you can lay the pipes in double pattern.
Please see recommended layout patterns in Danfoss application sheets.

Application sheet

Application Sheet **BasicRail**
Room with floor meeting window



Legend

FH Composite pipe
CC CZ 2 = 250 mm

FH Composite pipe
CC EZ 1 = 88 mm

Flow

Return

Perimeter insulation

BasicRail
Distances between rails:
Liquid screed 1.00 m
Cement screed 1.50 - 2.00 m

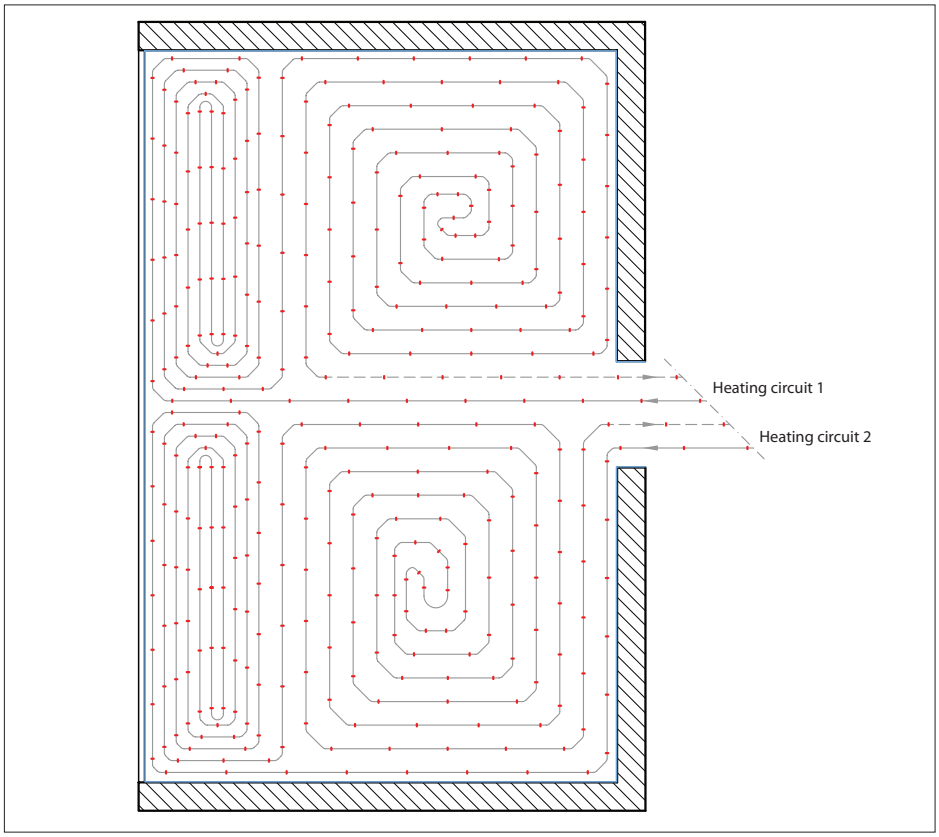
BasicClip and BasicGrip - types of installation

The Danfoss wet systems BasicGrip and BasicClip are laid in spiral form.
The Danfoss composite pipe is laid in spiral form starting from the edge, leading to the centre of the room. The pipe distance is twice that of the calculated pipe spacing. The pipe is then led out of the centre between the installed pipes.
The advantage is that pipes of higher temperature are next to those of lower temperature, thus producing an even surface temperature (higher output).

Edge Zone: if a higher heat output is required, the pipes in the Edge Zone (up to 1 m from wall) can be laid closer, thus producing a higher surface temperature.

Application sheet

Application Sheet BasicClip Conservatory



Legend

Pipe layout EZ 100
CC = 100 mm

Pipe layout CZ 200
CC = 200 mm

Supply

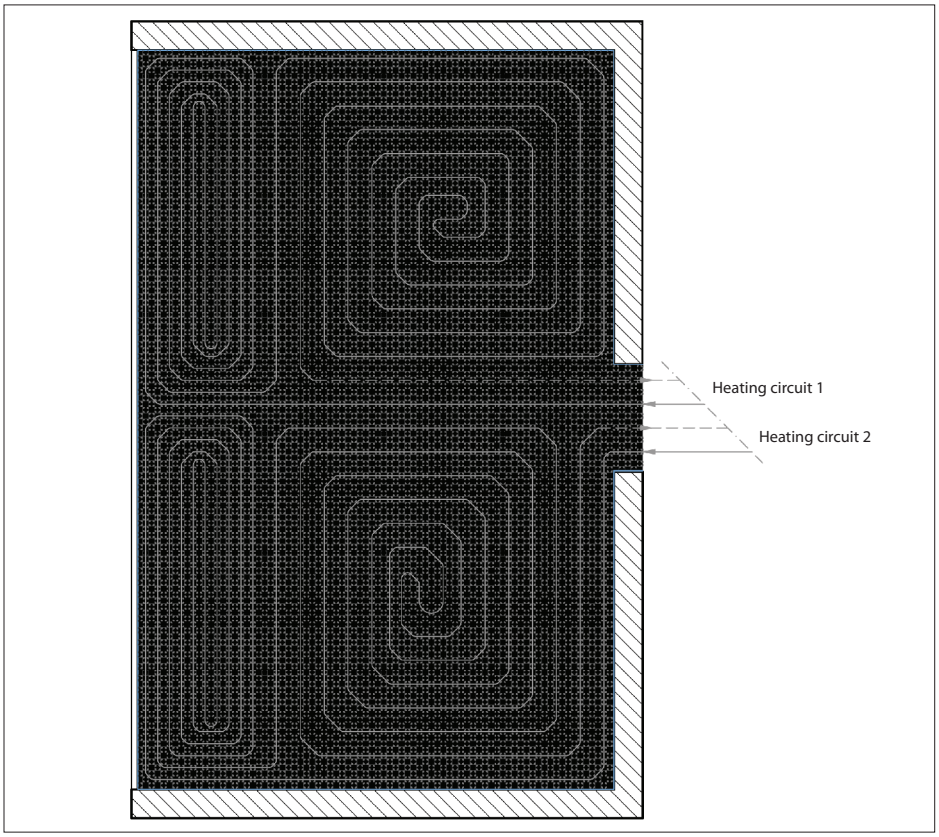
Return

Perimeter insulation

BasicClip clip,
2 clips per meter

Application sheet

Application Sheet BasicGrip Conservatory



Legend

Pipe layout EZ 100
CC = 100 mm

Pipe layout CZ 200
CC = 200 mm

Supply

Return

Perimeter insulation

BasicGrip panel

Size: 1 x 1 m

Danfoss HES **VA.EL.A1.02** © Danfoss 11/2008 **1**

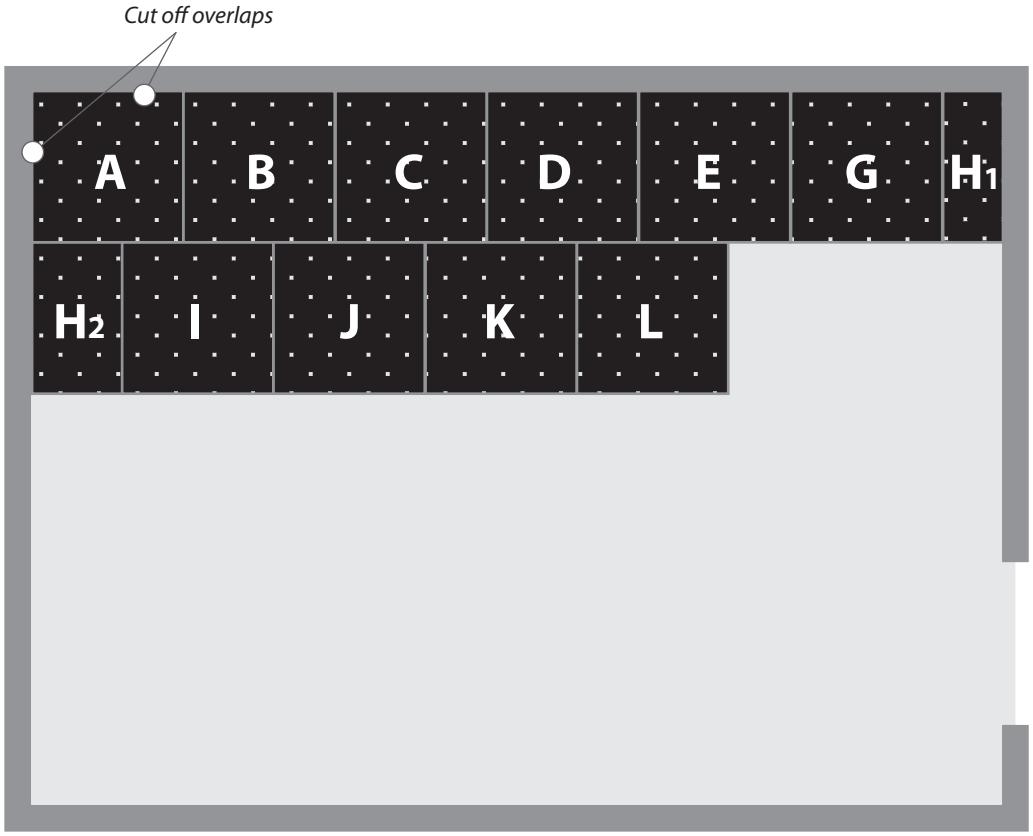
Advice on installing BasicGrip

1: Begin installing in left hand corner. In order to achieve a tight join at the wall, cut off both overlaps on the first BasicGrip panel.

2: For panels B to G, cut off overlaps against the wall.

3: Shorten H1 according to room calculations and also cut off overlap on wall side.

4: Start the next row with the remaining part (H2).



Tools

Pipe cutter
Danfoss pipe cutter incl. corrugated pipe cutter for trimming the Danfoss composite pipes 16 x 2.00 / 20 x 2.25 mm and the Danfoss protective pipe.

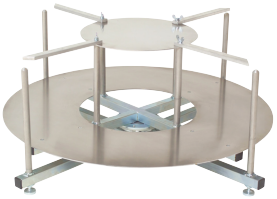
Pipe cutter
Danfoss universal pipe cutter for trimming composite pipes up to 32 x 3.00 mm and the Danfoss clip rail.

Bevelling tool
Danfoss bevelling tool for calibrating and bevelling the Danfoss composite pipes.
The handle is removable, so the tool can be attached to rechargeable drills (< 500 r/min).
Dimensions of 16 - 20 mm allow inner and outer bevels which facilitates installation

Pipe bending springs
Danfoss pipe bending springs are able to form radiuses of up to 4 x D.

Press tool
Danfoss press tool is, together with the inserts, suitable for pressing of Danfoss composite pipes with dimensions of 16 and 20 mm.

Pipe dispensing wheel
Danfoss pipe dispensing wheel is indispensable for one-man installations. It holds the coiled pipe, is compact and easy to transport, and will fit into narrow spaces.



Measurement base
Points marked out to measure the residual moisture in the screed without damaging the pipes.

Installation times

Installation Times for Basic Heating Systems *

Article / Unit	Minutes per unit	Unit
Installation of manifold without cabinet	55.00	Unit
Installation of manifold with cabinet	75.00	Unit
Installation of additional insulation without perimeter insulation, each layer	2.50	m²
Installation of insulation overlap panels 20 mm / 35 mm incl. perimeter insulation	2.50	m²
C-C = 88 mm type of installation 1 (pipe layout, connection to manifold)	11.30	m²
C-C = 120 mm type of installation 2 (pipe layout, connection to manifold)	8.40	m²
C-C = 200 mm type of installation 1 (pipe layout, connection to manifold)	5.00	m²
C-C = 250 mm type of installation 2 (pipe layout, connection to manifold)	4.00	m²
C-C = 300 mm type of installation 3 (pipe layout, connection to manifold)	3.50	m²

** 06/2004 Values based on practical experience.*

Heated screed

Only heated screed should be used. The Danfoss screed additive should be used when installing cement screed. The screed additive Normal CT F4 has the effect of increasing thermal conductivity as well as allowing the screed to retain more heat. Both contribute to an even distribution of heat within the room and guarantee better resistance to pressure and more flexibility.
Liquid screed should be prepared as heated screed. To achieve a very thin cement screed, the Danfoss Screed Additive Special should be used. It achieves an even better resistance to pressure and more flexibility, as well as a higher thermal conductivity.

Mastic asphalt is not suitable for Basic underfloor heating systems. The outer sleeve of the composite pipe is not resistant to the higher temperatures of this form of screed.
The mean heating water temperature must not exceed 55° C when using cement and Anhydrite screeds.

Danfoss screed additives

Normal:
The screed additive is added to the screed and not the water.
- Required quantity per m²: 215 g
- Height of heated screed: 70 mm
- Screed quality: CT F4
- Volume of can: 10 kg

Mixing cement screed in connection with underfloor heating.
Mortar-mix:
- 50 kg cement CEM I 32.5 R
- 250 kg gravel sand 0/8 mm (approx. 30-36 shovels full)
- 16-18 litres water
- 500 g (0.5 litre) Danfoss screed additive

Mixing instructions using a forced action mixer:
- 10 shovels full of gravel sand (approx. 30 litres)
- 50 kg cement CEM I 32.5 R
- 10 litres water
- 0.5 litres Danfoss screed additive
- 20-26 shovels full of gravel sand (approx. 110 litres)
- 6-8 litres water
- Mortar consistency of moist soil to malleable, minimum mixing time 1 min.

Special:
The screed additive Special is suitable when low height screed is required. This synthetically modified additive is added by the specialist screeder.
- Required quantity per m²: 1820 g
- Height of heated screed: 65 mm
- Screed quality: CTF 5
- Volume of can: 10 kg

Installation

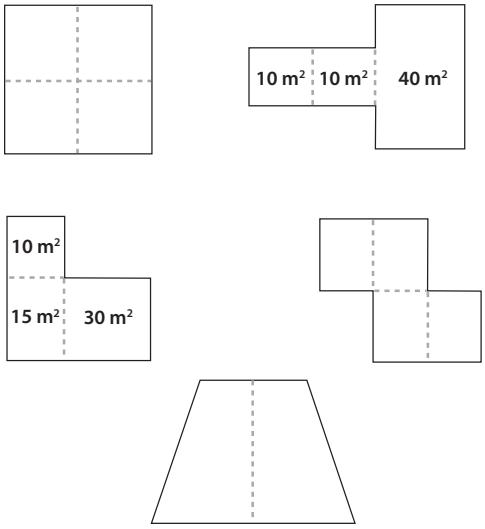
Fresh screed mortar should be poured along the length of the composite pipes and should be well tamped. It must be protected from frost.
Screed should be installed at room temperatures of above 5° C, and any draft should be avoided.
Fix certain points as measuring point to ascertain residual moisture.

There should be no heating pipes within a distance of 10 cm (Ø20 cm) around that point.

Screed joints

Floating screeds expand and contract depending on temperature, particularly heated screeds. To compensate for this, screed is divided into geometric fields. The perimeter insulation allows for some of the expansion, and movement gap strips between the fields allow for movement and avoid cracks (5 mm minimum expansion).
Movement gaps have to be allowed for on room edges and between large and multi-angular areas (e.g. L- or Z-shaped). The proportion of width to length should not exceed 1:2.
Joints in the building should be mirrored in the screed. The size of the areas should not exceed 40 m^2 with a maximum length of 8 m.
Unusual area shapes exposed to higher temperatures tend to crack easily, so careful planning of expansion joints is advisable.
The type of finished floor also determines the layout of the screed areas. Screed temperature is higher when carpet is laid but with tiles the difference in temperature between upper and lower surface of the screed is significantly higher, which means these constructions tend to crack more easily.
When composite pipes cross a screed joint, the pipes should be protected with a movement gap strip against expansion and shear stress.
This occurs when two adjacent screed slabs move towards each other (expansion, buckling of the embedded pipes), or move across each other (shearing), or even do both.

The 40 cm long pipe sleeves absorb any movement of the screed and the composite pipe remains permanently protected.



Movement gap strips for BasicRail and BasicClip

Basic movement gap strip consists of a 2 m long movement gap strips to install joints with double-sided adhesive strip and a 100 mm high perimeter insulation strip.

Pipe sleeves
- 40 cm long
- to protect crossing pipes

Installation
Before pouring the screed, the movement gap strips are installed. The movement gap strips are first attached to the given positions on the plan (in agreement with the screeder and floor finisher). They are attached to the insulation using the double-sided tape. Afterwards a section of perimeter insulation is inserted into the slot. Pipes going through the movement joint should be protected with an outer sleeve.

The sleeves are pushed into the profile and appropriate holes for the pipe channels are cut into the movement joint.

Important! Before and after installation of screed

- Heated screed is installed after pipe layout, insulations and joint gap strips are fixed.
- Before the screed is installed the building/room must be completely plastered, windows and doors must be firmly closed to avoid the screed drying too fast and thus possibly causing cracks or even other damage in the building.
- Before screeding, check again that screed areas and heating circuits are co-ordinated and the movement gap joints are not interrupted. If the Danfoss composite pipes cross movement joints they should be protected.
- When screeding, the pipes must be under pressure so that possible problems are noticed and can be rectified.
- Screed should be installed at temperatures above 5° C (risk of frost).
- Should a sudden unexpected frost occur after screeding, care must be taken not to let the temperature fall below 5° C. If it is possible to turn on the Danfoss underfloor heating the flow temperature must not exceed 25° C.
- Heating up should follow the Danfoss heating up protocol. It is important to check the residual moisture before laying the finished floor; this would be done by the professional laying the finished floor.
- The perimeter insulation remains in place and is only cut to the appropriate height after the floor is finished.

Table to show when to lay the finished floor (according to moisture content)

Finished floor	Approved moisture content when cement screed is used	Approved moisture content when Anhydrite screed is used
Ceramic tiles or thickbed natural-/ concrete stones thinbed	3.0 %	not applicable
	2.0 %	0.3 %
Textile finish vapour permeable e.g. carpet vapour proof	3.0 %	1.0 %
	1.8 %	0.3 %
Elastic finishes e.g. PVC, Linoleum, rubber	1.8 %	0.3 %
Engineered timber floor, laminates	1.8 %	0.3 %

Heating up of screed

The heating up of the screed should be carried out according to the Heating Up Protocol.
After 7 days it is possible to walk on the cement screed, but only after 21 days should the heating up take place.
For Anhydride or Calcium Sulphate based screed heating up can begin after 7 days, or according to manufacturers' recommendation. During heating up, the automatic control should be off and the supply temperature should be adjusted manually. All joints should be checked and any solid matter should be removed from the joints. For the first three days, the flow temperature should be kept at 25° C, after that the maximum supply temperature should be run for four days, and the heating circuits should be turned off. While cooling down the heated screed should be protected from draft and rapid cooling. The floorer should now measure the residual moisture and decide whether the final floor can be laid.
It must be noted here, that during the first year, because of residual moisture in new buildings, the heating temperature should be higher than normal. This additional moisture should dry out during the first heating period. The heating up process does not guarantee to achieve the required moisture level of the screed. An additional heating up operation may be necessary to establish whether the final floor can be laid.
Commissioning of the underfloor heating after the floor has been finished should be decided by the final flooring firm.

Active load and height of screed

Depending on use, the floor construction will have to meet different demands. These are defined in EN 1991: Action on Structures.

Categories of loaded areas, in accordance with EN 1991

The Danfoss construction sheets describe the approved type of use. Depending on active and point load, EN 1991 is also applicable for constructions other than home and office buildings.

Category	Use	Examples	qK (Active load) [kN/m²]	QK (Point load) [kN]
A1	Areas for domestic and residential activities	Floors	1.5 - **2.0**	**2.0** - 3.0
A2		Stairs	**2.0** - 4.0	**2.0** - 4.0
A3		Balconies	**2.5** - 4.0	**2.0** - 3.0
B	Office areas		2.0 - **3.0**	1.5 - **4.5**
C1	Areas where people may congregate (with the exception of areas defined under category A, B, D)	Areas with tables , e.g. areas in schools, cafés, restaurants, dining halls, reading rooms, receptions	2.0 - **3.0**	3.0 - **4.0**
C2		Areas with fixed seats, e.g. areas in churches, theatres or cinemas, conference rooms, lecture halls, assembly halls, waiting rooms, railway waiting rooms	3.0 - **4.0**	2.5 - 7.0 (note 3)
C3		Areas without obstacles for moving people, e.g. areas in museums, exhibition rooms etc. and access areas in public administration buildings, hotels, hospitals, railway station forecourts	3.0 - **5.0**	**4.0** - 7.0
C4		Areas with possible physical activities, e.g. dance halls, gymnastic rooms, stages	4.5 - **5.0**	3.5 - **7.0**
C5		Areas susceptible to large crowds, e.g. in buildings for public events like concert halls, sports halls including stands, terraces and access areas and railway platforms	**5.0** - 7.5	3.5 - **4.5**
D1	Shopping areas	Areas in general retail shops	**4.0** - 5.0	3.5 - 7.0 (note 3)
D2		Areas in department stores	4.0 - **5.0**	3.5 - **7.0**

Note 1: Depending on their anticipated uses, areas likely to be categorised as C2, C3, C4 may be categorised as C5 by decision of the client and/or National annex.

Note 2: The National annex may provide sub categories to A, B, C1 to C5, D1 and D2.

Note 3: Recommended values are highlighted. For categories C2 and D1 the recommended value is 4.0.

Minimum nominal thickness in mm for active loads in heated screed with Basic heating systems

Different active loads are accomodated in the thickness of the heated screed.

	< 2 kN/m²	< 3 kN/m²		5 kN/m²
		Point load below 2 kN/m²	Point load below 3 kN/m²	Point load below 4 kN/m²
CT F4 with screed additive Normal	65	85	90	95
CAF F4	60	70	80	85
CT F5 with screed additive Special	60*	75	80	85
CAF F5	50*	65	70	75
Compactibility of insulation:	max. 5 mm		max. 3 mm.	

**For insulation thickness < 40 mm the screed can be reduced by 5 mm .*

After installation

When the installation is completed the individual heating circuits are filled with water via the fill and drain on the manifold.
The pressure test follows, which in winter can also be done with pressurised air.
The project manager/architect is ready to sign the hand-over protocol.
Now the screed has to be installed quickly and heated up according to protocol (for liquid screed the manufacturer's information needs to be followed).
After starting the heat source, the individual heat circuits are set via the valves.
Then the actuators are screwed onto the return valves and connected via the Danfoss wiring centre to the room thermostats.

Information for finished floors

The following floor finishes can be laid on underfloor heating if they meet the thermal resistance requirements of $R_{\lambda,B} \leq 0.15$ m² K/W and are approved by the manufacturer :

- Ceramic tiles
- Natural worked stone
- Elastic finishes (PVC)
- Textile finishes (carpets)
- Engineered timber floor and laminates

It is important to adhere to the manufacturers' advice.
The adhesives for stone tiles or ceramic finishes used in the the thinbed method must be appropriate for underfloor heating and for the load bearing.
If the floor is laid using the thickbed method, the heating up and response times are much greater due to a higher build up.
Elastic and textile floor finishes should be fully glued down. When laying textile floor finishes, it is possible to use adhesives that allow a later removal of the floor.
Natural products, such as engineered timber floors or other timber products, adjust to their environment which can cause contraction. This does not mean a faulty floor. Depending on the wood, expansion and contraction vary, but this can be minimised by keeping an even temperature.
When installing engineered timber floors or laminates, the thermal resistance data should be provided as well as data for possible air gaps and additional carpets.
It may be necessary to fill gaps between dry floor elements before laying the finished floor.

Thermal resistance $R_{finished\ floor}$ of different finishes fully bonded to the floor

Finished floor surface	Thermal resistance: $R_{\lambda,B}$ [m² K/W]
Natural stone	0.009
Ceramic tiles	0.01
PVC	0.012
Linoleum	0.015
Mosaic engineered timber - oak	0.044
Cork	0.062
Standard EN-1264 value	0.100
Carpet	0.108
Strip flooring - oak	0.122
Laminates	0.044
Multi-layer engineered timber (Parquett)	0.050 - 0.080
Maximum recommendation	0.150

Output table, BasicRail heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.00 (e.g. tiles).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Cement screed

Mean heating water temperature	Room temperature	C-C 8.8 Cement screed	Surface temperature	C-C 12 Cement screed	Surface temperature	VA 20 Cement screed	Surface temperature	VA 25 Cement screed	Surface temperature	VA 30 Cement screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	101.0	24.1	92.1	23.4	73.6	21.8	63.9	21.0	55.7	20.3
30	18	80.4	25.4	73.3	24.8	58.5	23.5	50.8	22.9	44.3	22.3
30	20	66.6	26.2	60.7	25.7	48.5	24.7	42.1	24.1	36.7	23.6
30	22	52.6	27.0	47.9	26.6	38.3	25.8	33.2	25.3	29.0	24.9
30	24	38.3	27.8	34.9	27.5	27.9	26.8	24.2	26.5	21.1	26.2
35	15	135.3	26.8	123.4	25.9	98.5	23.9	85.6	22.8	74.6	21.9
35	18	114.8	28.2	104.6	27.4	83.5	25.6	72.6	24.7	63.3	23.9
35	20	101.0	29.1	92.1	28.4	73.6	26.8	63.9	26.0	55.7	25.3
35	22	87.3	30.0	79.6	29.3	63.5	28.0	55.2	27.2	48.1	26.6
35	24	73.5	30.8	67.0	30.3	53.5	29.1	46.5	28.5	40.5	28.0
40	15	169.4	29.5	154.5	28.4	123.3	25.9	107.1	24.6	93.4	23.5
40	18	149.0	30.9	135.8	29.9	108.4	27.7	94.2	26.5	82.1	25.5
40	20	135.3	31.8	123.4	30.9	98.5	28.9	85.6	27.8	74.6	26.9
40	22	121.6	32.7	110.9	31.9	88.5	30.1	76.9	29.1	67.1	28.3
40	24	107.9	33.6	98.4	32.9	78.6	31.2	68.2	30.4	59.5	29.6
45	15	203.5	32.2	185.6	30.8	148.2	27.9	128.7	26.3	112.2	25.0
45	18	183.1	33.6	166.9	32.3	133.3	29.7	115.8	28.3	101.0	27.1
45	20	169.4	34.5	154.5	33.4	123.3	30.9	107.1	29.6	93.4	28.5
45	22	155.8	35.5	142.0	34.4	113.4	32.1	98.5	30.9	85.9	29.8
45	24	142.1	36.4	129.6	35.4	103.5	33.3	89.9	32.2	78.4	31.2
50	15	237.6	34.8	216.6	33.2	173.0	29.8	150.2	28.0	131.0	26.5
50	18	217.2	36.2	198.0	34.7	158.1	31.6	137.3	30.0	119.8	28.6
50	20	203.5	37.2	185.6	35.8	148.2	32.9	128.7	31.3	112.2	30.0
50	22	189.9	38.1	173.1	36.8	138.2	34.1	120.1	32.6	104.7	31.4
50	24	176.3	39.1	160.7	37.8	128.3	35.3	111.5	33.9	97.2	32.8
55	15	271.6	37.3	247.7	35.5	197.7	31.7	171.8	29.7	149.8	28.0
55	18	251.2	38.8	229.1	37.1	182.9	33.6	158.9	31.7	138.5	30.1
55	20	237.6	39.8	216.6	38.2	173.0	34.8	150.2	33.0	131.0	31.5
55	22	224.0	40.7	204.2	39.2	163.0	36.0	141.6	34.3	123.5	32.9
55	24	210.3	41.7	191.8	40.3	153.1	37.3	133.0	35.7	116.0	34.3

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicRail heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.00 (e.g. tiles).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Liquid Screed

Mean heating water temperature	Room temperature	C-C 8.8 Liquid screed	Surface temperature	C-C 12 Liquid screed	Surface temperature	VA 20 Liquid screed	Surface temperature	VA 25 Liquid screed	Surface temperature	VA 30 Liquid screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	117.1	25.4	106.4	24.5	84.3	22.7	73.0	21.8	63.2	20.9
30	18	93.2	26.4	84.7	25.7	67.0	24.3	58.1	23.5	50.3	22.8
30	20	77.1	27.1	70.1	26.5	55.5	25.3	48.1	24.6	41.6	24.1
30	22	60.9	27.7	55.4	27.3	43.8	26.3	38.0	25.7	32.9	25.3
30	24	44.4	28.3	40.3	27.9	32.0	27.2	27.7	26.8	23.9	26.5
35	15	156.8	28.5	142.5	27.4	112.8	25.0	97.7	23.8	84.6	22.7
35	18	133.0	29.7	120.8	28.7	95.7	26.6	82.9	25.6	71.7	24.7
35	20	117.1	30.4	106.4	29.5	84.3	27.7	73.0	26.8	63.2	25.9
35	22	101.2	31.1	91.9	30.3	72.8	28.7	63.0	27.9	54.6	27.2
35	24	85.2	31.8	77.4	31.1	61.3	29.8	53.1	29.1	45.9	28.4
40	15	196.3	31.6	178.4	30.2	141.3	27.3	122.3	25.8	105.9	24.5
40	18	172.6	32.8	156.8	31.5	124.2	29.0	107.6	27.6	93.1	26.4
40	20	156.8	33.5	142.5	32.4	112.8	30.0	97.7	28.8	84.6	27.7
40	22	140.9	34.3	128.0	33.3	101.4	31.1	87.8	30.0	76.0	29.0
40	24	125.0	35.0	113.6	34.1	90.0	32.2	77.9	31.2	67.4	30.3
45	15	235.9	34.6	214.3	33.0	169.7	29.6	147.0	27.8	127.2	26.2
45	18	212.2	35.8	192.8	34.3	152.7	31.2	132.2	29.6	114.4	28.2
45	20	196.3	36.6	178.4	35.2	141.3	32.3	122.3	30.8	105.9	29.5
45	22	180.5	37.4	164.0	36.1	129.9	33.4	112.5	32.0	97.4	30.8
45	24	164.7	38.2	149.6	37.0	118.5	34.5	102.6	33.2	88.8	32.1
50	15	275.3	37.6	250.2	35.7	198.1	31.7	171.6	29.7	148.5	27.9
50	18	251.6	38.8	228.7	37.1	181.1	33.4	156.8	31.5	135.7	29.9
50	20	235.9	39.6	214.3	38.0	169.7	34.6	147.0	32.8	127.2	31.2
50	22	220.1	40.4	199.9	38.9	158.3	35.7	137.1	34.0	118.7	32.5
50	24	204.2	41.2	185.6	39.8	147.0	36.8	127.3	35.2	110.2	33.8
55	15	314.8	40.5	286.0	38.4	226.5	33.9	196.1	31.6	169.8	29.6
55	18	291.1	41.8	264.5	39.8	209.5	35.6	181.4	33.5	157.0	31.6
55	20	275.3	42.6	250.2	40.7	198.1	36.7	171.6	34.7	148.5	32.9
55	22	259.5	43.4	235.8	41.6	186.8	37.9	161.7	35.9	140.0	34.2
55	24	243.7	44.2	221.5	42.5	175.4	39.0	151.9	37.2	131.5	35.5

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicRail heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.05 (e.g. engineered timber floor / synthetic fibre).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Liquid Screed

Mean heating water temperature	Room temperature	C-C 8.8 Liquid screed	Surface temperature	C-C 12 Liquid screed	Surface temperature	VA 20 Liquid screed	Surface temperature	VA 25 Liquid screed	Surface temperature	VA 30 Liquid screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	81.7	22.5	75.5	22.0	62.3	20.8	55.0	20.2	48.7	19.7
30	18	65.0	24.1	60.1	23.7	49.5	22.8	43.8	22.2	38.8	21.8
30	20	53.8	25.1	49.7	24.8	41.0	24.0	36.2	23.6	32.1	23.2
30	22	42.5	26.1	39.3	25.8	32.4	25.2	28.6	24.9	25.4	24.6
30	24	31.0	27.1	28.6	26.9	23.6	26.4	20.8	26.2	18.5	25.9
35	15	109.4	24.8	101.1	24.1	83.4	22.6	73.6	21.8	65.3	21.1
35	18	92.8	26.4	85.7	25.8	70.7	24.6	62.4	23.9	55.4	23.3
35	20	81.7	27.5	75.5	27.0	62.3	25.8	55.0	25.2	48.7	24.7
35	22	70.6	28.6	65.2	28.1	53.8	27.1	47.5	26.6	42.1	26.1
35	24	59.4	29.6	54.9	29.2	45.3	28.4	40.0	27.9	35.4	27.5
40	15	137.0	27.0	126.6	26.1	104.4	24.4	92.2	23.4	81.7	22.5
40	18	120.5	28.7	111.3	27.9	91.8	26.3	81.0	25.4	71.8	24.7
40	20	109.4	29.8	101.1	29.1	83.4	27.6	73.6	26.8	65.3	26.1
40	22	98.4	30.9	90.8	30.2	74.9	28.9	66.2	28.2	58.7	27.5
40	24	87.3	32.0	80.6	31.4	66.5	30.2	58.7	29.5	52.1	29.0
45	15	164.6	29.2	152.0	28.2	125.4	26.1	110.7	24.9	98.2	23.8
45	18	148.1	30.9	136.8	30.0	112.8	28.0	99.6	27.0	88.3	26.0
45	20	137.0	32.0	126.6	31.1	104.4	29.4	92.2	28.4	81.7	27.5
45	22	126.0	33.1	116.4	32.3	96.0	30.7	84.8	29.7	75.1	28.9
45	24	115.0	34.2	106.2	33.5	87.6	32.0	77.3	31.1	68.6	30.4
50	15	192.2	31.3	177.5	30.2	146.4	27.7	129.3	26.4	114.6	25.2
50	18	175.6	33.0	162.2	32.0	133.8	29.7	118.2	28.5	104.7	27.4
50	20	164.6	34.2	152.0	33.2	125.4	31.1	110.7	29.9	98.2	28.8
50	22	153.6	35.3	141.9	34.4	117.0	32.4	103.3	31.3	91.6	30.3
50	24	142.6	36.4	131.7	35.6	108.6	33.7	95.9	32.7	85.0	31.8
55	15	219.7	33.4	202.9	32.1	167.4	29.4	147.8	27.8	131.0	26.5
55	18	203.2	35.1	187.7	33.9	154.8	31.4	136.7	30.0	121.2	28.7
55	20	192.2	36.3	177.5	35.2	146.4	32.7	129.3	31.4	114.6	30.2
55	22	181.2	37.4	167.3	36.4	138.0	34.1	121.9	32.8	108.0	31.7
55	24	170.1	38.6	157.1	37.6	129.6	35.4	114.5	34.2	101.5	33.1

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicRail heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.05 (e.g. engineered timber floor / synthetic fibre).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Cement screed

Mean heating water temperature	Room temperature	C-C 8.8 Cement screed	Surface temperature	C-C 12 Cement screed	Surface temperature	VA 20 Cement screed	Surface temperature	VA 25 Cement screed	Surface temperature	VA 30 Cement screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	73.3	21.8	67.8	21.3	56.2	20.3	49.9	19.8	44.4	19.3
30	18	58.3	23.5	53.9	23.1	44.7	22.3	39.7	21.9	35.4	21.5
30	20	48.3	24.6	44.6	24.3	37.0	23.6	32.9	23.3	29.3	22.9
30	22	38.1	25.7	35.3	25.5	29.2	24.9	26.0	24.6	23.1	24.4
30	24	27.8	26.8	25.7	26.6	21.3	26.2	18.9	26.0	16.8	25.8
35	15	98.1	23.8	90.7	23.2	75.2	21.9	66.8	21.2	59.5	20.6
35	18	83.2	25.6	77.0	25.1	63.8	24.0	56.7	23.4	50.5	22.8
35	20	73.3	26.8	67.8	26.3	56.2	25.3	49.9	24.8	44.4	24.3
35	22	63.3	27.9	58.5	27.5	48.5	26.7	43.1	26.2	38.4	25.8
35	24	53.3	29.1	49.3	28.7	40.9	28.0	36.3	27.6	32.3	27.2
40	15	122.8	25.8	113.6	25.1	94.2	23.5	83.7	22.7	74.5	21.9
40	18	108.0	27.6	99.9	27.0	82.8	25.6	73.6	24.8	65.5	24.1
40	20	98.1	28.8	90.7	28.2	75.2	26.9	66.8	26.2	59.5	25.6
40	22	88.2	30.0	81.5	29.5	67.6	28.3	60.1	27.7	53.5	27.1
40	24	78.2	31.2	72.4	30.7	60.0	29.7	53.3	29.1	47.4	28.6
45	15	147.6	27.8	136.5	26.9	113.1	25.1	100.6	24.0	89.5	23.1
45	18	132.7	29.6	122.8	28.8	101.8	27.1	90.5	26.2	80.5	25.4
45	20	122.8	30.8	113.6	30.1	94.2	28.5	83.7	27.7	74.5	26.9
45	22	112.9	32.0	104.5	31.4	86.6	29.9	77.0	29.1	68.5	28.4
45	24	103.0	33.2	95.3	32.6	79.0	31.3	70.2	30.5	62.5	29.9
50	15	172.3	29.8	159.3	28.7	132.1	26.6	117.4	25.4	104.5	24.4
50	18	157.4	31.6	145.6	30.7	120.7	28.7	107.3	27.6	95.5	26.6
50	20	147.6	32.8	136.5	31.9	113.1	30.1	100.6	29.0	89.5	28.1
50	22	137.7	34.0	127.3	33.2	105.6	31.5	93.8	30.5	83.5	29.6
50	24	127.8	35.2	118.2	34.5	98.0	32.8	87.1	31.9	77.5	31.1
55	15	196.9	31.7	182.2	30.5	151.0	28.1	134.2	26.8	119.4	25.6
55	18	182.1	33.5	168.5	32.5	139.6	30.2	124.1	29.0	110.5	27.8
55	20	172.3	34.8	159.3	33.7	132.1	31.6	117.4	30.4	104.5	29.4
55	22	162.4	36.0	150.2	35.0	124.5	33.0	110.7	31.9	98.5	30.9
55	24	152.5	37.2	141.1	36.3	116.9	34.4	103.9	33.3	92.5	32.4

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicRail heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.10 (e.g. carpet).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Liquid screed

Mean heating water temperature	Room temperature	C-C 8.8 Liquid screed	Surface temperature	C-C 12 Liquid screed	Surface temperature	VA 20 Liquid screed	Surface temperature	VA 25 Liquid screed	Surface temperature	VA 30 Liquid screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	62.7	20.9	58.7	20.5	49.8	19.8	44.9	19.3	40.6	19.0
30	18	49.9	22.8	46.7	22.5	39.6	21.9	35.7	21.5	32.3	21.2
30	20	41.3	24.0	38.7	23.8	32.8	23.3	29.6	23.0	26.7	22.7
30	22	32.6	25.3	30.5	25.1	25.9	24.6	23.4	24.4	21.1	24.2
30	24	23.8	26.4	22.3	26.3	18.9	26.0	17.0	25.8	15.4	25.6
35	15	84.0	22.7	78.6	22.2	66.6	21.2	60.1	20.7	54.3	20.2
35	18	71.2	24.6	66.7	24.2	56.5	23.4	51.0	22.9	46.1	22.4
35	20	62.7	25.9	58.7	25.5	49.8	24.8	44.9	24.3	40.6	24.0
35	22	54.2	27.2	50.7	26.9	43.0	26.2	38.8	25.8	35.0	25.5
35	24	45.6	28.4	42.7	28.2	36.2	27.6	32.6	27.3	29.5	27.0
40	15	105.1	24.4	98.4	23.9	83.5	22.6	75.2	21.9	68.0	21.3
40	18	92.4	26.4	86.5	25.9	73.4	24.8	66.2	24.2	59.8	23.6
40	20	84.0	27.7	78.6	27.2	66.6	26.2	60.1	25.7	54.3	25.2
40	22	75.5	29.0	70.6	28.6	59.9	27.6	54.0	27.1	48.8	26.7
40	24	67.0	30.2	62.7	29.9	53.2	29.1	47.9	28.6	43.3	28.2
45	15	126.3	26.1	118.2	25.5	100.3	24.0	90.4	23.2	81.7	22.5
45	18	113.6	28.1	106.3	27.5	90.2	26.2	81.3	25.5	73.5	24.8
45	20	105.1	29.4	98.4	28.9	83.5	27.6	75.2	26.9	68.0	26.3
45	22	96.7	30.7	90.5	30.2	76.7	29.1	69.2	28.4	62.5	27.9
45	24	88.2	32.0	82.6	31.6	70.0	30.5	63.1	29.9	57.1	29.4
50	15	147.4	27.8	138.0	27.1	117.1	25.4	105.5	24.4	95.4	23.6
50	18	134.8	29.8	126.1	29.1	107.0	27.6	96.4	26.7	87.2	25.9
50	20	126.3	31.1	118.2	30.5	100.3	29.0	90.4	28.2	81.7	27.5
50	22	117.8	32.4	110.3	31.8	93.6	30.5	84.3	29.7	76.2	29.0
50	24	109.4	33.8	102.4	33.2	86.8	31.9	78.3	31.2	70.8	30.6
55	15	168.6	29.5	157.8	28.6	133.8	26.7	120.6	25.7	109.1	24.7
55	18	155.9	31.5	145.9	30.7	123.8	28.9	111.6	27.9	100.9	27.1
55	20	147.4	32.8	138.0	32.1	117.1	30.4	105.5	29.4	95.4	28.6
55	22	139.0	34.1	130.1	33.4	110.3	31.8	99.5	31.0	89.9	30.2
55	24	130.5	35.5	122.2	34.8	103.6	33.3	93.4	32.5	84.4	31.7

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicRail heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.10 (e.g. carpet).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Cement screed

Mean heating water temperature	Room temperature	C-C 8.8 Cement screed	Surface temperature	C-C 12 Cement screed	Surface temperature	VA 20 Cement screed	Surface temperature	VA 25 Cement screed	Surface temperature	VA 30 Cement screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	57.7	20.5	53.9	20.1	46.1	19.4	41.8	19.1	37.7	18.7
30	18	45.9	22.4	42.9	22.2	36.7	21.6	33.2	21.3	30.0	21.0
30	20	38.0	23.7	35.5	23.5	30.3	23.0	27.5	22.8	24.9	22.5
30	22	30.0	25.0	28.1	24.8	24.0	24.5	21.7	24.2	19.6	24.0
30	24	21.9	26.3	20.5	26.1	17.5	25.8	15.8	25.7	14.3	25.5
35	15	77.2	22.1	72.2	21.7	61.7	20.8	55.9	20.3	50.5	19.8
35	18	65.5	24.1	61.3	23.8	52.3	23.0	47.4	22.6	42.9	22.2
35	20	57.7	25.5	53.9	25.1	46.1	24.4	41.8	24.1	37.7	23.7
35	22	49.8	26.8	46.6	26.5	39.8	25.9	36.1	25.6	32.6	25.2
35	24	41.9	28.1	39.2	27.8	33.5	27.3	30.4	27.0	27.5	26.8
40	15	96.7	23.7	90.4	23.2	77.2	22.1	70.0	21.5	63.3	20.9
40	18	85.0	25.8	79.5	25.3	67.9	24.3	61.6	23.8	55.6	23.3
40	20	77.2	27.1	72.2	26.7	61.7	25.8	55.9	25.3	50.5	24.8
40	22	69.4	28.5	64.9	28.1	55.4	27.3	50.3	26.8	45.4	26.4
40	24	61.6	29.8	57.6	29.4	49.2	28.7	44.6	28.3	40.3	27.9
45	15	116.1	25.3	108.6	24.7	92.8	23.4	84.1	22.7	76.0	22.0
45	18	104.5	27.4	97.7	26.8	83.5	25.6	75.7	25.0	68.4	24.4
45	20	96.7	28.7	90.4	28.2	77.2	27.1	70.0	26.5	63.3	25.9
45	22	88.9	30.1	83.2	29.6	71.0	28.6	64.4	28.0	58.2	27.5
45	24	81.1	31.4	75.9	31.0	64.8	30.1	58.7	29.5	53.1	29.1
50	15	135.6	26.9	126.8	26.2	108.3	24.7	98.2	23.8	88.7	23.1
50	18	123.9	28.9	115.9	28.3	99.0	26.9	89.7	26.2	81.1	25.4
50	20	116.1	30.3	108.6	29.7	92.8	28.4	84.1	27.7	76.0	27.0
50	22	108.4	31.7	101.4	31.1	86.6	29.9	78.5	29.2	70.9	28.6
50	24	100.6	33.0	94.1	32.5	80.4	31.4	72.8	30.7	65.8	30.2
55	15	155.0	28.4	145.0	27.6	123.8	25.9	112.3	25.0	101.5	24.1
55	18	143.3	30.5	134.1	29.7	114.5	28.2	103.8	27.3	93.8	26.5
55	20	135.6	31.9	126.8	31.2	108.3	29.7	98.2	28.8	88.7	28.1
55	22	127.8	33.2	119.6	32.6	102.1	31.2	92.6	30.4	83.7	29.7
55	24	120.0	34.6	112.3	34.0	95.9	32.7	86.9	31.9	78.6	31.2

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicRail heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.15 (e.g. terry velvet / engineered timber, solid timber planks).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Cement screed

Mean heating water temperature	Room temperature	C-C 8.8 Cement screed	Surface temperature	C-C 12 Cement screed	Surface temperature	VA 20 Cement screed	Surface temperature	VA 25 Cement screed	Surface temperature	VA 30 Cement screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	47.6	19.6	44.9	19.3	39.1	18.8	35.8	18.5	33.0	18.3
30	18	37.8	21.7	35.7	21.5	31.1	21.1	28.5	20.9	26.3	20.7
30	20	31.3	23.1	29.6	23.0	25.7	22.6	23.6	22.4	21.7	22.2
30	22	24.7	24.5	23.4	24.4	20.3	24.1	18.6	24.0	17.2	23.8
30	24	18.0	25.9	17.0	25.8	14.8	25.6	13.6	25.5	12.5	25.4
35	15	63.7	21.0	60.1	20.7	52.3	20.0	47.9	19.6	44.2	19.3
35	18	54.0	23.1	51.0	22.9	44.4	22.3	40.7	22.0	37.5	21.7
35	20	47.6	24.6	44.9	24.3	39.1	23.8	35.8	23.5	33.0	23.3
35	22	41.1	26.0	38.8	25.8	33.8	25.4	30.9	25.1	28.5	24.9
35	24	34.6	27.4	32.6	27.3	28.4	26.9	26.0	26.6	24.0	26.5
40	15	79.7	22.3	75.2	21.9	65.5	21.1	60.0	20.7	55.3	20.3
40	18	70.1	24.5	66.2	24.2	57.6	23.5	52.8	23.0	48.6	22.7
40	20	63.7	26.0	60.1	25.7	52.3	25.0	47.9	24.6	44.2	24.3
40	22	57.2	27.4	54.0	27.1	47.0	26.5	43.1	26.2	39.7	25.9
40	24	50.8	28.9	47.9	28.6	41.7	28.1	38.2	27.8	35.2	27.5
45	15	95.8	23.7	90.4	23.2	78.7	22.2	72.1	21.7	66.4	21.2
45	18	86.2	25.9	81.3	25.5	70.8	24.6	64.9	24.1	59.8	23.6
45	20	79.7	27.3	75.2	26.9	65.5	26.1	60.0	25.7	55.3	25.3
45	22	73.3	28.8	69.2	28.4	60.3	27.7	55.2	27.2	50.9	26.9
45	24	66.9	30.2	63.1	29.9	55.0	29.2	50.4	28.8	46.4	28.5
50	15	111.8	25.0	105.5	24.4	91.9	23.3	84.2	22.7	77.6	22.1
50	18	102.2	27.2	96.4	26.7	84.0	25.7	77.0	25.1	70.9	24.6
50	20	95.8	28.7	90.4	28.2	78.7	27.2	72.1	26.7	66.4	26.2
50	22	89.4	30.1	84.3	29.7	73.4	28.8	67.3	28.3	62.0	27.8
50	24	82.9	31.6	78.3	31.2	68.2	30.4	62.5	29.9	57.5	29.4
55	15	127.8	26.2	120.6	25.7	105.1	24.4	96.3	23.7	88.7	23.1
55	18	118.2	28.5	111.6	27.9	97.2	26.8	89.0	26.1	82.0	25.5
55	20	111.8	30.0	105.5	29.4	91.9	28.3	84.2	27.7	77.6	27.1
55	22	105.4	31.4	99.5	31.0	86.6	29.9	79.4	29.3	73.1	28.8
55	24	99.0	32.9	93.4	32.5	81.4	31.5	74.5	30.9	68.7	30.4

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicRail heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.15 (e.g. terry velvet / engineered timber, solid timber planks).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Liquid screed

Mean heating water temperature	Room temperature	C-C 8.8 Liquid screed	Surface temperature	C-C 12 Liquid screed	Surface temperature	VA 20 Liquid screed	Surface temperature	VA 25 Liquid screed	Surface temperature	VA 30 Liquid screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	51.1	19.9	48.3	19.6	41.9	19.1	38.2	18.8	35.1	18.5
30	18	40.7	22.0	38.4	21.8	33.3	21.3	30.4	21.0	27.9	20.8
30	20	33.7	23.3	31.8	23.2	27.6	22.8	25.2	22.6	23.1	22.4
30	22	26.6	24.7	25.1	24.6	21.8	24.3	19.9	24.1	18.2	23.9
30	24	19.4	26.0	18.3	25.9	15.9	25.7	14.5	25.6	13.3	25.4
35	15	68.4	21.4	64.7	21.1	56.1	20.3	51.1	19.9	47.0	19.5
35	18	58.1	23.5	54.8	23.2	47.6	22.6	43.4	22.2	39.8	21.9
35	20	51.1	24.9	48.3	24.6	41.9	24.1	38.2	23.8	35.1	23.5
35	22	44.2	26.3	41.7	26.1	36.2	25.6	33.0	25.3	30.3	25.0
35	24	37.2	27.7	35.1	27.5	30.5	27.1	27.8	26.8	25.5	26.6
40	15	85.7	22.8	81.0	22.4	70.3	21.5	64.0	21.0	58.8	20.6
40	18	75.4	25.0	71.2	24.6	61.8	23.8	56.3	23.3	51.7	22.9
40	20	68.4	26.4	64.7	26.1	56.1	25.3	51.1	24.9	47.0	24.5
40	22	61.5	27.8	58.1	27.5	50.4	26.8	46.0	26.4	42.2	26.1
40	24	54.6	29.2	51.6	28.9	44.8	28.3	40.8	28.0	37.5	27.7
45	15	103.0	24.2	97.3	23.8	84.4	22.7	76.9	22.1	70.6	21.6
45	18	92.6	26.4	87.5	26.0	75.9	25.0	69.2	24.4	63.5	24.0
45	20	85.7	27.8	81.0	27.4	70.3	26.5	64.0	26.0	58.8	25.6
45	22	78.8	29.2	74.5	28.9	64.6	28.0	58.9	27.6	54.1	27.1
45	24	71.9	30.7	67.9	30.3	58.9	29.6	53.7	29.1	49.3	28.7
50	15	120.2	25.6	113.6	25.1	98.5	23.9	89.8	23.2	82.5	22.6
50	18	109.9	27.8	103.8	27.3	90.1	26.2	82.1	25.5	75.4	25.0
50	20	103.0	29.2	97.3	28.8	84.4	27.7	76.9	27.1	70.6	26.6
50	22	96.1	30.7	90.8	30.2	78.7	29.2	71.8	28.7	65.9	28.2
50	24	89.2	32.1	84.2	31.7	73.1	30.8	66.6	30.2	61.2	29.8
55	15	137.4	27.0	129.8	26.4	112.7	25.0	102.7	24.2	94.3	23.5
55	18	127.1	29.2	120.1	28.6	104.2	27.3	94.9	26.6	87.2	25.9
55	20	120.2	30.6	113.6	30.1	98.5	28.9	89.8	28.2	82.5	27.6
55	22	113.3	32.1	107.0	31.6	92.9	30.4	84.6	29.7	77.7	29.2
55	24	130.5	35.5	122.2	34.8	103.6	33.3	93.4	32.5	84.4	31.7

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicClip and BasicGrip heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.00 (e.g. tiles).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Liquid screed

Mean heating water temperature	Room temperature	C-C 10 Liquid screed	Surface temperature	C-C 15 Liquid screed	Surface temperature	C-C 20 Liquid screed	Surface temperature	C-C 25 Liquid screed	Surface temperature	C-C 30 Liquid screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	112.8	25.0	97.9	23.8	84.3	22.7	73.0	21.8	63.2	20.9
30	18	89.7	26.2	77.9	25.2	67.0	24.3	58.1	23.5	50.3	22.8
30	20	74.3	26.9	64.5	26.0	55.5	25.3	48.1	24.6	41.6	24.1
30	22	58.7	27.5	51.0	26.9	43.8	26.3	38.0	25.7	32.9	25.3
30	24	42.8	28.2	37.1	27.7	32.0	27.2	27.7	26.8	23.9	26.5
35	15	151.0	28.1	131.1	26.5	112.8	25.0	97.7	23.8	84.6	22.7
35	18	128.1	29.3	111.2	27.9	95.7	26.6	82.9	25.6	71.7	24.7
35	20	112.8	30.0	97.9	28.8	84.3	27.7	73.0	26.8	63.2	25.9
35	22	97.4	30.8	84.6	29.7	72.8	28.7	63.0	27.9	54.6	27.2
35	24	82.0	31.5	71.2	30.6	61.3	29.8	53.1	29.1	45.9	28.4
40	15	189.1	31.1	164.2	29.1	141.3	27.3	122.3	25.8	105.9	24.5
40	18	166.3	32.3	144.4	30.6	124.2	29.0	107.6	27.6	93.1	26.4
40	20	151.0	33.1	131.1	31.5	112.8	30.0	97.7	28.8	84.6	27.7
40	22	135.7	33.9	117.9	32.4	101.4	31.1	87.8	30.0	76.0	29.0
40	24	120.4	34.7	104.6	33.4	90.0	32.2	77.9	31.2	67.4	30.3
45	15	227.2	34.0	197.2	31.7	169.7	29.6	147.0	27.8	127.2	26.2
45	18	204.3	35.2	177.4	33.2	152.7	31.2	132.2	29.6	114.4	28.2
45	20	189.1	36.1	164.2	34.1	141.3	32.3	122.3	30.8	105.9	29.5
45	22	173.9	36.9	151.0	35.1	129.9	33.4	112.5	32.0	97.4	30.8
45	24	158.6	37.7	137.7	36.0	118.5	34.5	102.6	33.2	88.8	32.1
50	15	265.2	36.8	230.3	34.2	198.1	31.7	171.6	29.7	148.5	27.9
50	18	242.4	38.1	210.5	35.7	181.1	33.4	156.8	31.5	135.7	29.9
50	20	227.2	39.0	197.2	36.7	169.7	34.6	147.0	32.8	127.2	31.2
50	22	212.0	39.8	184.0	37.7	158.3	35.7	137.1	34.0	118.7	32.5
50	24	196.7	40.6	170.8	38.6	147.0	36.8	127.3	35.2	110.2	33.8
55	15	303.2	39.7	263.3	36.7	226.5	33.9	196.1	31.6	169.8	29.6
55	18	280.4	41.0	243.5	38.2	209.5	35.6	181.4	33.5	157.0	31.6
55	20	265.2	41.8	230.3	39.2	198.1	36.7	171.6	34.7	148.5	32.9
55	22	250.0	42.7	217.1	40.2	186.8	37.9	161.7	35.9	140.0	34.2
55	24	234.8	43.5	203.8	41.2	175.4	39.0	151.9	37.2	131.5	35.5

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicClip and BasicGrip heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.00 (e.g. tiles).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Cement screed

Mean heating water temperature	Room temperature	C-C 10 Cement screed	Surface temperature	C-C 15 Cement screed	Surface temperature	C-C 20 Cement screed	Surface temperature	C-C 25 Cement screed	Surface temperature	C-C 30 Cement screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	96.4	23.7	84.2	22.7	73.6	21.8	63.9	21.0	55.7	20.3
30	18	76.7	25.1	67.0	24.3	58.5	23.5	50.8	22.9	44.3	22.3
30	20	63.5	26.0	55.5	25.3	48.5	24.7	42.1	24.1	36.7	23.6
30	22	50.1	26.8	43.8	26.3	38.3	25.8	33.2	25.3	29.0	24.9
30	24	36.5	27.6	31.9	27.2	27.9	26.8	24.2	26.5	21.1	26.2
35	15	129.0	26.3	112.7	25.0	98.5	23.9	85.6	22.8	74.6	21.9
35	18	109.4	27.8	95.6	26.6	83.5	25.6	72.6	24.7	63.3	23.9
35	20	96.4	28.7	84.2	27.7	73.6	26.8	63.9	26.0	55.7	25.3
35	22	83.3	29.6	72.8	28.7	63.5	28.0	55.2	27.2	48.1	26.6
35	24	70.1	30.5	61.2	29.8	53.5	29.1	46.5	28.5	40.5	28.0
40	15	161.6	28.9	141.2	27.3	123.3	25.9	107.1	24.6	93.4	23.5
40	18	142.1	30.4	124.1	29.0	108.4	27.7	94.2	26.5	82.1	25.5
40	20	129.0	31.3	112.7	30.0	98.5	28.9	85.6	27.8	74.6	26.9
40	22	116.0	32.3	101.3	31.1	88.5	30.1	76.9	29.1	67.1	28.3
40	24	102.9	33.2	89.9	32.2	78.6	31.2	68.2	30.4	59.5	29.6
45	15	194.1	31.4	169.6	29.5	148.2	27.9	128.7	26.3	112.2	25.0
45	18	174.6	32.9	152.6	31.2	133.3	29.7	115.8	28.3	101.0	27.1
45	20	161.6	33.9	141.2	32.3	123.3	30.9	107.1	29.6	93.4	28.5
45	22	148.6	34.9	129.8	33.4	113.4	32.1	98.5	30.9	85.9	29.8
45	24	135.5	35.9	118.4	34.5	103.5	33.3	89.9	32.2	78.4	31.2
50	15	226.6	33.9	198.0	31.7	173.0	29.8	150.2	28.0	131.0	26.5
50	18	207.1	35.4	181.0	33.4	158.1	31.6	137.3	30.0	119.8	28.6
50	20	194.1	36.4	169.6	34.5	148.2	32.9	128.7	31.3	112.2	30.0
50	22	181.1	37.4	158.3	35.7	138.2	34.1	120.1	32.6	104.7	31.4
50	24	168.1	38.4	146.9	36.8	128.3	35.3	111.5	33.9	97.2	32.8
55	15	259.1	36.4	226.4	33.9	197.7	31.7	171.8	29.7	149.8	28.0
55	18	239.6	37.9	209.4	35.6	182.9	33.6	158.9	31.7	138.5	30.1
55	20	226.6	38.9	198.0	36.7	173.0	34.8	150.2	33.0	131.0	31.5
55	22	213.6	39.9	186.7	37.9	163.0	36.0	141.6	34.3	123.5	32.9
55	24	200.6	40.9	175.3	39.0	153.1	37.3	133.0	35.7	116.0	34.3

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicClip and BasicGrip heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.05 (e.g. engineered timber floor / synthetic fibre).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Liquid screed

Mean heating water temperature	Room temperature	C-C 10 Liquid screed	Surface temperature	C-C 15 Liquid screed	Surface temperature	C-C 20 Liquid screed	Surface temperature	C-C 25 Liquid screed	Surface temperature	C-C 30 Liquid screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	79.5	22.3	70.8	21.6	62.3	20.8	55.0	20.2	48.7	19.7
30	18	63.3	23.9	56.4	23.3	49.5	22.8	43.8	22.2	38.8	21.8
30	20	52.4	25.0	46.6	24.5	41.0	24.0	36.2	23.6	32.1	23.2
30	22	41.4	26.0	36.9	25.6	32.4	25.2	28.6	24.9	25.4	24.6
30	24	30.1	27.0	26.9	26.7	23.6	26.4	20.8	26.2	18.5	25.9
35	15	106.4	24.5	94.8	23.6	83.4	22.6	73.6	21.8	65.3	21.1
35	18	90.3	26.2	80.4	25.4	70.7	24.6	62.4	23.9	55.4	23.3
35	20	79.5	27.3	70.8	26.6	62.3	25.8	55.0	25.2	48.7	24.7
35	22	68.7	28.4	61.2	27.8	53.8	27.1	47.5	26.6	42.1	26.1
35	24	57.8	29.5	51.5	28.9	45.3	28.4	40.0	27.9	35.4	27.5
40	15	133.3	26.7	118.8	25.5	104.4	24.4	92.2	23.4	81.7	22.5
40	18	117.2	28.4	104.4	27.4	91.8	26.3	81.0	25.4	71.8	24.7
40	20	106.4	29.5	94.8	28.6	83.4	27.6	73.6	26.8	65.3	26.1
40	22	95.7	30.6	85.2	29.8	74.9	28.9	66.2	28.2	58.7	27.5
40	24	84.9	31.8	75.6	31.0	66.5	30.2	58.7	29.5	52.1	29.0
45	15	160.1	28.8	142.6	27.4	125.4	26.1	110.7	24.9	98.2	23.8
45	18	144.0	30.5	128.3	29.3	112.8	28.0	99.6	27.0	88.3	26.0
45	20	133.3	31.7	118.8	30.5	104.4	29.4	92.2	28.4	81.7	27.5
45	22	122.6	32.8	109.2	31.7	96.0	30.7	84.8	29.7	75.1	28.9
45	24	111.8	34.0	99.6	33.0	87.6	32.0	77.3	31.1	68.6	30.4
50	15	186.9	30.9	166.5	29.3	146.4	27.7	129.3	26.4	114.6	25.2
50	18	170.9	32.6	152.2	31.2	133.8	29.7	118.2	28.5	104.7	27.4
50	20	160.1	33.8	142.6	32.4	125.4	31.1	110.7	29.9	98.2	28.8
50	22	149.4	35.0	133.1	33.7	117.0	32.4	103.3	31.3	91.6	30.3
50	24	138.7	36.1	123.5	34.9	108.6	33.7	95.9	32.7	85.0	31.8
55	15	213.7	32.9	190.4	31.2	167.4	29.4	147.8	27.8	131.0	26.5
55	18	197.6	34.7	176.1	33.0	154.8	31.4	136.7	30.0	121.2	28.7
55	20	186.9	35.9	166.5	34.3	146.4	32.7	129.3	31.4	114.6	30.2
55	22	176.2	37.1	157.0	35.6	138.0	34.1	121.9	32.8	108.0	31.7
55	24	165.5	34.2	147.4	32.8	129.6	35.4	114.5	34.2	101.5	33.1

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicClip and BasicGrip heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.05 (e.g. engineered timber floor / synthetic fibre).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Cement screed

Mean heating water temperature	Room temperature	C-C 10 Cement screed	Surface temperature	C-C 15 Cement screed	Surface temperature	C-C 20 Cement screed	Surface temperature	C-C 25 Cement screed	Surface temperature	C-C 30 Cement screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	70.4	21.5	63.0	20.9	56.2	20.3	49.9	19.8	44.4	19.3
30	18	56.0	23.3	50.1	22.8	44.7	22.3	39.7	21.9	35.4	21.5
30	20	46.4	24.5	41.5	24.0	37.0	23.6	32.9	23.3	29.3	22.9
30	22	36.7	25.6	32.8	25.3	29.2	24.9	26.0	24.6	23.1	24.4
30	24	26.7	26.7	23.9	26.4	21.3	26.2	18.9	26.0	16.8	25.8
35	15	94.3	23.5	84.4	22.7	75.2	21.9	66.8	21.2	59.5	20.6
35	18	80.0	25.3	71.6	24.6	63.8	24.0	56.7	23.4	50.5	22.8
35	20	70.4	26.5	63.0	25.9	56.2	25.3	49.9	24.8	44.4	24.3
35	22	60.9	27.7	54.4	27.2	48.5	26.7	43.1	26.2	38.4	25.8
35	24	51.2	28.9	45.8	28.4	40.9	28.0	36.3	27.6	32.3	27.2
40	15	118.1	25.5	105.7	24.5	94.2	23.5	83.7	22.7	74.5	21.9
40	18	103.8	27.3	92.9	26.4	82.8	25.6	73.6	24.8	65.5	24.1
40	20	94.3	28.5	84.4	27.7	75.2	26.9	66.8	26.2	59.5	25.6
40	22	84.8	29.7	75.8	29.0	67.6	28.3	60.1	27.7	53.5	27.1
40	24	75.2	30.9	67.3	30.3	60.0	29.7	53.3	29.1	47.4	28.6
45	15	141.9	27.4	126.9	26.2	113.1	25.1	100.6	24.0	89.5	23.1
45	18	127.6	29.2	114.2	28.1	101.8	27.1	90.5	26.2	80.5	25.4
45	20	118.1	30.5	105.7	29.5	94.2	28.5	83.7	27.7	74.5	26.9
45	22	108.6	31.7	97.2	30.8	86.6	29.9	77.0	29.1	68.5	28.4
45	24	99.1	32.9	88.6	32.1	79.0	31.3	70.2	30.5	62.5	29.9
50	15	165.6	29.2	148.2	27.9	132.1	26.6	117.4	25.4	104.5	24.4
50	18	151.4	31.1	135.4	29.9	120.7	28.7	107.3	27.6	95.5	26.6
50	20	141.9	32.4	126.9	31.2	113.1	30.1	100.6	29.0	89.5	28.1
50	22	132.4	33.6	118.4	32.5	105.6	31.5	93.8	30.5	83.5	29.6
50	24	122.9	34.8	109.9	33.8	98.0	32.8	87.1	31.9	77.5	31.1
55	15	189.4	31.1	169.4	29.5	151.0	28.1	134.2	26.8	119.4	25.6
55	18	175.1	33.0	156.7	31.5	139.6	30.2	124.1	29.0	110.5	27.8
55	20	165.6	34.2	148.2	32.9	132.1	31.6	117.4	30.4	104.5	29.4
55	22	156.1	35.5	139.7	34.2	124.5	33.0	110.7	31.9	98.5	30.9
55	24	146.6	32.7	131.2	31.5	116.9	34.4	103.9	33.3	92.5	32.4

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicClip and BasicGrip heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.10 (e.g. carpet).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Liquid screed

Mean heating water temperature	Room temperature	C-C 10 Liquid screed	Surface temperature	C-C 15 Liquid screed	Surface temperature	C-C 20 Liquid screed	Surface temperature	C-C 25 Liquid screed	Surface temperature	C-C 30 Liquid screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	61.3	20.8	55.6	20.3	49.8	19.8	44.9	19.3	40.6	19.0
30	18	48.8	22.7	44.2	22.3	39.6	21.9	35.7	21.5	32.3	21.2
30	20	40.4	23.9	36.6	23.6	32.8	23.3	29.6	23.0	26.7	22.7
30	22	31.9	25.2	28.9	24.9	25.9	24.6	23.4	24.4	21.1	24.2
30	24	23.2	26.4	21.1	26.2	18.9	26.0	17.0	25.8	15.4	25.6
35	15	82.1	22.5	74.4	21.9	66.6	21.2	60.1	20.7	54.3	20.2
35	18	69.6	24.5	63.1	23.9	56.5	23.4	51.0	22.9	46.1	22.4
35	20	61.3	25.8	55.6	25.3	49.8	24.8	44.9	24.3	40.6	24.0
35	22	53.0	27.0	48.0	26.6	43.0	26.2	38.8	25.8	35.0	25.5
35	24	44.6	28.3	40.4	28.0	36.2	27.6	32.6	27.3	29.5	27.0
40	15	102.8	24.2	93.2	23.4	83.5	22.6	75.2	21.9	68.0	21.3
40	18	90.4	26.2	81.9	25.5	73.4	24.8	66.2	24.2	59.8	23.6
40	20	82.1	27.5	74.4	26.9	66.6	26.2	60.1	25.7	54.3	25.2
40	22	73.8	28.8	66.9	28.2	59.9	27.6	54.0	27.1	48.8	26.7
40	24	65.5	30.1	59.4	29.6	53.2	29.1	47.9	28.6	43.3	28.2
45	15	123.5	25.9	112.0	25.0	100.3	24.0	90.4	23.2	81.7	22.5
45	18	111.1	27.9	100.7	27.1	90.2	26.2	81.3	25.5	73.5	24.8
45	20	102.8	29.2	93.2	28.4	83.5	27.6	75.2	26.9	68.0	26.3
45	22	94.5	30.5	85.7	29.8	76.7	29.1	69.2	28.4	62.5	27.9
45	24	86.2	31.9	78.2	31.2	70.0	30.5	63.1	29.9	57.1	29.4
50	15	144.1	27.5	130.7	26.5	117.1	25.4	105.5	24.4	95.4	23.6
50	18	131.7	29.6	119.5	28.6	107.0	27.6	96.4	26.7	87.2	25.9
50	20	123.5	30.9	112.0	30.0	100.3	29.0	90.4	28.2	81.7	27.5
50	22	115.2	32.2	104.5	31.4	93.6	30.5	84.3	29.7	76.2	29.0
50	24	106.9	33.6	97.0	32.7	86.8	31.9	78.3	31.2	70.8	30.6
55	15	164.8	29.2	149.4	28.0	133.8	26.7	120.6	25.7	109.1	24.7
55	18	152.4	31.2	138.2	30.1	123.8	28.9	111.6	27.9	100.9	27.1
55	20	144.1	32.5	130.7	31.5	117.1	30.4	105.5	29.4	95.4	28.6
55	22	135.9	33.9	123.2	32.9	110.3	31.8	99.5	31.0	89.9	30.2
55	24	127.6	35.2	115.7	34.3	103.6	33.3	93.4	32.5	84.4	31.7

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicClip and BasicGrip heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.10 (e.g. carpet).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Cement screed

Mean heating water temperature	Room temperature	C-C 10 Cement screed	Surface temperature	C-C 15 Cement screed	Surface temperature	C-C 20 Cement screed	Surface temperature	C-C 25 Cement screed	Surface temperature	C-C 30 Cement screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	55.7	20.3	50.7	19.9	46.1	19.4	41.8	19.1	37.7	18.7
30	18	44.3	22.3	40.4	21.9	36.7	21.6	33.2	21.3	30.0	21.0
30	20	36.7	23.6	33.4	23.3	30.3	23.0	27.5	22.8	24.9	22.5
30	22	29.0	24.9	26.4	24.7	24.0	24.5	21.7	24.2	19.6	24.0
30	24	21.1	26.2	19.2	26.0	17.5	25.8	15.8	25.7	14.3	25.5
35	15	74.5	21.9	67.9	21.3	61.7	20.8	55.9	20.3	50.5	19.8
35	18	63.2	23.9	57.6	23.4	52.3	23.0	47.4	22.6	42.9	22.2
35	20	55.7	25.3	50.7	24.9	46.1	24.4	41.8	24.1	37.7	23.7
35	22	48.1	26.6	43.8	26.2	39.8	25.9	36.1	25.6	32.6	25.2
35	24	40.5	28.0	36.9	27.6	33.5	27.3	30.4	27.0	27.5	26.8
40	15	93.3	23.4	85.0	22.8	77.2	22.1	70.0	21.5	63.3	20.9
40	18	82.0	25.5	74.8	24.9	67.9	24.3	61.6	23.8	55.6	23.3
40	20	74.5	26.9	67.9	26.3	61.7	25.8	55.9	25.3	50.5	24.8
40	22	67.0	28.2	61.0	27.7	55.4	27.3	50.3	26.8	45.4	26.4
40	24	59.4	29.6	54.2	29.2	49.2	28.7	44.6	28.3	40.3	27.9
45	15	112.1	25.0	102.2	24.2	92.8	23.4	84.1	22.7	76.0	22.0
45	18	100.8	27.1	91.9	26.3	83.5	25.6	75.7	25.0	68.4	24.4
45	20	93.3	28.4	85.0	27.8	77.2	27.1	70.0	26.5	63.3	25.9
45	22	85.8	29.8	78.2	29.2	71.0	28.6	64.4	28.0	58.2	27.5
45	24	78.3	31.2	71.3	30.6	64.8	30.1	58.7	29.5	53.1	29.1
50	15	130.9	26.5	119.3	25.6	108.3	24.7	98.2	23.8	88.7	23.1
50	18	119.6	28.6	109.0	27.7	99.0	26.9	89.7	26.2	81.1	25.4
50	20	112.1	30.0	102.2	29.2	92.8	28.4	84.1	27.7	76.0	27.0
50	22	104.6	31.4	95.3	30.6	86.6	29.9	78.5	29.2	70.9	28.6
50	24	97.1	32.8	88.5	32.0	80.4	31.4	72.8	30.7	65.8	30.2
55	15	149.6	28.0	136.3	26.9	123.8	25.9	112.3	25.0	101.5	24.1
55	18	138.4	30.1	126.1	29.1	114.5	28.2	103.8	27.3	93.8	26.5
55	20	130.9	31.5	119.3	30.6	108.3	29.7	98.2	28.8	88.7	28.1
55	22	123.3	32.9	112.4	32.0	102.1	31.2	92.6	30.4	83.7	29.7
55	24	115.8	34.3	105.6	33.5	95.9	32.7	86.9	31.9	78.6	31.2

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicClip and BasicGrip heating systems

Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.15 (e.g. terry velvet / engineered timber, solid timber planks).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Liquid screed

Mean heating water temperature	Room temperature	C-C 10 Liquid screed	Surface temperature	C-C 15 Liquid screed	Surface temperature	C-C 20 Liquid screed	Surface temperature	C-C 25 Liquid screed	Surface temperature	C-C 30 Liquid screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	50.0	19.8	46.0	19.4	41.9	19.1	38.2	18.8	35.1	18.5
30	18	39.8	21.9	36.6	21.6	33.3	21.3	30.4	21.0	27.9	20.8
30	20	32.9	23.3	30.3	23.0	27.6	22.8	25.2	22.6	23.1	22.4
30	22	26.0	24.6	23.9	24.5	21.8	24.3	19.9	24.1	18.2	23.9
30	24	19.0	26.0	17.4	25.8	15.9	25.7	14.5	25.6	13.3	25.4
35	15	66.9	21.2	61.6	20.8	56.1	20.3	51.1	19.9	47.0	19.5
35	18	56.8	23.4	52.2	23.0	47.6	22.6	43.4	22.2	39.8	21.9
35	20	50.0	24.8	46.0	24.4	41.9	24.1	38.2	23.8	35.1	23.5
35	22	43.2	26.2	39.7	25.9	36.2	25.6	33.0	25.3	30.3	25.0
35	24	36.4	27.6	33.4	27.3	30.5	27.1	27.8	26.8	25.5	26.6
40	15	83.8	22.7	77.1	22.1	70.3	21.5	64.0	21.0	58.8	20.6
40	18	73.7	24.8	67.8	24.3	61.8	23.8	56.3	23.3	51.7	22.9
40	20	66.9	26.2	61.6	25.8	56.1	25.3	51.1	24.9	47.0	24.5
40	22	60.2	27.7	55.3	27.3	50.4	26.8	46.0	26.4	42.2	26.1
40	24	53.4	29.1	49.1	28.7	44.8	28.3	40.8	28.0	37.5	27.7
45	15	100.7	24.1	92.6	23.4	84.4	22.7	76.9	22.1	70.6	21.6
45	18	90.6	26.2	83.3	25.6	75.9	25.0	69.2	24.4	63.5	24.0
45	20	83.8	27.7	77.1	27.1	70.3	26.5	64.0	26.0	58.8	25.6
45	22	77.1	29.1	70.9	28.6	64.6	28.0	58.9	27.6	54.1	27.1
45	24	70.3	30.5	64.7	30.1	58.9	29.6	53.7	29.1	49.3	28.7
50	15	117.5	25.4	108.1	24.7	98.5	23.9	89.8	23.2	82.5	22.6
50	18	107.4	27.6	98.8	26.9	90.1	26.2	82.1	25.5	75.4	25.0
50	20	100.7	29.1	92.6	28.4	84.4	27.7	76.9	27.1	70.6	26.6
50	22	93.9	30.5	86.4	29.9	78.7	29.2	71.8	28.7	65.9	28.2
50	24	87.2	31.9	80.2	31.4	73.1	30.8	66.6	30.2	61.2	29.8
55	15	134.4	26.8	123.6	25.9	112.7	25.0	102.7	24.2	94.3	23.5
55	18	124.3	29.0	114.3	28.2	104.2	27.3	94.9	26.6	87.2	25.9
55	20	117.5	30.4	108.1	29.7	98.5	28.9	89.8	28.2	82.5	27.6
55	22	110.8	31.9	101.9	31.2	92.9	30.4	84.6	29.7	77.7	29.2
55	24	104.1	33.3	95.7	32.6	103.6	33.3	93.4	32.5	84.4	31.7

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C

Output table, BasicClip and BasicGrip heating systems

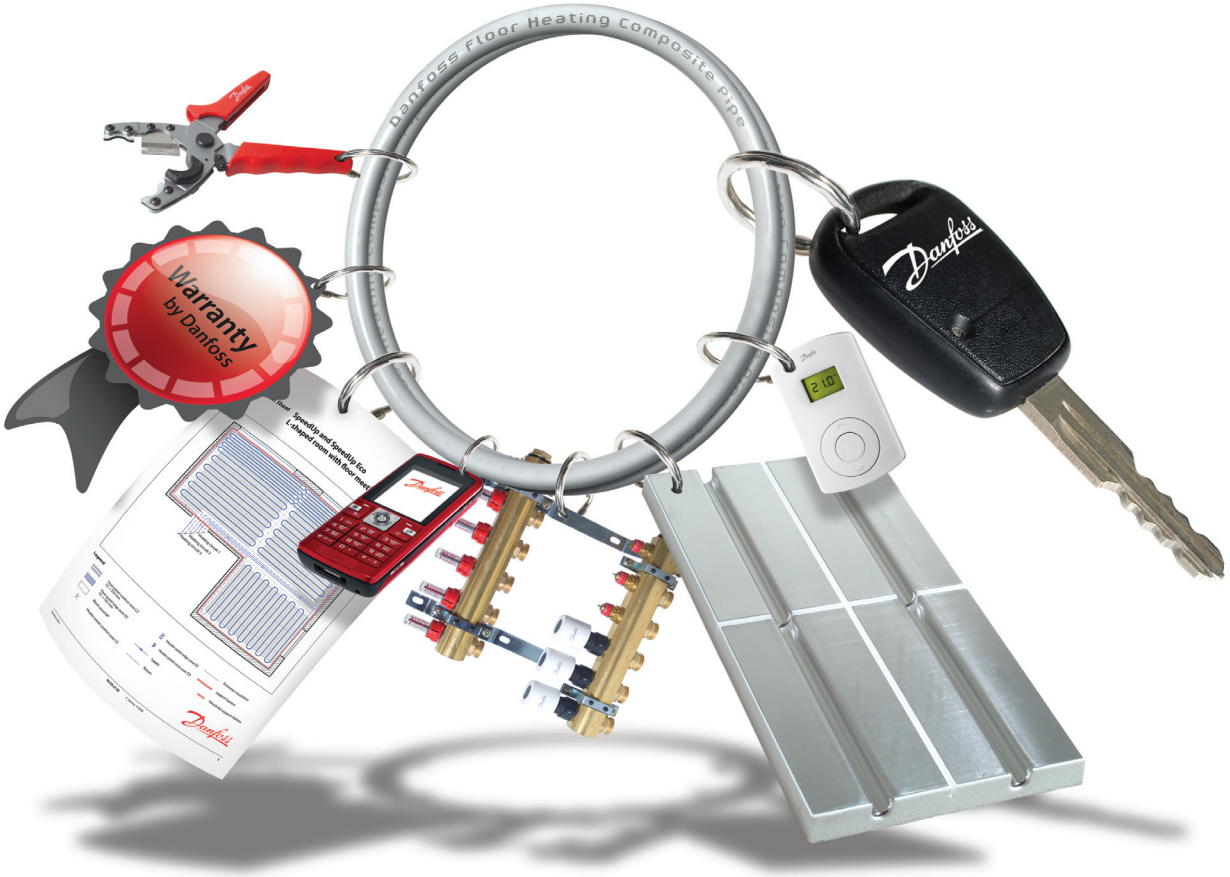
Thermal resistance of the finished floor covering: $R_{\lambda,B}$ m² K/W 0.15 (e.g. terry velvet / engineered timber, solid timber planks).

Differential temperature (σ K) 5.
Heat output on the basis of EN 1264.

Cement screed

Mean heating water temperature	Room temperature	C-C 10 Cement screed	Surface temperature	C-C 15 Cement screed	Surface temperature	C-C 20 Cement screed	Surface temperature	C-C 25 Cement screed	Surface temperature	C-C 30 Cement screed	Surface temperature
θ_m	θ_i		θ_F		θ_F		θ_F		θ_F		θ_F
°C	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C	W/m²	°C
30	15	46.0	19.4	42.5	19.1	39.1	18.8	35.8	18.5	33.0	18.3
30	18	36.6	21.6	33.8	21.4	31.1	21.1	28.5	20.9	26.3	20.7
30	20	30.3	23.0	28.0	22.8	25.7	22.6	23.6	22.4	21.7	22.2
30	22	23.9	24.5	22.1	24.3	20.3	24.1	18.6	24.0	17.2	23.8
30	24	17.4	25.8	16.1	25.7	14.8	25.6	13.6	25.5	12.5	25.4
35	15	61.6	20.8	56.9	20.4	52.3	20.0	47.9	19.6	44.2	19.3
35	18	52.2	23.0	48.2	22.6	44.4	22.3	40.7	22.0	37.5	21.7
35	20	46.0	24.4	42.5	24.1	39.1	23.8	35.8	23.5	33.0	23.3
35	22	39.7	25.9	36.7	25.6	33.8	25.4	30.9	25.1	28.5	24.9
35	24	33.5	27.3	30.9	27.1	28.4	26.9	26.0	26.6	24.0	26.5
40	15	77.1	22.1	71.2	21.6	65.5	21.1	60.0	20.7	55.3	20.3
40	18	67.8	24.3	62.6	23.9	57.6	23.5	52.8	23.0	48.6	22.7
40	20	61.6	25.8	56.9	25.4	52.3	25.0	47.9	24.6	44.2	24.3
40	22	55.3	27.3	51.1	26.9	47.0	26.5	43.1	26.2	39.7	25.9
40	24	49.1	28.7	45.4	28.4	41.7	28.1	38.2	27.8	35.2	27.5
45	15	92.6	23.4	85.5	22.8	78.7	22.2	72.1	21.7	66.4	21.2
45	18	83.3	25.6	76.9	25.1	70.8	24.6	64.9	24.1	59.8	23.6
45	20	77.1	27.1	71.2	26.6	65.5	26.1	60.0	25.7	55.3	25.3
45	22	70.9	28.6	65.5	28.1	60.3	27.7	55.2	27.2	50.9	26.9
45	24	64.7	30.1	59.7	29.6	55.0	29.2	50.4	28.8	46.4	28.5
50	15	108.1	24.7	99.9	24.0	91.9	23.3	84.2	22.7	77.6	22.1
50	18	98.8	26.9	91.3	26.3	84.0	25.7	77.0	25.1	70.9	24.6
50	20	92.6	28.4	85.5	27.8	78.7	27.2	72.1	26.7	66.4	26.2
50	22	86.4	29.9	79.8	29.3	73.4	28.8	67.3	28.3	62.0	27.8
50	24	80.2	31.4	74.1	30.8	68.2	30.4	62.5	29.9	57.5	29.4
55	15	123.6	25.9	114.2	25.1	105.1	24.4	96.3	23.7	88.7	23.1
55	18	114.3	28.2	105.6	27.5	97.2	26.8	89.0	26.1	82.0	25.5
55	20	108.1	29.7	99.9	29.0	91.9	28.3	84.2	27.7	77.6	27.1
55	22	101.9	31.2	94.1	30.5	86.6	29.9	79.4	29.3	73.1	28.8
55	24	95.7	32.6	88.4	32.0	81.4	31.5	74.5	30.9	68.7	30.4

Maximum floor surface temperature in accordance with EN 1264:		
	Edge Zone 1.00 m	35 °C
	Comfort Zone	29 °C
	Bathrooms	33 °C



Your Key to Optimum Floor Heating

Floor heating is much more than pipes! The optimum floor heating solution provides accurate temperature control, instant heat, comfort and energy efficiency. Danfoss will provide you with optimum floor heating solutions.

The Danfoss solutions rank among the best and the most advanced in the world; combining years of experience with development and technical know-how. We provide floor heating solutions which are both quickly and easily installed for you.

Our wide range of products and our technical expertise make Danfoss your one-stop provider, saving you both time and worries. And the more time you save on installation and servicing, the more time you have to optimise your business opportunities.