DEVI™
Member of the Danfoss Group

Thin Embedded Floor Heating under All Floorings
Application Sheet

Intelligent heating

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Application Briefing

When floors in flats, houses, basements or patios are renovated, floor heating can be added without breaking up the old floor. The comfort is provided by either a Deviflex™ cable system or a Devimat™ system, which is embedded on top of the old floor or subfloor.

The freedom in design and choice of flooring makes it applicable in almost any existing room
- Bathrooms, kitchens
- Halls, utility rooms, basements
- Bed rooms etc.

The system can in most cases cover the room heating 100% which means e.g. old radiators can be removed and you can utilize more space for a shower, cupboard or just living.
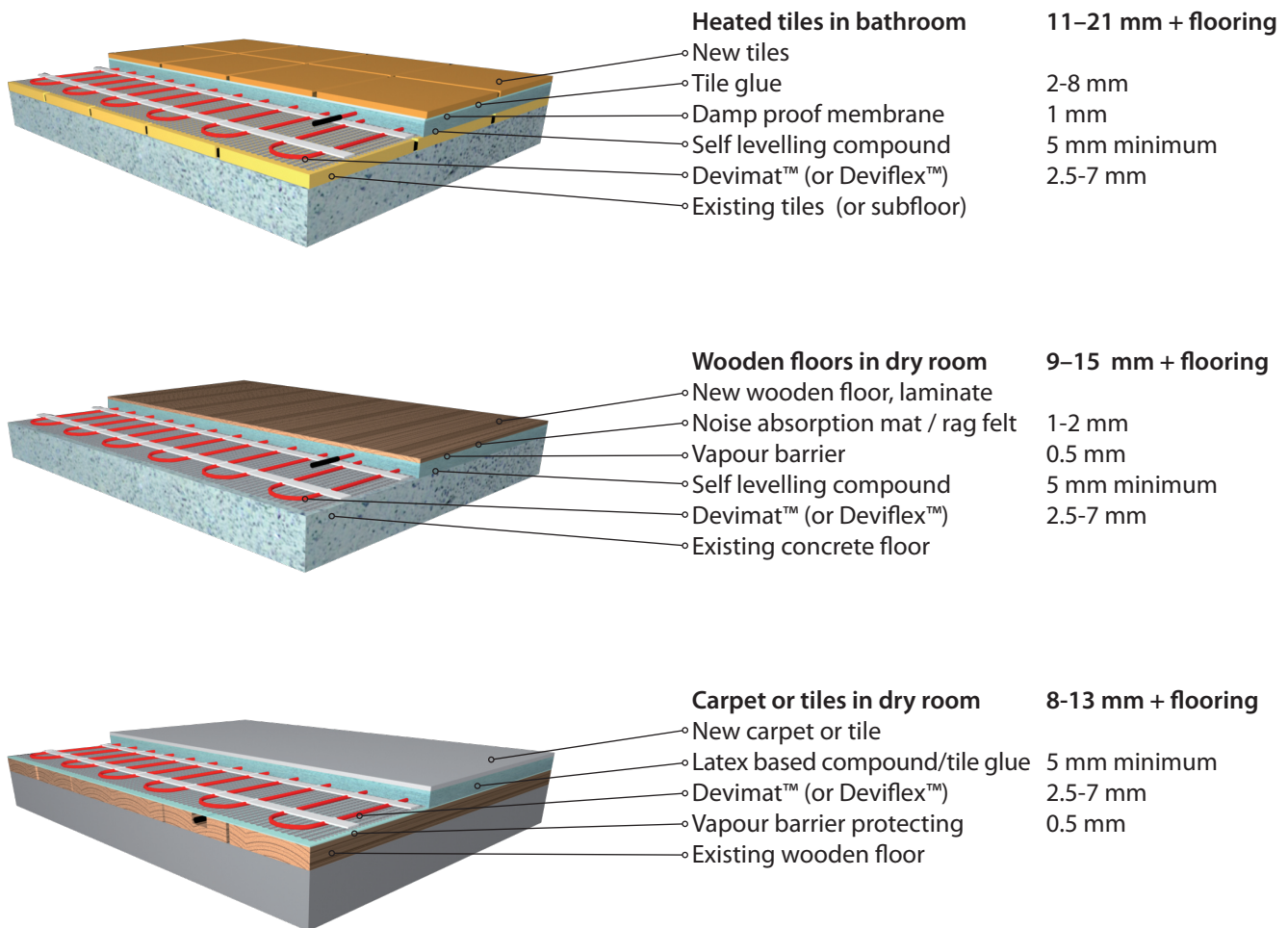

Opportunities
Warm feet
No break up of the old floor
Freedom of design
Under any top flooring

Installation
Building height from 8 mm + flooring
Strong adhesive Devimat™
Flexible installation with Deviflex™

Performance
Quick responding floor heat
Reduce heat loss with insulation
Save up to 12% with timer thermostat
10-years system warranty

Heated tiles in bathroom	**11–21 mm + flooring**
New tiles	
Tile glue	2-8 mm
Damp proof membrane	1 mm
Self levelling compound	5 mm minimum
Devimat™ (or Deviflex™)	2.5-7 mm
Existing tiles (or subfloor)	

Wooden floors in dry room	**9–15 mm + flooring**
New wooden floor, laminate	
Noise absorption mat / rag felt	1-2 mm
Vapour barrier	0.5 mm
Self levelling compound	5 mm minimum
Devimat™ (or Deviflex™)	2.5-7 mm
Existing concrete floor	

Carpet or tiles in dry room	**8-13 mm + flooring**
New carpet or tile	
Latex based compound/tile glue	5 mm minimum
Devimat™ (or Deviflex™)	2.5-7 mm
Vapour barrier protecting	0.5 mm
Existing wooden floor	

Other combinations of top flooring and existing floor construction are also optional.

Additional insulation (tilebacker boards) can be applied between existing subfloor and heating mat/cable

- if made of polystyrene (XPS) with high compressive strength >300 kN/m^2
- if concrete or foil faced
- if installed as prescribed by the manufacturer
- if floor sensor is installed above insulation
- if cables are <11 W/m and mats <150 W/m^2

Product Selection

Product	Options	Description
Devimat™ DIN IEC 60335-2-96	DTIF-100, DTIF-150, DTIF-200* DTIR-100, DTIR-150 DSVF-100, DSVF-150	Twin conductor mat, Ø3.5 mm, PVC-free Twin conductor mat, Ø4 mm Single conductor mat, Ø2.5 mm, PVC-free
Deviflex™ DIN IEC 60800	DTIR-10 DTIP-6, DTIP-10 DSIG-6, DSIG-10	Twin conductor cable, Ø4 mm Twin conductor cable, Ø7,5 mm Single conductor cable, Ø5.5 mm
Thermostats	Devilink™ CC and FT/RS Devireg™ 550 Devireg™ 535*	Wireless control system, IP31 Advanced timer thermostat, IP21 Simple timer thermostat, IP31
Sensor	NTC floor sensor cable Room sensor	Included in the Devireg™ / Devilink™ FT Built in the Devireg™ / Devilink™ RS
Accessories	Mounting set for sensor Devifast™ Deviclip™ C-C	Included in the Devimat™ Galvanised steel, C-C steps 2.5 cm. 3 m per m² PP, C-C steps 1 cm, 3 m per m²
Other	Insulation (tilebacker board) Tile adhesive or Self-levelling compound Vapour barrier or Damp proof membrane Noise absorption mat or rag felt Top flooring	XPS with compressive strength >300 kN/m² Latex based on wooden sub floors Latex based on wooden sub floors To protect wood from vapour To protect cables in wet rooms

* DTIF-200 must be installed with Devireg 130M, Devireg 530M or Devireg 535.

Maximum heat densities

The installed heat density must
- cover the room heat loss but
- be limited, with respect to the sub-floor and top flooring and
- be limited, with respect to the power supply available

Subfloor			Flooring		
Wood	**XPS**	**Concrete or Tiles**	**Tiles**	**Wood or Laminate**	**Carpet**
W/m²	W/m²	W/m²	W/m²	W/m²	W/m²
100	100	100	100	100	100
	150	150	150		
		200	200		

Example

Old, 6 m² bathrooms in 45 apartments need to be renovated.
Investor finds it too expensive to break up the old floor.
Possible extra height for new tiles is 30 mm.

A new bath tub is to be added where the old radiator is placed.
Out of 6 m² it is possible to heat a net area of 3.5 m².
Approximate room heat loss is 65 W/m².

For total heating, 1.3 x 6 x 65 = 507 W are required (145 W/m²). Due to the sub floor and new floor, is tiles up to 200 W/m² can be chosen.

DTIF-150, 525W, 0.5 x 7 m, 230V is chosen. The building height is 12 mm + tiles.
2.3A is required at 230V.
Devireg™ 535 is the chosen thermostat, due to IP31 class and timer function.

Optionally, DTIR-10, 500W, 50 m, 230V installed at a C-C distance of 7 cm, giving a building height of 12 mm + tiles. Requires 10,5 m Deviclip™ C-C. Devireg™ 550 can be chosen but outside wet zones.
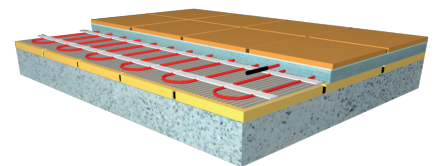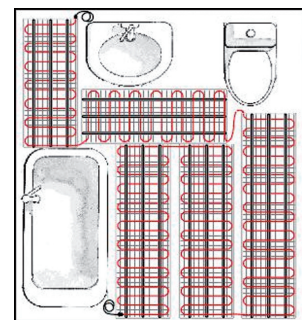
Calculation

The Devimat™ system can be used for
- comfort floor heating, which means additional room heating is required to maintain a stable room temperature all year round.
- total heating of a room if the room is sufficiently insulated; however, this requires a calculation of the actual room heat loss.

The room heat loss q_{room} depends on the degree and the age of the insulation. In new houses, the building contractor can provide these details but in old houses, it is often difficult to find details about how the building is constructed and thus this can be difficult to calculate. In such situations, the present energy consumption can give a rough estimation. This must be multiplied by up to 1.5, depending on where in the house the room is located and the general condition of the room.

$$q_{room} = 1.0...1.5 \cdot \frac{E_{house}}{2 \cdot A_{house}}$$

q_{room}	W/m²	Room heat loss provided by the contractor or calculated
E_{house}	kWh	Total energy consumption for the house
A_{house}	W/m²	Total living area in the house

If the room has obstacles such as fixed cupboards, baths etc, this must be taken into consideration when calculating the actual required heat density q_{heat}.

$$q_{heat} = 1.3 \cdot q_{room} \frac{A_{room}}{A_{heat}}$$

q_{heat}	W/m²	Required heat density incl. 30% safety
A_{room}	m²	Gross room area
A_{heat}	m²	Net free laying area without obstacles.

$$P_{heat} \geq q_{heat} \cdot A_{heat}$$

P_{heat}	W	Power required by cable or mat

The floor heating system may be undersized up to 10% but this means that the floor heating will respond slower.

At 10% shortage, additional heat emitters must be considered to remedy the room's heat loss q_{room}, otherwise the room temperature will decrease 1 degree for every 10 W/m² shortage.

At 25% shortage or more, the heat density provides comfort floor heating only, and supplementary heating is required for sufficient room heating.

Devimat™

$$q_{mat} \geq q_{heat}$$
$$A_{mat} \leq A_{heat}$$

q_{mat}	W/m²	Mat output = 100, 150 or 200 W/m
A_{mat}	m²	Area of mat (see Product Sheets)

Deviflex™

$$P_{heat} = q_{cable} \cdot L_{cable}$$

q_{cable}	W/m	Cable output = 6 or 10 W/m
L_{cable}	m	Length of cable (see Product Sheets)

$$CC = \frac{A_{ground} \cdot 100 \cdot \frac{cm}{m}}{L_{cable}}$$

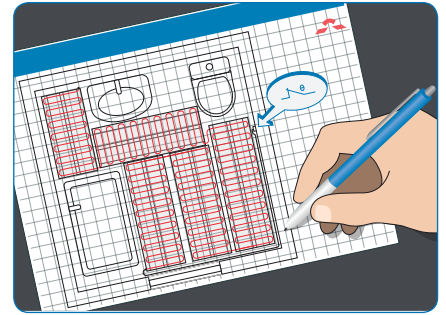|		
C-C	cm	Exact C-C distance between cable lines = 5…10 cm

Installation Summary

Required tools:
• Hammer
• Chisel
• Glue gun
• Scissor
• Installation manuals
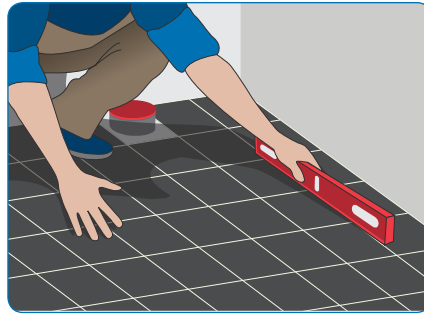
1) Make sure that the sub floor is reasonably level, firm and stable.

2) Draw a plan in order to position cable, cold tail, floor sensor, thermostat and connection box, if any. Avoid all present and future objects fixed to the floor such as toilets, bath tubs etc.
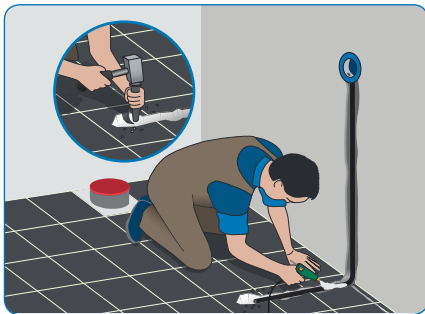
3) Cut out a wall groove and fix cable ducts and connection box. Chisel off a groove for the sensor conduit and cold cable. Fix the sensor conduit e.g. with a glue gun.
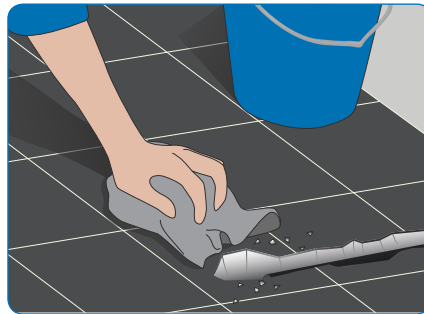
4) Clean the sub floor in order to protect the cable during installation and to ensure the maximum adhesion of the mat.
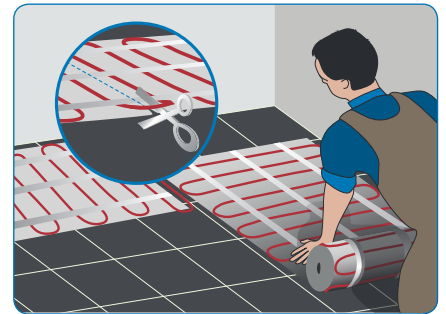
5) Roll out the mat. Cut and turn the mat when meeting walls or obstacles.
DO NOT CUT THE CABLE.
Min 2 cm between any two cable lines.
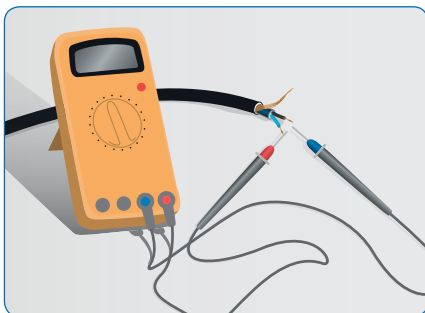
6) Check the insulation resistance and Ohm rating of the heating cables/mats before, during and after installation. Compare the Ohm rating with the nominal, written on the cable/mat label.
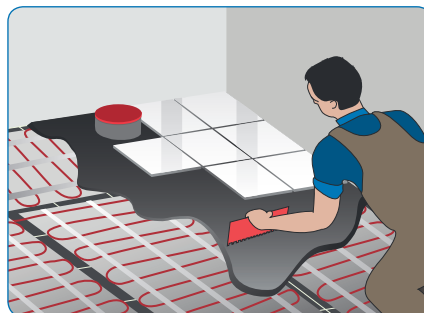
7) Apply flexible self-levelling compound and/or tile glue, depending on the flooring.

In wet rooms: Apply damp proof membrane, if not already installed between self levelling compound and tile glue.

8) Recheck and compare the insulation resistance and Ohm rating for the heating cables and check earth resistance.

Plaster the wall groove and connect the cold tail, sensor and thermostat according to the manual.

Commissioning

9) The Devireg™ thermostat must be commissioned as prescribed in the thermostat manual.

   According to ISO 13732-2, the comfortable floor surface temperature depends on the flooring material.

   However, observe the maximum floor surface temperature according to the flooring manufacturer. For most wooden floor products, the temperature is usually around 27°C.

   All temperature settings must be a few degrees higher to compensate for the heat resistance in the top flooring.

10) Train the end-user or daily supervisor in the operation of the heating system.

11) The floor temperature must be increased slowly during the first week to allow the new floor settle. This is also recommended in the beginning of a heating season.

Concrete floor (tiles)	26 - 28,5°C
Soft wood (pine)	22.5 - 28°C
Hard wood (oak)	24.5 - 28°C
Textiles (rugs, carpets)	21 - 28°C

Thermal resistance [m^2K/W]	Examples of flooring	Details	Approximate setting for 25°C floor temperature
0.02	15 mm tile	Stone or ceramic	26°C
0.05	8 mm HDF based laminate	> 800 kg/m3	28°C
0.10	14 mm beech parquet	650 - 800 kg/m^3	31°C
0.13	22 mm solid oak plank	> 800 kg/m3	32°C
<0.17	Max. carpet thickness suitable for floor heating	acc. to EN 1307	34°C
0.18	22 mm solid fir planks	450 - 650 kg/m^3	35°C

Important

Do not install cables in temperatures below -5 ° C.

The cable/mat may not be in direct contact with insulation materials.

Make sure that the cable/mat and floor sensor is fully embedded.

The sensor must be placed a min. of 2 cm but no more than 10 cm from the nearest heating cable.

Install the floor sensor away from door openings and not under objects.

Do not cut or cross Deviflex™ constant wattage cables.

Do not connect 2 or more mats / cables in series – only in parallel.

Check the insulation resistance and Ohm rating of the heating cables before and after installation.

All electrical connections must be done by authorised persons according to local regulations.

The total insulation value R above heating elements is max. 0.18 m^2K/W (1.8 Tog).

Keep a min. 6 cm air gap beneath permanent objects like desks and beds

Avoid Beech and Maple in multilayered constructions unless press dried.

Follow the prescription of the floor manufacturer when installing the floor finish.

Performance

Insulation
Additional insulation can be applied between existing subfloor and heating mat/cable if the precautions written on page 3 are observed. Applying e.g. 12 mm insulation reduces the downward heat loss.

Floor constructions	R-value [m²K/W] Without / with 12 mm XPS	Reduction of downward heat loss
Ground floor – no insulation	0.17 / 0.43	60%
Ground floor - 100 mm insulation	2.39 / 2.65	10%
Upper floor – no insulation	0.33 / 0.59	44%
Upper floor – 50 mm insulation	1.44 / 1.70	15%

Response Time
The result is a quick responding floor surface temperature, which makes this application ideal for timer thermostats.

Energy Consumption
For short time comfort floor heating ($\tau_{heat} \leq 2$ hrs/day), the approx. annual energy consumption is:

$$e_{heat} = 0.3 \cdot q_{inst} \cdot \tau_{heat}$$

For 100 W/m² and 2-hours daily comfort heating, the approx. annual energy consumption is:

$$e_{heat} = 0.3 \cdot 100 \cdot 2 = 60 \cdot \frac{kWh}{m^2}$$

Approx. response time at 20°C Room temperature
Devimat™ under 10 mm tiles
Installed on upper / ground floors with poor insulation

Legend:
- 200 W/m² on 65 mm concrete subfloor
- 150 W/m² on 65 mm concrete subfloor
- 100 W/m² on wooden subfloor
- 100 W/m² on XP5 tilebacker board

Energy Savings with Timer Thermostat.
The combination of high placed heating mats/cables and optional insulation give a quick responding floor heat and ideal for installation with timer control like Devireg 535, Devireg 550 and Devilink.

Setting back the temperature 4 degrees during night (8 hours) all week and in working hours (6-7 hours) on working days the savings are
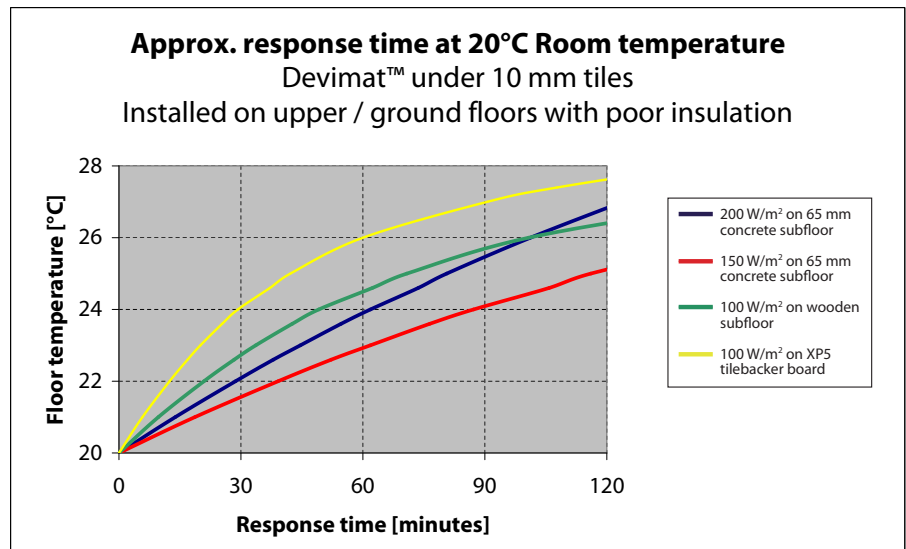
	Floor construction	Energy saving
	No timer thermostat	Reference
A	Embedded under 65 mm concrete slab	3-7%
B	Embedded in 1 cm self-levelling compound and/or tile glue on top of 65 mm concrete	5-10%
C	As B but with tilebacker board applied between existing subfloor and heating mat/cable	9-12%

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