Indoor
Floor Heating Systems

Application guide

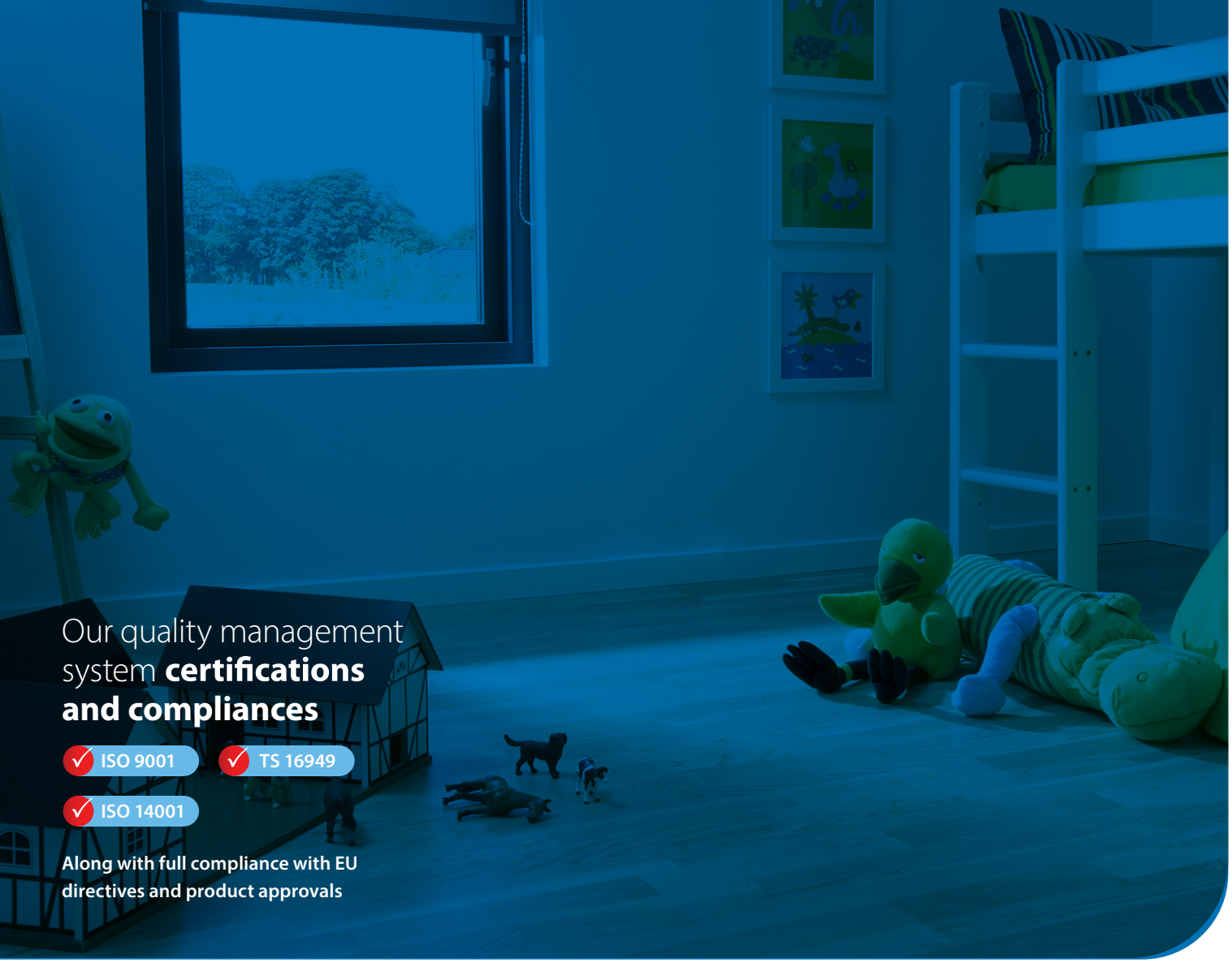
DEVI® by Danfoss

Make it easy,
make it DEVI



Table of contents

1. Application Overview 4
2. System description 6
3. System design 7
3.1 Comfort Floor Heating 7
3.1.1 System description 7
3.1.2 System output 8
3.1.3 Important information 9
3.1.4 Example. Comfort Floor Heating- calculation and selection of equipment 13
3.2 Total (Direct) Heating 15
3.2.1 System description 15
3.2.2 System output 15
3.2.3 Important information 17
3.2.4 Example. Total Heating – calculation and selection of equipment 21
3.3 Combined Floor Heating 24
3.3.1 System description 24
3.3.2 System output 24
3.3.3 Important information 25
3.4 Acceptable floor constrictions and limitations 28
3.4.1 Thick concrete floor constructions 29
3.4.2 Thin floor constructions 31
3.4.3 Wooden floor constructions 33
3.4.4 DEVIcell™ LowCarbon insulation plates for Dry and Wet installations 37
3.5 Tables 39
4. Product selection 45
4.1 Heating cables 45
4.2 Heating mats 46
4.3 Other heating elements 47
4.4 Thermostats 47
4.5 Fixing elements 51
5. Installation process 53
5.1 Installation instructions 53
5.1.1 Installation of heating cables in thick floor constructions 53
5.1.2 Installation of heating mats inside thick floor constructions 55
5.1.3 Installation process in wooden constructions 58
5.1.4 Installation of heating cables in wooden floors on joists 59
5.1.5 Installation of heating cables with DEVIcell™ LowCarbon 61
5.2 Floor sensor installation 65
6. Safety instruction 67
6.1 General safety instructions 67
6.2 DO's 68
6.3 DON'Ts 68
7. Cases 69
8. Technical support 70



Let DEVI do the work

DEVI - an abbreviation of Dansk El-Varme Industri – was established in Copenhagen, Denmark, in 1942. As from January 1st 2003 DEVI has become a part of the Danfoss Group - Denmark's largest industrial Group. Danfoss is one of the world's leading companies within heating, cooling and air-conditioning. The Danfoss Group has more than 23.000 employees and serves customers in more than 100 countries.

DEVI is a European brand offering electrical cable heating systems for residential, commercial, industrial applications and electric pipe heating systems with over 80 years of experience. The production of heating cables takes place in France and Poland while the head office is situated in Denmark.

The value of experience

We have installed literally thousands of systems across the globe, in every conceivable setting. Our experience enables us to provide practical guidance on selecting suitable components for your installation.

Indoor Cable Floor Heating Systems

This design guide presents DEVI's recommendations for design and installation of cable floor heating systems for indoor application. It provides guidance for heating cable positioning, electrical data and system configurations.

Following DEVI's recommendations supports the correct selection and installation of constant wattage heating cables. The cables are supplied with a 20-year warranty, subject to the applicable warranty terms and conditions.

1. Application Overview

Uneven heat distribution and cold floor surfaces

Indoor spaces such as houses, apartments, offices, hotels, and public buildings often face a range of comfort and climate-related challenges. These may include cold floors, uneven room temperatures, condensation, damp areas, poor comfort and mold in bathrooms, and insufficient heating in specific zones. In many cases, conventional heating systems do not provide heat exactly where it is needed, or they react too slowly to changing indoor conditions.

Electric floor heating solutions – with a first class product range

DEVI electric heating elements offer an efficient and flexible way to improve indoor comfort by delivering heat directly to the required area. They can be installed under floor finishes, inside floor constructions, or in selected building zones where additional or primary heating is needed. This makes them especially suitable both for new construction and renovation projects where space, installation height, or design freedom are important.

DEVI electric heating systems are designed for applications where controlled indoor heating and temperature management are required. By providing controlled and evenly distributed heat, they help create a more comfortable indoor environment while reducing common heating-related issues.

Benefits

- **Increased comfort and even heat distribution** in the room
- Flexible **solution for renovations and new builds**
- **Dry floor surface** in bathrooms easier cleaning
- **Free space** for interior design, ability to install big windows from the floor up to ceiling
- **Fast and responsive** heating
- Indoor climate conditions with **lower temperatures**, **higher relative humidity**, and **limited air movement** during operation.
- There are **no radiators**, which are often sources of dust, require cleaning and take up space in the room
- System requires minimal routine maintenance with **20 year full warranty** on cables and heating



Optimal comfort

Heat from the floor is distributed evenly throughout the room. This simple principle explains why a floor heating system provides a higher level of comfort than a traditional radiator system.

Radiator systems mainly create convective air movement, heating the air up to head height and ceiling level before it cools down and circulates back as a cold draft around the feet. DEVI's floor heating system, on the other hand, provides pleasant and balanced warmth for the feet, body, and head.

The system operates with gentle upward air movement generated by the heated floor surface. The floor heating principle supports heat distribution within the room and can contribute to maintaining suitable conditions at floor level.

Controlled energy consumption

Thanks to heat distribution from the floor and precise temperature control with a DEVIreg™ thermostat, the average room temperature can often be reduced by 1–2 °C compared with traditional radiator heating, without reducing thermal comfort – and in many cases, even improving it.

The solution is designed to support temperature management and reduce heat transfer through the building envelope.

Flexible system

DEVI's floor heating system ensures comfortable room temperatures in a wide range of applications – at home, in offices, workshops, sports halls, and virtually anywhere comfortable heating is required.

Equally important, DEVI's floor heating systems can be installed in almost all floor constructions, including new concrete floors, wooden floors, and renovation projects.

Invisible heat source

DEVI's floor heating system is completely invisible.

Because the system is installed beneath the floor surface, it opens up new possibilities for furniture placement and interior design. It also eliminates the need to consider bulky and visually intrusive radiators or heaters.

Ease of installation

DEVI electric underfloor heating is supplied as a complete system – whether as a heating mat, heating cable with installation accessories, or a thermostat with easy setup features — enabling quick and straightforward installation.

High durability and no maintenance

DEVI floor heating systems are designed for long-term use.

Heating cables and mats are suitable for permanent installation and are intended to operate without routine maintenance under normal operating conditions.

Quick and precise response time

Electric floor heating systems offer a quick response time.

Combined with DEVIreg™ intelligent thermostats, they provide precise room temperature control and faster heat adjustment compared with water-based floor heating systems. The system responds efficiently to temperature changes and user settings, helping to maintain a stable and comfortable indoor climate.



20-year DEVI Warranty™ and Full Service Warranty

A 20-year DEVI Warranty™ applies to most DEVI heating mats and heating cables.

DEVI also offers a Full Service Warranty for indoor floor heating cables and mats. This warranty includes not only the replacement or repair of the defective product, but also associated installation costs and restoration of floor materials, such as tiles or brickwork, if required due to a valid warranty claim.

2. System description

DEVI electric heating systems for indoor applications are designed to provide reliable, controllable, and support specific operational objectives in residential, commercial, and public buildings. The systems consist of electric heating cables or heating mats installed within the floor construction and controlled by an electronic thermostat with floor and/or room temperature sensing.

Depending on the design objective and thermal requirements of the space, DEVI indoor heating systems can be used for:

Comfort Floor Heating

Comfort Floor Heating is used to create a **warm and pleasant floor surface temperature** without necessarily covering the full heat loss of the room. Room's heat loss should be covered with other heat source e.g. radiators

Total (Direct) Heating

Total Heating, also referred to as **primary heating**, means that the electric floor heating system is designed to cover the **entire heat loss of the room or building zone.**

Combined Floor Heating

Combined Floor Heating provides **both comfort floor temperature and covers all room heat loss** to achieve both high comfort and sufficient heating capacity.

This makes the system suitable for a wide range of indoor environments, including bathrooms, kitchens, living rooms, bedrooms, hallways, basements, offices, hotel rooms, and renovation projects.

Electric heating elements are installed beneath the finished floor surface or embedded within the floor structure. When activated, they convert electrical energy into heat, which is then transferred through the floor and emitted into the room as radiant and conductive heat.

The system is controlled by a thermostat, allowing accurate adjustment of floor and room temperature according to the desired comfort level and heat loss. Depending on the room type, floor construction, and building insulation, the system can serve different heating functions.



3. System design

Electrical floor heating systems for indoor heating can be divided into 3 main heating categories (types):

- Comfort Floor Heating;
- Total or Direct Heating;
- Combined Floor Heating.

This will be described in details on the following pages.

3.1 Comfort Floor Heating

3.1.1 System description

Comfort Floor Heating, also known as a **"Warm Floor" system**, provides a pleasantly heated floor surface and is particularly well suited for bathrooms, kitchens, and other areas where floor comfort is important.

This type of heating **can be installed in any room that already has another heating system responsible** for maintaining the required room air temperature, such as wall-mounted water-based radiators.

In these applications, the Warm Floor / Comfort Floor Heating system is primarily used **to maintain a constant and comfortable floor temperature throughout the year**, regardless of the heating season.

As an added benefit, Comfort Floor Heating also contributes to the room's overall air temperature. Thanks to the large heated floor area, it can help compensate for insufficient heating during very cold winter days or in rooms where the existing heating system does not provide adequate temperature control.

The system is **controlled by a thermostat with a floor sensor** (usually a wired sensor), which activates the heating element according to the floor temperature set by the user.

A comfortable floor surface temperature has been evaluated in a number of studies and is, for example, referenced in ISO/TS 13732-2.

The maximum long-term comfortable floor surface temperature is generally defined as 29.5 °C. For small kids or elderly people an additional 1–2 °C may be required to achieve the desired comfort level. In wet rooms, **the maximum comfortable floor surface temperature may be increased up to 31 °C**.

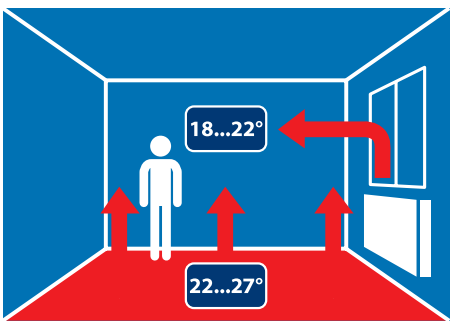
These values may be used as a basis for the calculation and selection of the required installed output (W/m^2) for Comfort Floor Heating systems.

The perceived comfort **temperature depends on the floor finish**. For example, **wooden floor** coverings have an optimal comfort temperature of approximately **26 °C**, while **carpeted floors** are often perceived as comfortable at approximately **24 °C**.

Since the final floor covering may change during the lifetime of the building, and because thermal comfort is subjective and varies from person to person, **it is generally recommended to design the system using the maximum comfort floor temperature** criteria in order to accommodate a wide range of possible conditions.

In many practical cases, however, a floor temperature only slightly above the room temperature is already sufficient to provide acceptable comfort for most users.

Special attention should be given to wooden floor coverings, as many manufacturers specify a maximum floor surface temperature of 27 °C. **For exact limitations, the floor covering manufacturer's installation instructions should always be followed**.



3.1.2 System output

Comfort Floor Heating systems are designed based **on the desired floor comfort level and the type of floor construction**.

As a general guideline, an installed output of at least **100 W/m² is recommended for dry (e.g. bedrooms, living rooms) areas, while at least 150 W/m² is recommended for wet (e.g. bathrooms) areas**.

However, special attention should be given to **wooden floor constructions**, as relevant standards and floor covering manufacturers often limit **the maximum installed output to 100 W/m²** and require the system to be controlled by a thermostat with a floor sensor in order to restrict the maximum floor surface temperature.

When selecting the installed output, it is also important to take into account the **thermal properties of the floor materials**, including their thermal conductivity and overall **ability to transfer heat to the floor surface**. Different floor finishes and floor constructions will affect how quickly and efficiently heat is distributed and perceived by the user.

The heating system must always be controlled by a thermostat.

It should also be noted that a higher installed output, for example 150 W/m² instead of 100 W/m², does not automatically mean higher energy consumption. In Comfort Floor Heating applications, **a higher installed output mainly influences the heat-up time, system responsiveness, and the ability to achieve the desired floor comfort** under different floor construction conditions.

The following **power outputs for Comfort Floor Heating systems** are recommended based on floor constructions, insulation levels, surface types, room air temperature and individual user preferences:

- Wooden floor constructions – no more than 100 W/m²;
- Dry rooms, thermal insulated floors – 100 W/m² or more;
- Floors without thermal insulation – 130-160 W/m²;
- Wet rooms – 150-180 W/m²;
- Low voltage, insufficient insulation, covered balcony slabs – 160-200 W/m²;
- Maximum output in floor construction – should not exceed 200 W/m².

Recommendation: it is always advised to insulate the floor structure below the heating cables.

Find more details and restrictions for special floor constructions such as wood, later in this document.

C-C distance with DEVIfast™ step, cm	Specific output of DEVI heating cables at 230 V			
	6 W/m	10 W/m	18 W/m	20 W/m
	DEVIflex™ 6T	DEVIflex™ 10T, DEVIcomfort™ 10T, DEVIbasic™ 10S	DEVIflex™ 18T	DEVIbasic™ 20S
5	120	200		
7,5		133		
10		100	180	200
12,5			144	160

C-C distance with DEVIclip™ C-C step, cm	Specific output of DEVI heating cables at 230 V			
	6 W/m	10 W/m	18 W/m	20 W/m
	DEVIflex™ 6T	DEVIflex™ 10T, DEVIcomfort™ 10T, DEVIbasic™ 10S	DEVIflex™ 18T	DEVIbasic™ 20S
5	120	200		
7		143		
10		100	180	200
12			150	167

It should be noted that in some countries the supply voltage is lower than 230 V. This results in a reduced specific output of the heating cable and, consequently, a different [W/m²] installed output at the same cable spacing (C-C distance). For example, if the rated output is specified at 230 V, a correction factor of 0.915 should be applied when the actual supply voltage is 220 V.

Example

The optimal required output (in [W/m^2]) for Comfort Floor Heating system, can be evaluated by a simple calculation. Assuming that the room temperature is 20 °C (supported by another heating system during the heating season) and the floor surface needs to reach up to 29 °C. The floor temperature must be increased as follows:

29 - 20 = 9 °C. Information about the installed output (in [W/m^2]) needed to heat up 1 m^2 of floor surface to 1 °C can be found in physic books and standards (e.g. DS/EN 1264. Heat exchange coefficient, usually named alfa – α [W/(m^2·K)], can vary, however for general evaluation α =10 W/(m^2·K) can be used.

Consequently to heat 1 m^2 of floor up to 9 °C in relation to air temperature, approximately an installation of 9 °C · 10 W/(m^2·K) = 90 W/m^2 is required.

As a "rule of thumb" a safety value of 30% should also be added offering a minimum output for electrical heating element used in Comfort Floor Heating system as calulated in the following example: 90 W/m^2 · 1,3 ≈ 120 W/m^2.

3.1.3 Important information

Choice of heating element type (mat or cable)

The selection of the heating element type — heating mat or heating cable — depends primarily on the available floor build-up height and the type of floor construction.

In renovation applications, where only a limited increase in floor height is acceptable, a heating mat is typically the preferred solution because of its low installation profile.

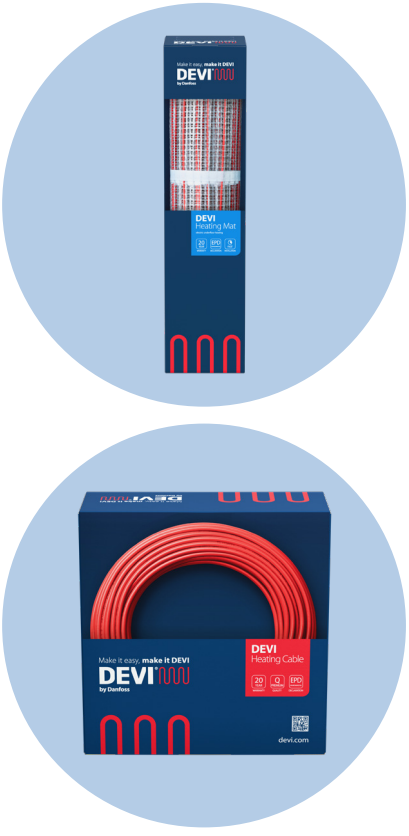
As a general guideline:

If the planned floor build-up increase is less than 30 mm, a heating mat is usually recommended. Heating mats are particularly suitable for installations with a floor build-up increase of only 3–5 mm.

If the planned floor build-up increase is more than 30 mm, a heating cable is generally used.

At the same time, it should be noted that heating mats may also be installed in concrete or other thick floor constructions, where appropriate.

In all cases, the design should also consider the thermal insulation level (minimum compressive strength is 150 kPa) and the position of the heating element within the floor construction, as these factors significantly influence downward heat losses and overall system efficiency.



Choice of a specific heating element length (mat or cable)

Heating cable

Heating cable is normally chosen based on required heating output for room (the calculated total output P_{CALC} [W]).

This output is calculated as the chosen specific output P_{INST} [W/m^2] multiplied by the installation area A_{INST} [m^2]:

$$P_{CALC}\,[W] = P_{INST}\,[W/m^2] \cdot A_{INST}\,[m^2].$$

The heating element is selected from the product list of factory-produced elements, with specific output P_{INST} [W]. Always the product nearest to, but larger

than, calculated total output P_{CALC} [W], is to be chosen.

For indoor heating DEVI recommends to use screened heating cables:

- twin conductor of 6,9 mm: DEVIflex™ 6T, DEVIflex™ 10T, DEVIflex™ 18T;
- twin conductor of 4,0 mm: DEVIcomfort™ 10T;
- single conductor of 5,5 mm: DEVIbasic™ 10S, DEVIbasic™ 20S..

Note. The number at the end of the cable's name refers to: its specific output for 1 m in [W/m] at 230 V, and letter "T" means a twin conductor cable (Twin), letter "S" - single conductor cable (Single).

The most frequently used cable type is DEVIflex™ 18T – twin conductor, 18 W/m at 230 V (16,5 W/m at 220 V). A linear output of DEVIbasic™ of 20 W/m, is not the best choice for even temperature distribution along the floor construction, if installed in the same floor, compared to DEVIflex™ 6,10 or 18 W/m.

Heating mat

The heating mat is selected from a range of factory-produced elements (covering area from 0,5 to 12 m^2), with an area covering usually the nearest less value to available installation space A_{INST} [m^2]. If the installation area (A_{INST} [m^2]) exceeds 12 m^2, a multiplication of chosen heating mats needs to be applied.

For example, DEVI screened heating mats designed for floor installation have the cable/mat thickness for:

- twin conductor of ~3,5 mm: DEVImat™ 70T, DEVImat™ 100T, DEVImat™ 150T, DEVImat™ 200T;
- twin conductor of ~4,0 mm: DEVIcomfort™ 100T;
- twin conductor of ~6,9 mm: DEVIflex™ 50T, DEVIflex™ 75T, DEVIflex™ 100T, DEVIflex™ 150T, DEVIflex™ 175T;
- single conductor of ~3,0 mm: DEVIheat™ 150S.

Note. The number at the end of a mat's name refers to its specific output for 1 m^2 in [W/m^2] at 230 V, and letter "T" means twin conductor mat (Twin), letter "S" a single conductor mat (Single). A single conductor heating mat requires more planning before installation, to ensure that the power supply cord attached to both ends of the heating mat starts and ends at the same place.

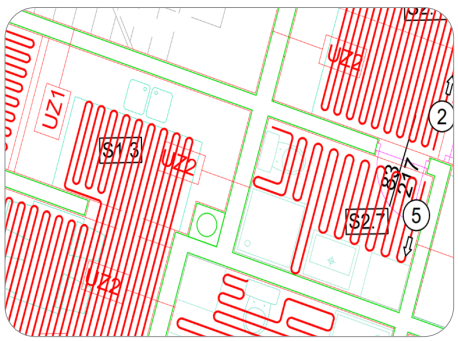
For Comfort Floor Heating DEVImat™ 150T heating mat are used most often – twin conductor, 150 W/m^2 at 230 V (135 W/m^2 for 220 V).

Estimation of heated floor area

The installation area of the heating cable or heating mat, A [m^2], must be determined as part of the system design.

To calculate the effective heated floor area, the following should be deducted from the total room floor area [m^2]:

- the area covered by permanently fixed or stationary objects, such as bathtubs, toilets, showers, built-in cabinets, cupboards, etc.;
- a perimeter strip along the walls, typically **10 cm wide**;
- and any additional areas excluded based on the customer's preferences or expected room layout.



Since electric floor heating systems are embedded in the floor construction for the long term, it is advisable to exclude from the heated area not only permanently fixed objects, but also locations where large furniture may be placed during the operational lifetime of the room, such as cupboards, cabinets, beds, and similar furnishings.

Along interior walls, where furniture is likely to be positioned, an unheated zone of approximately 30–40 cm is often recommended.

Where furniture is placed above heated floor areas, furniture on legs is preferred in order to allow sufficient air circulation under-

neath. The minimum clearance between the finished floor surface and the underside of the furniture should be at least 3 cm to ensure proper heat dissipation and to prevent excessive heat accumulation above the electric heating elements.

Thermostat selection

For Comfort Floor Heating application, the heating system **must be controlled by a thermostat with a floor sensor**, since the primary function of the system is to maintain the required floor surface comfort.

The thermostat uses a wired floor sensor to measure the temperature within the floor construction. The sensor should be positioned directly between adjacent heating cable runs or heating mat lines and, if possible, slightly above the heating element.

It is important to note that the temperature measured by the floor sensor does not correspond exactly to the actual floor surface temperature, as it depends on the sensor location, floor build-up, and thermal properties of the floor construction. For this reason, it is not possible to define universal thermostat settings for all floor types and constructions.

A thermostat with a floor sensor typically uses a control scale without direct temperature degree markings.

Following is recommended:

- DEVIreg™ Display Connect
  DEVIreg™ InControl
  DEVIreg™ Touch
  DEVIreg™ Room
  DEVIreg™ Solo
  DEVIreg™ Basic

The maximum connected load that a thermostat can switch directly is typically in the range of 3450–3600 W (15–16 A, depending on the product and supply voltage). This limitation must be considered when designing systems for larger heated areas.



If the total connected load exceeds the thermostat's direct switching capacity, one of the following solutions should be applied:

1. Division into separate heating zones.

The total heated area may be divided into several independent heating zones, each equipped with:

- a separate heating cable or heating mat,
- an individual thermostat,
- and the same installed output [W/m^2], where applicable.

Each individual zone must remain within the thermostat's maximum permissible connected load.

2. Use of a contactor.

Alternatively, the heating system may be controlled via a contactor (auxiliary relay) with a higher switching capacity, for example 20 A or more.

The contactor is typically mounted on a DIN rail inside the electrical distribution board.

Recommendation

As a general design recommendation, the thermostat load should preferably not exceed 70–80% of the thermostat's maximum rated switching capacity.

Choice of additional equipment

In addition to the heating element and thermostat, the installation may require a number of supplementary components, such as:

- a mounting box for the thermostat,
- a conduit pipe for the floor temperature sensor,
- screws, nails, or anchors for fixing the mounting strip or installation accessories to the floor,
- and other installation-related materials as required by the specific floor construction.

It is generally assumed that the electrical supply is stable and has been designed and installed in accordance with the applicable electrical regulations of the country of installation.

This includes, for example:

- appropriate overcurrent protection (fuse or circuit breaker),
- an RCD (Residual Current Device),
- and correctly selected power supply cable length, conductor cross-section, and current rating.

If these conditions are not already fulfilled, the required electrical supply components must also be selected and verified as part of the installation design.

Floor construction

Follow installation instructions provided by manufacturers of floor elements, and local building regulations.

Calculation of the fixing elements length (DEVIfast™ or DEVIclip™ C-C)

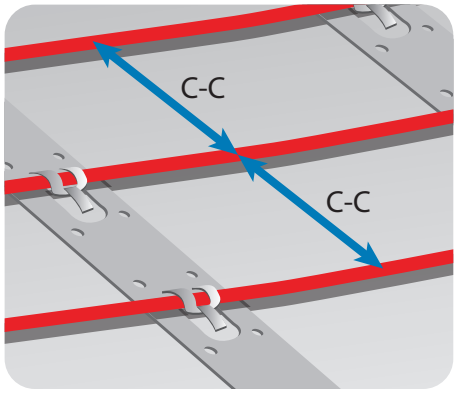
If heating cable is applied, it is recommended to use fixing elements to fix it to the floor base. For example, metal galvanized DEVIfast™ fixing elements or plastic DEVIclip™ C-C. It is attached to the floor (nailed or fixed with screws or glued) in parallel lines, usually every 50 cm.

This equals 2 meters of band for each square meter [m^2] of cable installation.

Simple calculation of the DEVIfast™ fixing elements length L_{FIX} (m): cable installation space is multiplied by two, e.g. $L_{FIX} = S_{INST} \cdot 2$ (m).

C-C distance

The C-C distance is a centre-to-centre distance between adjacent cables (sometimes named “installation step”).



In order to achieve a warm floor, it determines how evenly the heat is spread across the floor. If the cables are placed too far apart, cold spots can appear between them, making the floor feel unevenly heated. To ensure a warm and comfortable surface, the C-C distance should be chosen carefully so the heat is distributed evenly.

Rule of thumb

A commonly used rule of thumb is:

- The thickness of the floor construction above the heating cable should be approximately equal to one-half of the C-C distance.

For Comfort Floor Heating systems installed in thick concrete or screed constructions, a C-C distance of **5–12.5 cm** is generally suitable.

In such applications, heating cables mostly used. The upper concrete or screed layer is usually at least 3-5 cm thick.

For thin floor constructions, such as installations in tile adhesive, under laminate flooring, or in other low-profile floor systems, the C-C distance should not exceed 10 cm and is preferably limited to approximately 7.5 cm.

For direct installation under tiles, DEVI thin heating mats with a fixed 7.5 cm C-C distance are often the most suitable solution, as they help provide a more even floor surface temperature and reduce the risk of cold zones.

For loose heating cable installations, DEVIfast™ galvanized fixing strips or DEVIclip™ C-C plastic fixing elements are typically used. DEVIfast™ allow cable attachment at 2.5 cm intervals, which defines the practically achievable cable spacing DEVIclip™ C-C allow cable attachment at 1 cm intervals.

Consequently, the installed output of a heating cable system cannot always be selected arbitrarily. The selected cable type, available spacing intervals, and required installed output must be coordinated during system design.



DEVIfast™



DEVIclip™ C-C

3.1.4 Example. Comfort Floor Heating- calculation and selection of equipment

Comfort Floor Heating for bathroom

Input data: bathroom, 2nd floor (over heated room), no floor insulation, size 3 x 4 m, total area of 12 m^2, with installed 0,9 x 1,7 m bathtub, stable power supply voltage of 230 V, floor surface made of tiles. Restrictions for the floor height: can be increased maximum by 2 cm.

Heating mat or cable?

Since the floor height is an issue the concrete thickness is less than 3 cm. Choose a mat, DEVImat™ or DEVIcomfort™ twin conductor screened mat (find a detailed description of products in the DEVI Product Catalogue).

Installed output

Wet room, stable voltage, 2-nd floor, tiles, heated room below: an output of 150-180 W/m^2 is recommended.

Calculation of heated floor space (area of cable installation)

Out of the total space A (in [m^2]) bathtub area (0,9 x 1,7 m) and strips of floor of 10 cm along the walls are subtracted:

$$A_{INST} = 12\,m^2 - (0{,}9\,m \cdot 1{,}7\,m) - ((3\,m + 4\,m) + (3\,m - 0{,}9\,m) + (4\,m - 1{,}7\,m)) \cdot 0{,}1\,m = 12\,m^2 - 1{,}53\,m^2 - 1{,}14\,m^2 \approx 9{,}33\,m^2.$$

Select the desired mat size

Available floor area is 9,33 m^2.

DEVImat™ 150T covering 9 m^2 of floor, and with total output of 1235 W at 230 V, is chosen.

If the mat covering 10 m^2 of floor is chosen, there will be a surplus of 0,67 m^2 of mat, and since it's not allowed to cut or shorten a heating cables and mats, the mat covering 9 m^2 of floor is a preferred choice.

Thermostat selection

DEVImat™ 150T with 1235 W output, less than 3450- 3680 W maximum allowed, can be connected to a DEVI thermostat. For the heating area exceeding 5 m^2 – thermostat with a timer is recommended. For example, choose the programmable thermostat with intelligent timer – DEVIreg™ Display Connect.

Type	System	Temperature sensor	Range	IP class	Load, max.
DEVIreg™ Display Connect	Programmable: Comfort Floor Heating or Heating with floor temperature limiting	Air: embedded, Floor: included wire sensor	Floor 5…45 °C. Air 5…35 °C	IP21	3680 W

When thermostat is installed in a wet room, the requirements of electrical safety norms and corresponding IP class should be strictly followed! It is recommended to install the thermostat outside the bathroom.

Fixing elements

It is not needed, since DEVImat™ has a self-adhesive glue on the underside. We advise to clean the floor and remove all debris and dust.

Additional equipment

Electrical materials necessary for installation will typically include the following: wall mounting box for thermostat, 2-3 m conduit pipe for a floor temperature sensor and additional power supply if necessary. It is assumed that there is a proper power supply, according to the rules and regulations for safety elements of electrical installation, e.g. fuse and RCD are installed.

Summary:

For comfortably warm floor in 12 m^2 bathroom (with free area of 9,33 m^2), the following DEVI floor system elements are recommended:

Equipment	Characteristics	Quantity
Twin conductor screened DEVImat™ 150T heating mat	9 m^2 1235 W (at 230 V), (150 W/m^2)	1 pc.
DEVIreg™ Display Connect thermostat	Programmable, APP enabled, intelligent timer, air and floor sensors, IP21	1 pc.
Flexpipe Ø6,7 mm	Ø 6.7 mm, 2.5 m	1 pc.
Mounting box		1 pc.

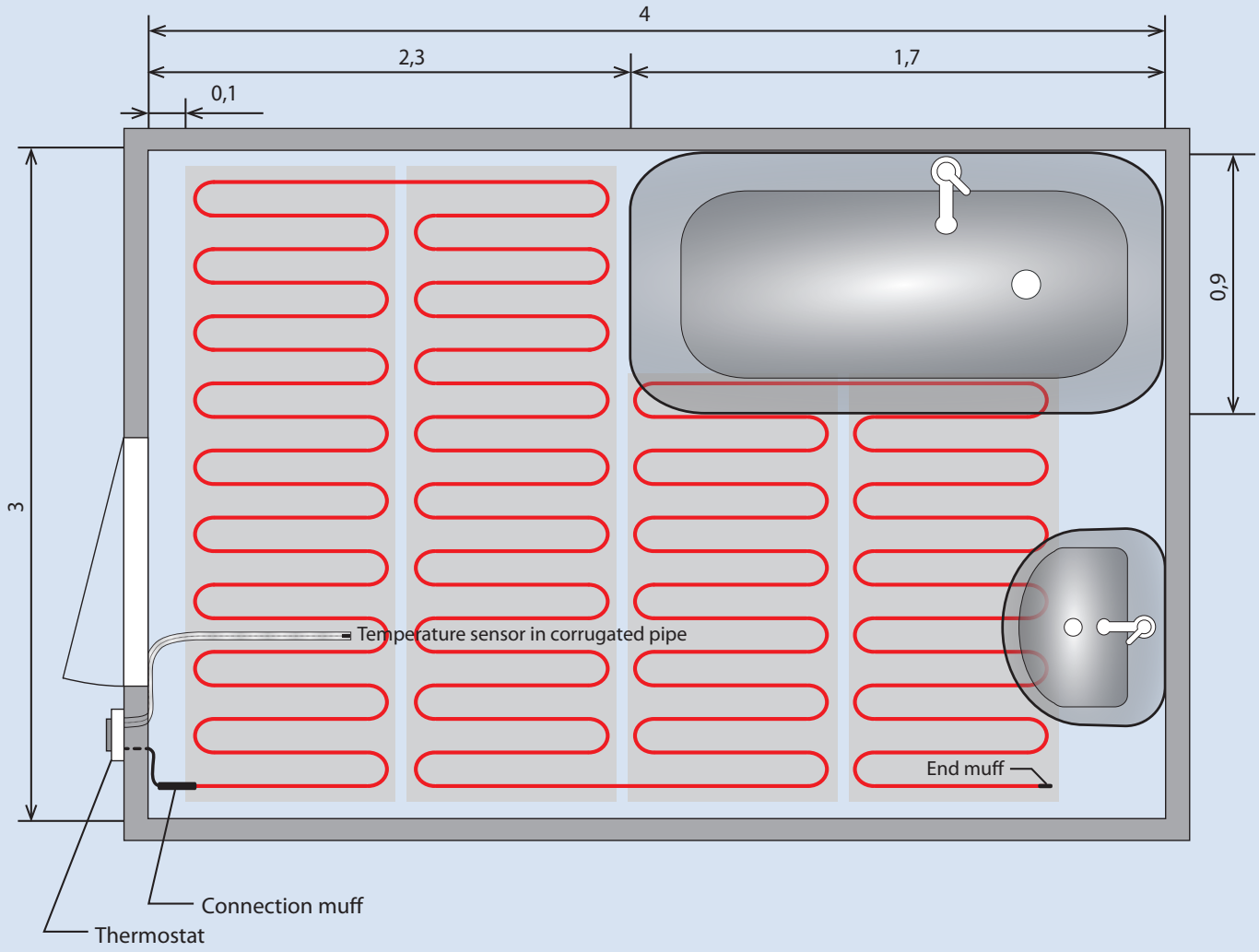


Fig. 1 – Example of heating mat installation in bathroom. All distances are in [m].

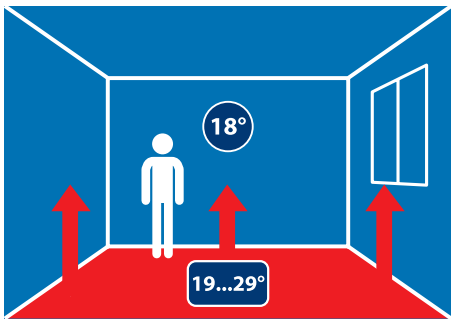
3.2 Total (Direct) Heating

3.2.1 System description

Total (Direct) electric floor Heating is a **primary heating system** installed in a room or defined area **to maintain a specified indoor air temperature**. Heat output is controlled by regulating the floor surface temperature in response to variable heat transfer conditions at the floor interface.

The system is controlled by a thermostat equipped with either **combined air and floor** temperature sensors or an **air temperature sensor only**. In **DEVIreg™ room** thermostats, the air temperature sensor is **integrated as a standard component**.

Due to the large active surface area, floor heating systems operate through a combination of radiant and convective heat transfer mechanisms. This results in a vertical temperature gradient characterized by higher temperatures in the occupied zone (near floor level) and lower temperatures toward the ceiling.



Such a temperature distribution aligns with established thermal comfort models and is considered optimal for occupants, independent of gender, age, or activity level.

Floor heating systems distribute heat through the floor surface and can be used as an alternative to conventional radiator-based heating systems.

The required indoor temperature setpoint and system energy consumption depend on factors such as building characteristics, heat losses, system design, and operating conditions.

3.2.2 System output

The output of a heating system is selected based **on the calculated heat loss** (in watts). The energy supplied by a floor heating system **must compensate for heat loss and maintain the specified indoor air (room) temperature**.

Typically, **a safety factor of 20–30% is added** to the calculated heat loss, depending on the specific thermal conditions of the room. As the heating system is **controlled by a thermostat**, installing a higher power output does not significantly affect the overall electrical energy consumption for heating.

Total Heating (heating via the floor) should not be confused with "Comfort Floor Heating" (or "Warm Floor"). The heat loss varies due to changing outdoor temperatures during the heating season, and accordingly, the floor temperature also varies. For example, in October, when the outdoor temperature is approximately +5 °C, heating the floor to 21–22 °C may be sufficient to maintain an indoor temperature of 20 °C. In contrast, in February, when the outdoor temperature drops to around –15 °C, the floor temperature may need to be increased to 25–26 °C to maintain the same indoor temperature.

When using a floor heating system as the primary heat source, it is essential to select a technically appropriate solution while observing the maximum permissible floor temperature. For system control, **a thermostat that measures air (room) temperature** and includes a floor temperature sensor is the preferred option. **This allows the user to set a maximum floor temperature** and continuously monitor it, preventing overheating. Such limitations are particularly important for floors with wooden surfaces.

The factory default setting for the maximum floor temperature limit is 35 °C.

Even if a specific installation does **not strictly require a**

C-C distance with DEVIfast™ step, cm	Specific output of DEVI heating cables at 230 V			
	6 W/m	10 W/m	18 W/m	20 W/m
	DEVIflex™ 6T	DEVIflex™ 10T, DEVIcomfort™ 10T, DEVIbasic™ 10S	DEVIflex™ 18T	DEVIbasic™ 20S
5	120	200		
7,5	80	133		
10	60	100	180	200
12,5	48	80	144	160
15	40	67	120	133
17,5	34	57	103	114
20	30	50	90	100

C-C distance with DEVIclip™ C-C step, cm	Specific output of DEVI heating cables at 230 V			
	6 W/m	10 W/m	18 W/m	20 W/m
	DEVIflex™ 6T	DEVIflex™ 10T, DEVIcomfort™ 10T, DEVIbasic™ 10S	DEVIflex™ 18T	DEVIbasic™ 20S
5	120	200		
7	86	143		
10	60	100	180	200
12	50	83	150	167
15	40	67	120	133
17	35	59	106	118
20	30	50	90	100

It should be noted that in some countries the supply voltage is lower than 230 V. This results in a reduced specific output of the heating cable and, consequently, a different [W/m^2] installed output at the same cable spacing (C-C distance). For example, if the rated output is specified at 230 V, a correction factor of 0.915 should be applied when the actual supply voltage is 220 V.

floor sensor, it is strongly recommended to install one. A plastic conduit should be installed to allow for future sensor installation if needed.

Safety Coefficient

For heating systems installed within floor structures, a safety coefficient of 1.2–1.3 shall be applied when determining the required installed power output. This coefficient is an empirical value commonly used in the industry and is based on the following factors:

- Manufacturing tolerances of heating cables, including length, electrical resistance, and rated power output;
- Variations in supply voltage within permissible limits;
- Downward heat losses, as well as the influence of floor construction and floor covering materials.

For example, if the installed heating output is 150 W/m^2 and downward heat losses are approximately 20%, the resulting upward heat flux is:

150 W/m^2 - (150 W/m^2 • 0.2) = = 120 W/m^2.

If the actual heat loss of the room is close to this value, it implies a required increase in floor surface temperature relative to the indoor air temperature of:

ΔT = 120 W/m^2 / 10 W/ (m^2 • K) = = 12 °C.

For instance, with an indoor air temperature of 18 °C, the floor surface temperature may reach 18 °C + 12 °C = 30 °C during peak heating conditions in the coldest period of the year in order to meet the room's heat loss.

Floor Surface Temperature

It shall be taken into account that high heat losses result in the need for higher heating system output and, consequently, may lead to elevated floor surface temperatures that could reduce thermal comfort.

Maximum permissible floor surface temperatures for different applications are defined in relevant standards. For a preliminary estimation of the achievable floor surface temperature at a given heat output, a heat transfer coefficient of $\alpha = 10$ W/ (m^2 / K) may be applied.

It should be noted that modern energy-efficient buildings with low heat losses typically require low-output heating systems. While such systems are generally sufficient to maintain the desired indoor air temperature, they may not provide enough heat flux to achieve a comfortable floor surface temperature.

Example

Consider a modern residential building with a design heat loss of approximate 60 W/m^2. If an electric floor heating system with a specific output of 60 W/m^2 is installed, its primary function will be to offset the building's heat losses and maintain the required indoor air temperature.

Assuming a design room temperature of +20°C and using the heat transfer coefficient (α), the expected temperature difference between the heated floor surface and the room air can be estimated. For a heat output of 60 W/m^2, the calculated temperature rise is approximately 6 K, resulting in a floor surface temperature of about +26 °C.

Although this temperature is sufficient for space heating purposes, it may not provide the level of thermal comfort typically expected from a floor heating system. This is particularly relevant in bathrooms, where a floor surface temperature of approximately +31°C is often preferred to ensure optimal comfort.

3.2.3 Important information

Choice of heating element type (mat or cable)

The selection of a specific heating element (heating mat or heating cable) depends primarily on the thickness of the floor construction above the heating element.

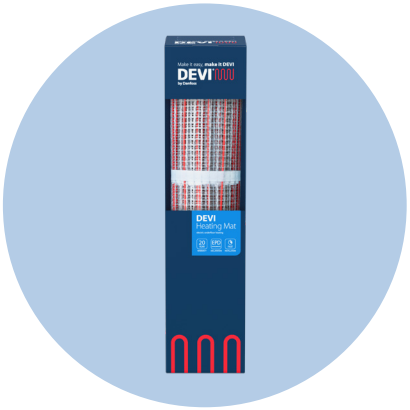
If the planned concrete layer is 3 cm or more, a heating cable is typically used. For thinner floor constructions (e.g., tile adhesive layers), a heating mat – with a typical thickness of approximately 3–4.5 mm – is the preferred option.

It should be noted that there are no restrictions on the use of heating mats in concrete or thicker floor constructions.

The installation of thermal insulation (minimum compressive strength is 150 kPa) within the floor structure is strongly recommended wherever possible. The insulation thickness should be determined in accordance with local standards and regulations.

In applications where the heating system operates for extended periods during the year (e.g., 6–8 months in Nordic countries), the thickness of the thermal insulation has a direct impact on heat loss and, consequently, on overall electricity consumption.

To ensure the durability of the floor construction, the concrete layer installed over the insulation must have a minimum thickness of 3 cm and comply with local building regulations.





Choice of a specific heating element length (mat or cable)

Total cable/mat output should not be less than the calculated heat loss, including the safety factor of 1,3.

Heating cable

Cable is usually fixed with help of DEVIfast™ metal fixing elements, with cable attachment points every 2,5 cm or DEVIclip™ C-C plastic fixing elements with attachment points every 1 cm and allows to implement different fixed output on 1 [m^2]. This fact should be taken into consideration during calculation of a specific solution. For example, if the cable is DEVIflex™ 18T and supply voltage is 230 V for C-C distance of 12,5 cm, output is 145 [W/m^2], and for C-C = 10 cm – 180 [W/m^2].

It should be noted that in some countries supply voltage is lower than 230 V, which leads to a decrease in cable output and, respectively, different [W/m^2] with the same installation distance. For example at 220 V electrical supply, the output form a heating element, rated at 230 V is only 91,5% (coefficient 0,915 should be applied to heating element output from DEVI Product Catalogue).

For heating cable with defined installation C-C distance, a specific output p_{INST} [W/m^2] is selected, with help of a product table or calculated using the formula. Usually a product with nearest larger value to calculated output p_{CALC} is chosen. This chosen/calculated output will be the actual output for 1 m^2 of the heating system. In other words, it is area specific output p_{INST} [W/m^2] of selected heating cable installation C-C distance.

Note that there will be two design approaches available when selecting an electric floor heating system.

The first option is to use a heating cable with a higher linear output and a larger cable spacing (C-C distance). This approach reduces the total cable length required and therefore lowers the overall system cost. However, the increased spacing may result in noticeable temperature variations across the floor surface, commonly referred to as cold spots between adjacent heating cable runs.

The second option is to use a heating cable with a lower linear output and a smaller C-C distance. This configuration requires a greater cable length, which increases material and installation costs. However, the reduced spacing provides a more uniform heat distribution and minimizes the risk of cold spots, resulting in improved floor surface temperature uniformity and enhanced thermal comfort.

Heating cable total output p_{CALC} [W] is calculated as the specific output p_{INST} [W/m^2] multiplied by the installation area A_{INST} [m^2]:

$$p_{CALC}\,[W] = p_{INST}\,[W/m^2] \cdot A_{INST}\,[m^2].$$

Cable is selected from a list of factory produced products, with output p_{INST} [W], usually the nearest larger to calculated output pCALC [W]. The nearest lower output can only be recommended, if it differs from the estimated no more than ~5%.

Output of the selected cable is the actual output of the heating system.

For Total Floor Heating DEVI recommends to use screened heating cables:

- twin conductor of 6,9 mm:
  DEVIflex™ 6T,
  DEVIflex™ 10T,
  DEVIflex™ 18T;
- twin conductor of 4,0 mm:
  DEVIcomfort™ 10T;
- single conductor of 5,5 mm:
  DEVIbasic™ 10S,
  DEVIbasic™ 20S.

Note. The number at the end of the cable's name refers to its specific output for 1 m – W/m at 230 V, letter T – twin conductor cable (Twin), letter S – single conductor cable (Single).

Heating mat

When installing thin heating mat, it is chosen with a specific output p_{INST} [W/m^2] the nearest larger to calculated output p_{CALC}. However installation also needs to look at the available floor area A_{INST} [m^2], and choose a mat, that covers an area close to available. Otherwise installation will leave unheated and cold floor areas, resulting in users dissatisfaction with the Total Heating system.

For example, DEVI screened heating mats designed for installation on thin floor construction:

- twin conductor of ~3,0 mm:
  DEVImat™ 70T,
  DEVImat™ 100T,

DEVImat™ 150T,
DEVImat™ 200T;

- twin conductor of ~4,0 mm:
  DEVIcomfort™ 100T,
  single conductor of ~3,0 mm:
  DEVIheat™ 150S.

Or use DEVI heating mats designed for thick floor constructions:

- twin conductor of ~6,9 mm:
  DEVIflex™ 50T,
  DEVIflex™ 75T,
  DEVIflex™ 100T,
  DEVIflex™ 150T,
  DEVIflex™ 175T;

Note. The number at the end of the mat's name refers to its specific output for 1 m2 in [W/m^2] at 230 V, letter T – twin conductor mat (Twin), letter S – single conductor mat (Single).

For example, DEVIcomfort™ 100T heating mat is a twin conductor, 100 W/m^2 at 230 V (91 W/m^2 at 220 V).

Output of the selected heating mat will be the actual output of the heating system.

Estimation of heated floor area

The installation area of the heating cable or mat, A_{inst} [m^2], is determined by subtracting the areas where heating elements are not installed from the total floor area of the room.



It is recommended to maintain an unheated perimeter zone along **external walls with a width of approximately 10 cm.** Along internal walls, particularly in areas where fixed furniture is likely to be installed, a wider **unheated zone of 30–40 cm** is recommended.

For floor heating systems, the use of furniture with legs providing a minimum **clearance of 3-5 cm** between the floor surface and the underside of the furniture is advised. This ensures adequate air circulation and prevents overheating of the heating cable or mat installed beneath the furniture.

Estimation of the calculated output per [m^2]

Specific calculated area output, p_{CALC} [W/m^2] is calculated by dividing the calculated heat loss Q [W] by the installation area A_{INST} [m^2]:

$p_{CALC} = Q / A_{INST}$ [W/m^2].

It should be noted that the calculated output is typically slightly less than real chosen output of heating cable, which is installed in the floor. This is due to the fact that cable can be attached on DEVIfast™ fixing elements with a fixed distance of 2,5 cm (or multiplication thereof) or DEVIclip™ C-C with a fixed distance of 1 cm.

Thermostat selection

Thermostat designed for electrical floor heating system for Total Heating is fitted with an internal air temperature sensor and usually with an additional floor temperature sensor (included with thermostat). The floor sensor allows controlling and limiting the maximum temperature of the floor surface. This restriction is often mandatory and standardized for some producers of floor coverings, e.g. for laminate or parquet boards.

Following is recommended:

- DEVIreg™ Display Connect
  DEVIreg™ InControl
  DEVIreg™ Touch
  DEVIreg™ Room
  DEVIreg™ Solo

Thermostats have an internal relay that has a limitation of the maximum output, that thermostat can switch on: typically 3450-3680 W (15-16 A).

In case of need to install more than maximum, following two solutions are possible:

1. Heating area is divided into independent zones with separate cables and individual thermostats, each zone not exceeding the connected

output indicated above, and with the same output (in [W/m^2]) installed;

2. Contactor for proper current isused (additional larger relay), usually mounted on a DIN rail in the switch panel.

Recommendation: it is better to choose thermostat load at 70-80% of maximum.



Choice of additional equipment

In addition to the heating element and thermostat, the installation may require a number of supplementary components, such as:

- a mounting box for the thermostat,
- a conduit pipe for the floor temperature sensor,
- screws, nails, or anchors for fixing the mounting strip or installation accessories to the floor,
- and other installation-related materials as required by the specific floor construction.

It is generally assumed that the electrical supply is stable and has been designed and installed in accordance with the applicable electrical regulations of the country of installation.

This includes, for example:

- appropriate overcurrent protection (fuse or circuit breaker),
- an RCD (Residual Current Device),
- and correctly selected power supply cable length, conductor cross-section, and current rating.

If these conditions are not already fulfilled, the required electrical supply components must also be selected and verified as part of the installation design.

Floor construction

In multi-layer floor construction, consisting of many elements, a wide range of considerations need to be made. Always follow the national rules for construction and in case of uncertainty get in contact with your local DEVI product supplier.

Calculation of the length of the fixing elements

If heating cable is chosen, it is recommended to use fixing elements to fasten it to the floor base, for example, galvanized DEVIfast™ fixing elements or plastic DEVIclip™ C-C fixing elements. These fixing elements are usually attached to the floor (screwed, nailed or glued) in parallel lines spaced every 50 cm, but not more than 1 m. As a result, approximately two

meters of band for each square meter of installation area are used.

Calculation of DEVIfast™ fixing elements length L_{FIX} (m) - cable installation area is multiplied by two: $L_{FIX} = A_{INST} \cdot 2$ [m].

Alternatively, if installation



DEVIfast™

allows, heating cable can be fixed to metal reinforcement mesh



DEVIclip™ C-C

placed in the floor construction with help of DEVIclip™ twist.

C-C distance

The heating element (cable or mat) is installed within the floor structure in parallel lines. When using a heating cable, the output density of the system (in W/m^2) is determined by the center-to-center (C-C) spacing between the cables. Increasing the spacing reduces the output density, and vice versa.

Once the required output density is determined, the corresponding C-C distance is calculated. This defines the number of cable runs per square meter or the cable length per square meter. Multiplying the cable length per unit area by the total heated area provides the total required cable length.

$$\text{C-C distance (cm)} = \frac{\text{Available floor area (m}^2\text{)} \cdot 100 \text{ (cm/m)}}{\text{Length of chosen cable (m)}}.$$

Detailed information about cable installation procedures is provided later in this document.

In modern buildings, calculated heat loss is typically low; consequently, the required output of the floor heating system is also limited. To avoid excessively large C-C spacing, it is advisable to use heating cables with lower linear output.

For example, with a calculated heat loss of 50 W/m^2, using a standard cable such as DEVIflex™ 18T may result in a C-C spacing of up to 36 cm. This can lead to uneven floor surface temperatures, with colder zones between cable runs.

Since the objective of a floor heating system is to maintain a uniform and comfortable floor temperature, it is recommended to use cables with lower linear output (e.g., DEVIflex™ 10T or DEVIflex™ 6T) for low specific output applications. This allows for reduced C-C spacing and results in a more uniform temperature distribution across the floor surface.

3.2.4 Example. Total Heating – calculation and selection of equipment

Total Heating system for new build living room

Total Heating via electrical floor, using the heating cable including limiting of maximum floor temperature.

Data:
Room size 3 x 5 m, total area of 15 m^2, concrete floor, stable supply voltage 230 V, ground floor, concrete is assumed more than 3 cm thick, calculated heat loss is 1100 W.

Definition of cable system's calculated output

The calculated heat loss Q is 1100 W. To select heating cable(s) take into account the safety factor of 1,3, the calculated output is:

P = 1100 W · 1,3 = 1430 W or per [m^2]: 95,3 W/m^2.

Choice: heating mat or cable.

Concrete is assumed not less than 3 cm thick, floor construction is "thick".
Twin conductor screened DEVIflex™ 18T heating cable is chosen for installation.

It is assumed that insulation of necessary thickness will be laid under the cable, so downward heat loss is minimal and does not require taking into account.

Estimation of heating cable installation area

It is proposed that the cable is placed at a distance of 10 cm (0,1 m) from the 3 m length outer wall and the same from opposite wall with the door. Permanent (fixed) installations are supposed along the 5 m length inner walls. It is proposed that the cable is placed at a distance of 35 cm (0,35 m) from 5 m length inner walls. Under these assumptions for 3 x 5 m room the area for cable installation is:

$$A_{INST} = 15\ m^2 - (3+3)\ m \cdot 0{,}1\ m - (5+5)\ m \cdot 0{,}8\ m = 15\ m^2 - 0{,}6\ m^2 - 3{,}5\ m^2 = 10{,}9\ m^2 \approx 11\ m^2.$$

Estimation of the calculated output per 1 m²

The calculated heat loss Q [W] should be divided into cable installation area AINST [m²]:

$$p_{CALC} = Q / A_{INST} = 1430\ W/11\ m^2 = 130{,}3 \approx 131\ W/m^2.$$

Calculation of the length of the heating cable

Choose twin conductor screened DEVIflex™ 18T heating cable. Cable installation on DEVIfast™ fixing elements requires the choice of C-C distance with step of 2,5 cm. Specific output p_{INST} [W/m²] is selected by the table or calculated using the formula as the nearest larger settlement to calculated output p_{CALC}.

For calculated above $p_{CALC} = 131$ [W/m²] for cable 18 [W/m] – DEVIflex™18T, choose from the table the nearest larger specific output (at 230 V) and appropriate C-C distance (see Tables in 3.2.2):

C-C distance, cm	18 W/m DEVIflex™18T
…	…
12,5	144 W/m²
15	120 W/m²
17,5	103 W/m²
…	…

Choose specific installation output $p_{INST} = 144\ W/m^2$ and respectively C-C = 12,5 cm.

Note. For the heating system, mat heating element can be installed in concrete too. The nearest larger to $p_{CALC} = 131\ W/m^2$ is mat output 150 W/m², so mats which names end with 150T are suitable (DEVIcomfort™ 150T etc.).

Heating cable calculated specific output:

$$P_{CALC} = p_{INST} \cdot A_{INST} = 144\ W/m^2 \cdot 11\ m^2 = 1584\ W.$$

Factory-produced cable DEVIflex™ 18T with the nearest larger to 1584 W output is 1625 W cable 90 m (see DEVI Product Catalogue) .

It should be noted that cable with less power – 1485 W (82 m) could not be selected as a variant, because its power varies more than 5% from the calculated of 1584 W.

Thermostat selection

Thermostat designed for heating system has to be selected. e.g. thermostat with air temperature sensor and an additional floor temperature sensor. The heating system will operate during the whole heating period: therefore, it is important to save electricity. To do this, choose thermostat with timer, with possibility to set low temperature at night and during periods of absence of people in the room.

For rooms with area smaller than 5 m², consider also the economic implication of choosing a thermostat without timer.

For this example the selected heating cable's output is1625 W. It is less than the maximum allowable 3500 W (15-16 A) for most DEVI thermostats. For example, DEVIreg™ Display Connect thermostat: it can be used for comfort or total room heating, with the ability to limit the maximum floor temperature. With DEVI Connect APP, an intelligent timer and stylish design, it should be installed in the wall mounting box, maximum load is 3,7 kW (16 A), 230 V, IP21.

Calculation of the length of the fixing elements

Using of metal fixing elements DEVIfast™ for cable fixing is supposed. Band is attached to the floor in parallel lines spaced every 50 cm. So band length can

be defined as the area of cable installation multiplied by two:

$L_{FIX} = A_{INST} \cdot 2 = 11\,m^2 \cdot 2 = 22\,m \approx \approx 23\,m.$

You can choose, for example, 1 packaging of 25 m of DEVIfast™.

Choice of additional equipment

Mounting box for thermostat, conduit pipe for floor temperature sensor, nails or anchors for attaching fixing elements to the floor, etc.

It is assumed that there is a stable voltage supply to the place of the thermostat installation, and safety fuse and RCD are installed in switchboard, section and length of power cable are properly chosen, etc.

Otherwise these elements have to be selected too.

Summarizing the above: DEVI electrical floor heating system for Total Heating (Direct Heating via Floor) with limitation of maximum floor temperature is implemented for a floor area of 15 m^2 with calculated heat loss of 1100 W, following equipment is needed:

Equipment	Characteristics	Quantity
Twin conductor screened heating cable DEVIflex™ 18T	90 m, 1625 W (at 230 V), C-C distance of 12,5 cm, ~144 [W/m^2], avaliable floor area of 11 m^2	1 pc.
DEVIfast™ Metal fixing elements	Galvanized metal, distance of 2,5 cm	1 pc. of 25 m pack
DEVIreg™ Display Connect thermostat, white	Programmable, Wi-Fi, accessible with APP, intelligent timer, air and floor sensors, IP21	1 pc.
Conduit pipe	Ø 16	4 m
Mounting box		1 pc.

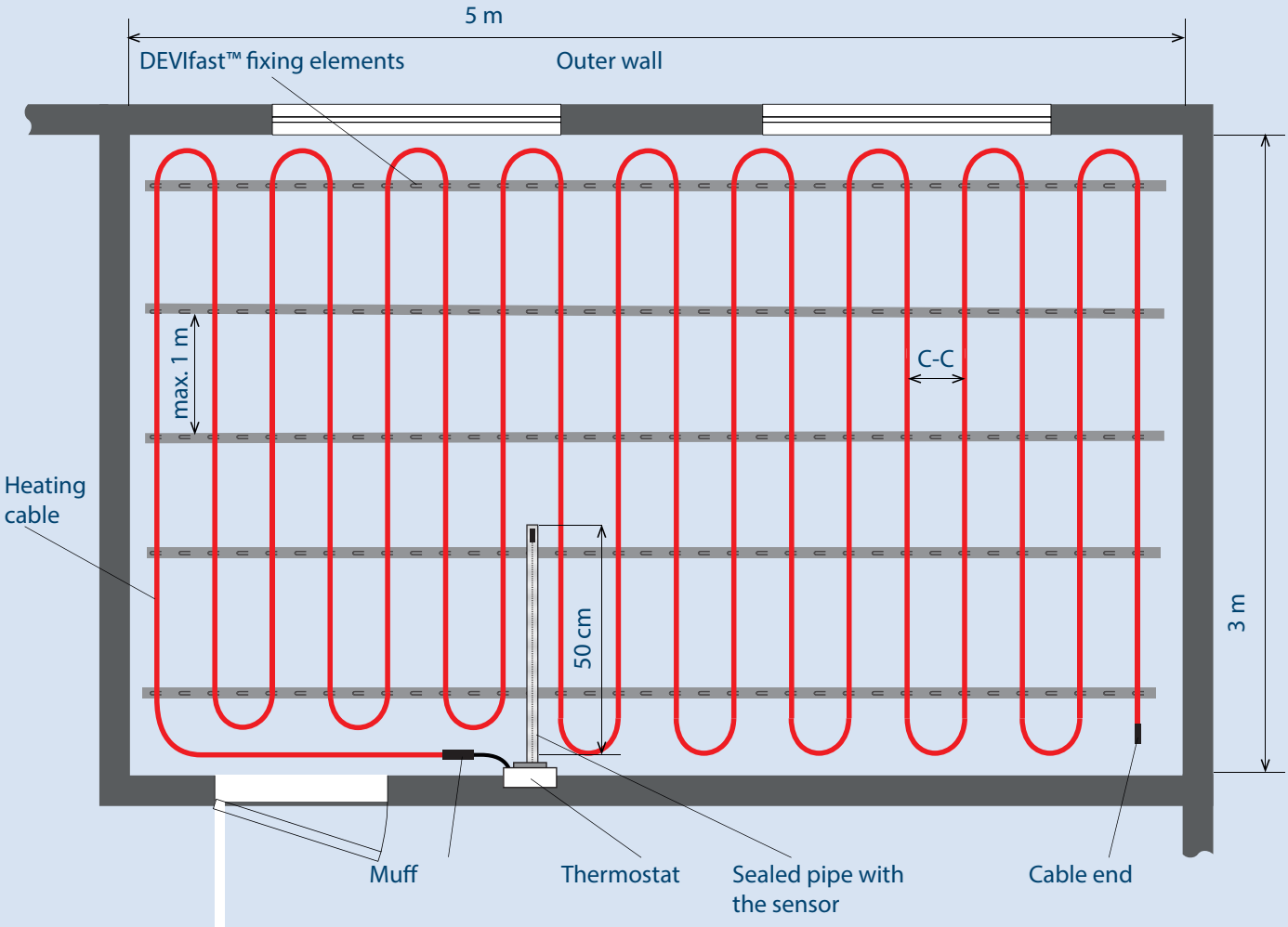


Fig. 2 - Example of heating cable installed in a room. Direct Floor Heating

3.3 Combined Floor Heating

3.3.1 System description

A Combined Floor Heating system is designed to **maintain both a comfortable room (air) temperature and a pleasant floor surface temperature at the same time**. It typically uses heating cables or mats installed in the floor, controlled by a thermostat with both air and floor sensors.

The system works by regulating the air temperature to the desired level while also limiting or maintaining minimum required floor surface temperature within a set range. This ensures that the room feels warm overall, while the floor remains comfortable to walk on. Even when the required air temperature is reached, the system can still keep the floor from becoming too cold.

One of the main benefits of a combined system is improved thermal comfort, as it eliminates cold floors and provides more even heat distribution in the room. It can also increase energy efficiency by optimizing heating based on both air and floor conditions. In addition, it offers flexibility, allowing users to set maximum or minimum floor temperature limits depending on the floor covering.

There are some restrictions to consider. Floor surface temperature must not exceed recommended limits, especially for sensitive floor coverings such as wood or laminate. Typically, the maximum floor temperature is around 27–29 °C for living areas with wooden or similar floorings, while higher values may be allowed in bathrooms (e.g. 31 °C). The system also requires proper installation, correct sensor placement, and appropriate cable spacing to function effectively.

Overall, a combined electric heating system provides a balanced solution by ensuring both comfortable air temperature and a warm floor surface, enhancing overall indoor comfort.

3.3.2 System output

For Combined Floor Heating systems, the specific heat output depends on the room type, floor construction, insulation level, and the heating purpose. In most cases, the system is designed to provide both sufficient room heating capacity and comfortable floor surface temperatures without overheating the floor.

Typical installed specific outputs are:

- 100–150 W/m^2 for combined heating systems used as the primary heat source in standard residential buildings.
- 150–200 W/m^2 may be required in rooms with higher heat losses, such as bathrooms, entrance areas, or poorly insulated spaces.

The selected output must always comply with the maximum allowed floor surface temperatures. For example:

- Living areas with wood or laminate floors are typically limited to floor temperatures of approximately 27°C.
- Bathrooms and tiled floors can usually operate at higher surface temperatures, often up to 33–35°C.

To achieve comfortable and even heating, the cable spacing (C-C distance) and floor construction must be designed carefully. Excessive specific output or incorrect spacing may lead to uneven floor temperatures or overheating of the floor covering.

Areas, m²	Calculated cable length for systems with 100 W/m², m			
	6 W/m	10 W/m	18 W/m	20 W/m
	DEVIflex™ 6T	DEVIflex™ 10T, DEVIcomfort™ 10T, DEVIbasic™ 10S	DEVIflex™ 18T	DEVIbasic™ 20S
5	83.3	50.0	27.8	25.0
10	166.7	100.0	55.6	50.0
15	250.0	150.0	83.3	75.0
20	333.3	200.0	111.1	100.0
25	416.7	250.0	138.9	125.0

Note that the required specific output can be achieved by using heating cables with different linear outputs by adjusting the cable spacing (C–C distance). Using a higher-output heating cable with a larger C–C distance can significantly reduce the total project cost for large projects; however, it also increases the risk of cold zones appearing.

3.3.3 Important information

Choice of heating element type (mat or cable)

Total cable/mat output should not be less than the calculated heat loss, including the safety factor of 1,3 and distance between heating cables can't be more than 12.5 cm to exclude appearing of cold spots.

The selection of the heating element type — either a heating mat or a heating cable — primarily depends on the available floor build-up height and the type of floor construction.

In renovation projects, where only a limited increase in floor height is acceptable, heating mats are typically the preferred solution due to their low installation profile.

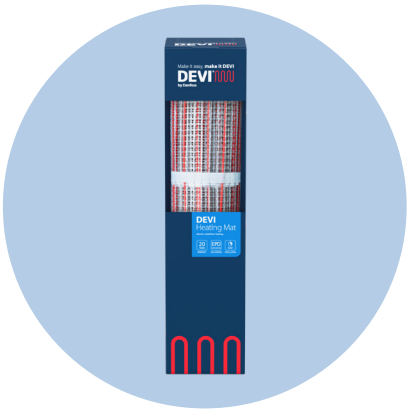
As a general guideline:

If the planned increase in floor build-up height is less than 30 mm, a heating mat is usually recommended. Heating mats are especially suitable for applications where the floor level increase is limited to approximately 3–5 mm.

If the planned floor build-up increase exceeds 30 mm, a heating cable is generally the preferred option.

However, it should also be noted that heating mats can be installed in concrete screeds or other thick floor constructions where appropriate.

In all cases, the system design should consider the thermal insulation level (minimum compressive strength is 150 kPa) and the position of the heating element within the floor construction, as these factors significantly affect downward heat losses, heat distribution, and the overall energy efficiency of the system.





Estimation of heated floor area

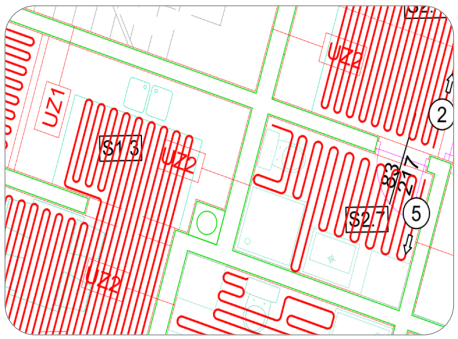
The installation area of the heating cable or heating mat, A [m²], shall be determined during the system design stage.

To calculate the effective heated floor area, the following areas shall be deducted from the total room floor area [m²]:

- areas occupied by permanently fixed or stationary objects, such as bathtubs, toilets, shower

enclosures, built-in cabinets, cupboards, and similar installations;
- a perimeter zone along the walls, typically 10–15 cm wide;
- any additional areas excluded according to the customer's requirements or the intended room layout.

Since electric floor heating systems are embedded within the floor construction as a long-term installation, it is recommended to exclude not only permanently fixed objects from the heated area, but also locations where large furniture items may be placed during the operational lifetime of the room, such as wardrobes, cabinets, beds, and similar furnishings.



Along interior walls where furniture is likely to be positioned, an unheated zone of approximately 30–40 cm is often recommended.

Where furniture is installed above heated floor areas, furniture supported on legs is preferred to allow sufficient air circulation beneath the furniture. The minimum clearance between the finished floor surface and the underside of the furniture should be at least 3 cm to ensure proper heat dissipation and to prevent excessive heat accumulation above the electric heating elements.

Thermostat selection

Since Combined heating has taks from both Total Heating (room temperature control) and Comfort Heating (floor surface temperature control) applications, the thermostats should have both room and floor sensor.

The floor sensor allows controlling and limiting the maximum temperature of the floor surface. This restriction is often mandatory and standardized for some producers of floor coverings, e.g. for laminate or parquet boards.

Following is recommended:

- DEVIreg™ Display Connect
  DEVIreg™ InControl
  DEVIreg™ Touch
  DEVIreg™ Room
  DEVIreg™ Solo

Thermostats have an internal relay that has a limitation of the maximum output, that thermostat can switch on: typically 3450-3680 W (15-16 A).

In case of need to install more than maximum, following two solutions are possible:

1. Heating area is divided into independent zones with separate cables and individual thermostats, each zone not exceeding the connected output indicated above, and with the same output (in [W/m^2]) installed;
2. Contactor for proper current isused (additional larger relay), usually mounted on a DIN rail in the switch panel.

Recommendation: it is better to choose thermostat load at 70-80% of maximum.



Choice of additional equipment

In addition to the heating element and thermostat, the installation may require several supplementary components, such as:

- a mounting box for the thermostat,
- a conduit pipe for the floor temperature sensor,
- screws, nails, or anchors for fixing the mounting strip or other installation accessories to the floor,
- and other installation materials as required by the specific floor construction.

It is generally assumed that the electrical supply is stable and has been designed and installed in accordance with the applicable electrical regulations of the country of installation. This includes, for example:

- appropriate overcurrent protection (fuse and circuit breaker),
- an RCD (Residual Current Device),
- and a correctly selected power supply cable, including proper length, conductor cross-section, and current rating.

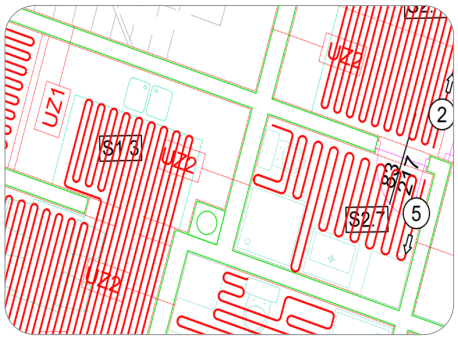
If these conditions are not already met, the necessary electrical supply components must also be selected and verified as part of the installation design.

Floor construction

Follow installation instructions provided by manufacturers of floor elements, and local building regulations.

C-C distance

The C-C distance (centre-to-centre distance), also referred to as the installation step, is the distance between heating cable runs.



For Combined Heating systems, the C-C distance is a critical design parameter. Since combined heating integrates both Total Heating (room temperature control) and Comfort Heating (floor surface temperature control), the cable spacing should be selected according to the design principles used for Comfort Heating applications.

A properly selected C-C distance ensures heat distribution across the floor surface and minimizes the risk of cold spots. Typical C-C distance values range from 5 to 12.5 cm.



DEVIfast™



DEVIclip™ C-C

3.4 Acceptable floor constrictions and limitations

DEVI designs and produces heating equipment: cables, mats, heating elements, thermostats, fixings, to fulfill installation requirements.

The floor constructions can be divided by such parameters:

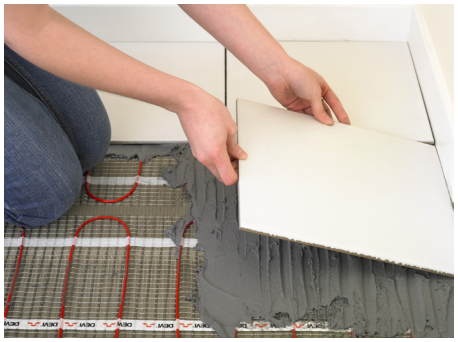
1. Thick (>3 cm) concrete floor construction;
2. Thin (<3 cm) floor and similar floor constructions;
3. Wooden floors:

- wooden floor on joists;
- floor with wooden surface and concrete or wooden subfloor;
- DEVIcell™ – heating system with heat distribution plates under laminate.

All these floor constructions and heating equipment for them are described in chapters below.

There are two main types of installation methods for electric floor heating systems: wet installation systems and dry installation systems.

Wet Installation Systems



Wet installation systems are electric floor heating systems where the heating cable or heating mat is embedded directly into a wet layer, such as concrete, screed, self-leveling compound, or tile adhesive. After installation, the heating element becomes an integral part of the floor construction.

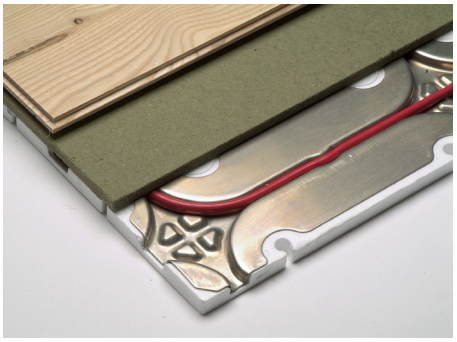
Typical applications include:

- Concrete floors
- Cement screed floors
- Bathrooms and tiled areas
- New buildings and major renovations

Main advantages:

- Excellent heat distribution across the whole floor surface
- High thermal stability and heat storage capacity
- Suitable for both Comfort Floor Heating and total room heating
- Mechanical protection of the heating elements supports their use in long-term floor heating installations.

Dry Installation Systems



Dry installation systems are electric floor heating systems where the heating element is installed without concrete or thick screed layers. The cable or heating mat is placed directly under the floor covering or inside specially designed dry floor constructions.

Typical applications include:

- Wooden floors
- Laminate and parquet floors
- Renovation projects with limited floor height
- Lightweight floor constructions

Main advantages:

- Fast and simple installation
- Low construction height
- Rapid heat-up response due to low thermal mass
- Reduced installation weight on the building structure
- Ideal for refurbishment and retrofit projects

Dry systems are especially suitable where quick response time, low installation height, and easy renovation are important design requirements.

3.4.1 Thick concrete floor constructions

The most commonly used floor construction is one in which the heating element is installed within concrete.

Heating cables or heating mats are embedded in a concrete layer and are typically positioned in the lower part of the top (finish) layer.

For Total (Direct) Floor Heating and Comfort Floor Heating systems, the typical thickness of concrete above the heating cables is 3–7 cm.

Building standards usually specify a minimum thickness of the finish concrete layer of 3–4 cm, in order to ensure the mechanical integrity of the floor (local regulations should always be followed). This requirement applies regardless of whether a heating cable is installed.

All applicable local standards and regulations concerning floor construction must be strictly observed.

However, it is important to ensure that:

- the C-C distance between cables does not exceed twice the thickness of the concrete layer above the heating cables,
- sufficient thermal insulation is installed beneath the heating element.

If these conditions are not met, the floor surface may develop cold areas, resulting in reduced thermal comfort.

C-C distance

For Comfort Floor Heating systems, one of the main requirements is to ensure a uniform and comfortable temperature distribution across the floor surface.

To achieve this, the C-C distance for heating cables installed in a concrete slab with a thickness of 3 cm or more should typically be in the range of 5–12.5 cm, with a preferred spacing of 10 cm or less.

For Total Floor Heating systems, the requirement for perfectly uniform floor surface temperature is less critical.

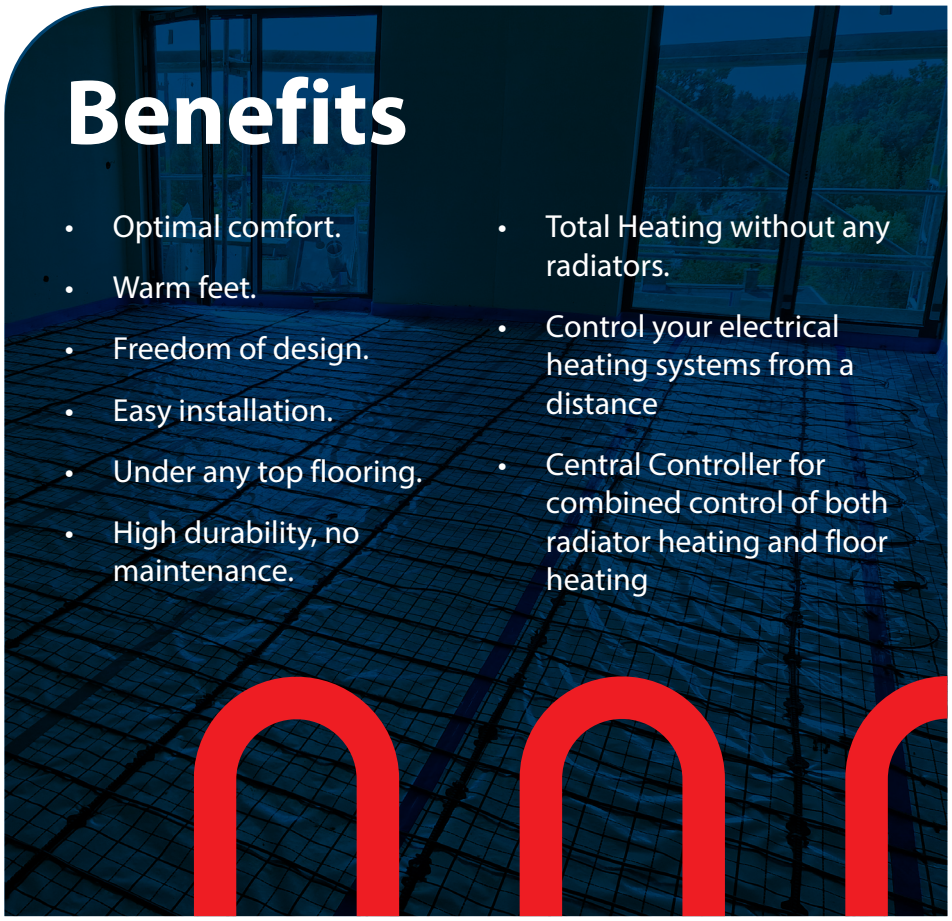
In such systems, the C-C distance depends primarily on the required heating output, which is related to the building's heat loss. In modern buildings, this heat loss is often relatively low (e.g. 30–60 W/m^2), which may result in larger cable spacing, for example C-C = 30–50 cm.

Installed output

The recommended maximum linear output of the heating cable is 20 W/m. It should be noted that some local regulations may specify lower limits, which must always be strictly followed.

To achieve lower cable temperatures and improved heat distribution across the entire floor surface, DEVI recommends using cables with a lower linear output, such as 10–18 W/m, or even 6 W/m for low-energy buildings.

The maximum specific installed



output for this type of floor construction is typically up to 200 W/m^2.

Floor surfaces

Nearly all types of floor surfaces are suited for floors in which heating cables have been installed, but the supplier of the floor surface should always be consulted.

The supplier's instructions must be very carefully followed when wooden floors are installed above floor heating. For further information about heating with wooden floors, please refer to the relevant paragraph later in this document.

Flooring materials with a high insulation value, like thick wool carpets, can limit the heat distribution from the floor. In these cases, please consult the supplier of the flooring material for further information.

The maximum value of the thermal resistance for the floor top layer material should not exceed 0,125 m^2·K/W.

Flooring materials suitable for floor heating will be fitted with following mark:



Thick concrete floors with wooden floor coverings (e.g. laminate, multi-layer boards, parquet)

For floor constructions with wooden surface finishes, the specific installed output is typically limited to a maximum of 150 W/m^2, and in some applications may need to be reduced to 100 W/m^2 or even 55 W/m^2, depending on the floor covering requirements.

If the floor construction lacks sufficient thermal insulation, downward heat losses must be considered, and the installed output may need to be adjusted accordingly.

For such installations, it is strongly recommended to use a thermostat with both a room (air) sensor and a floor temperature sensor to ensure proper temperature control and to prevent overheating.

Product choice

When heating system is installed in thick concrete floor, the following DEVI screened heating cables and mats can be recommended:

- twin conductor heating cables: DEVIflex™ 18T, DEVIflex™ 10T and DEVIflex™ 6T;
- twin conductor thin heating cable: DEVIcomfort™ 10T;
- single conductor heating cables: DEVIbasic™ 10S, DEVIbasic™ 20S.
- twin conductor thick heating mats: DEVIflex 175T, DEVIflex 150T, DEVIflex 100T, DEVIflex 75T, DEVIflex 50T.

It should be noted that it is also possible to use thin heating mat in thicker concrete floor types.

Heating in floor is independent of the thickness of the heating element (cable or mat), but depends on specific output of area (in [W/m^2]).

Thermal Insulation

It is essential that the floor construction is properly thermally insulated (minimum compressive strength is 150 kPa) in accordance with applicable international and local building codes and standards. The primary objective is to minimize downward heat loss. Otherwise, heat losses to the subfloor must be evaluated, and an appropriate increase in heating output should be determined.

In new buildings, compliance with modern construction requirements ensures that thermal insulation beneath the floor structure is standard practice. In renovation projects, however, this may not be the case. Therefore, special attention should be given to verifying the presence and condition of existing insulation.

It should be noted that the heating cable must not be in direct contact with thermal insulation. Direct contact may lead to excessive operating temperatures, potentially resulting in cable failure. To prevent this, a separating layer shall be installed above the insulation to ensure physical separation and to avoid embedding of the cable into the insulation. Suitable separating layers include:

- a thin concrete screed,
- aluminum foil (with a PE layer) or a thick plastic foil approved for use with electric heating cables,
- wire mesh reinforcement with a wire diameter of 1–2 mm and a mesh size not exceeding 2 × 2 cm.

Another important aspect is vertical insulation along external walls, particularly where these walls are insufficiently insulated. This insulation must be effective in reducing lateral heat losses to the exterior. Additionally, it should be capable of accommodating horizontal thermal expansion of the floor structure.

3.4.2 Thin floor constructions

Thin floor constructions are floor assemblies where the heating element is installed with minimal build-up height, typically directly beneath the floor finish or within a thin layer of adhesive, levelling compound, or self-levelling screed.

DEVI has developed a dedicated heating solution – thin heating mats – for applications where low floor build-up height is required.

Thin heating mats have a typical thickness of approximately 3–4.5 mm, which is generally lower than the thickness of most commonly used tile adhesives (including adhesive mortars and self-leveling compounds). These mats can be installed directly onto existing tile, wooden, or concrete floors, provided that the substrate is stable, free from mechanical or thermally induced movement, and does not contain sharp objects.

Typical areas of application include kitchens and bathrooms; however, thin heating mats can be used throughout residential buildings.

Heating cables may also be used in thin floor constructions such as DEVIcomfrot 10T with diameter of 4 mm.

To achieve a comfortable floor surface temperature in thin floor constructions it is strongly recommended to use a appropriate thermal insulation layer (minimum compressive strength is 150 kPa).

All installations must comply with applicable local building regulations. In case of uncertainty, consult a DEVI representative.

Benefits

- Warm feet.
- No breakup of the old floor.
- Freedom of design.
- Easy and quick installation.
- Under any top flooring.
- Building height increase by only 3-5 mm.
- Quick responding floor heat.
- Designed for heat-loss management.
- Total Heating without any radiators.
- Precise control of heating operation.
- Control your electrical heating systems from a distance
- Central Controller for combined control of both radiator heating and floor heating

C–C Distance

For Comfort Floor Heating systems, one of the primary requirements is to ensure a uniform and comfortable temperature distribution across the floor surface. To achieve this, the center-to-center (C–C) spacing for thin floor constructions with a thickness of less than 3 cm shall not exceed 10 cm and is recommended to be smaller, e.g., 7.5 cm or even 5 cm.

For Total Heating systems, a strictly uniform floor surface temperature is not mandatory; however, it is still desirable.

In new installations, where thermal insulation is typically provided, the C–C spacing becomes primarily dependent on the calculated heat loss, and a wider range of spacing values may be applied. Nevertheless, it is recommended to maintain a C–C distance of less than 15 cm in such applications.

Installed output

Thin glue/adhesive, self-leveling compound, etc. floors with thickness less than 3 cm.

For thin floor constructions using tile adhesive, self-leveling compounds, or similar materials

with a total thickness of less than 3 cm, heating cables or mats with a maximum linear output of 20 W/m shall be used. All DEVI thin heating mats comply with this requirement.

The surface-specific output for such floor constructions shall not exceed 200 W/m^2 and is typically in the range of 100–150 W/m^2.

Thin concrete floors with wooden surface (laminate, multi-layer boards, parquet, etc.).

For thin floor constructions with wooden surface finishes, heating cables or mats with a maximum linear output of 10 W/m are permitted.

The maximum allowable surface-specific output for this type of floor construction is 100 W/m^2. Appropriate thermal insulation beneath the floor is essential to minimize downward heat loss. In cases where insulation is insufficient or absent, heat loss must be evaluated, and the appropriate output level shall be determined accordingly.

Floor with wooden sub flooring.

If heating mat/cable is installed onto wooden subfloor, norms and regulations limiting maximum cable specific output to 10 W/m.

Specific output in this floor construction should be maximum 100 W/m^2. The heating elements can't be in direct contact with wooden subfloor. They should be divided by the metal mesh or layed on thin layer of primer (less than 1 cm).

Product choice

When heating system is installed in thin floor following DEVI thin screened heating mats can be recommended:

- twin conductor ~3,5 mm: DEVImat™ 70T, DEVImat™ 100T, DEVImat™ 150T, DEVImat™ 200T;
- twin conductor ~4 mm: DEVIcomfort™ 100T, DEVIcomfort™ 150T;
- single conductor ~3 mm DEVIheat™ 150S.

The width of mat covers ~ 50 cm while the length ranges usually from 1 to 24 m (0,5-12 m^2).

Thin heating cable recommended:

- twin conductors thin heating cables DEVIcomfort™ 10T.

More information about heating mats and cables can be found in this manual or in DEVI Product Catalogue and Installation Instructions.

Fixing

For the installation of thin heating mats onto subfloor no fixing is needed. Mats have self-adhesive glass fiber mesh which is designed for quick and safe installation.

For the installation of heating cables we recommend the use of DEVIfast™ metal fixing elements with possibility of C-C distance of 2,5 cm, or DEVIclip™ with C-C distance of 1 cm. It is also possible to attach the cables directly to foundation with a glue gun, but observe the maximum temperature, that cables can be subjected to.

Mats and cables must be installed securely to prevent its moving during the installation. It is forbidden for lines of heating cable to touch or cross each other. Failure in strictly following this rule will result in cable overheating and a likely fault of the installation.

Thermal insulation

It is essential that the floor construction is properly thermally insulated in accordance with applicable local building regulations and standards. This ensures that downward heat loss is minimized. Otherwise, heat loss to the subfloor must be evaluated, and an appropriate increase in heating output shall be determined.

It should be noted that the **heating cable must not be in direct contact with thermal insulation.** Direct contact may lead to excessive temperatures, which could result in cable degradation or failure over time.

Vertical insulation is also an important component of the installation and should be provided along external walls, particularly where these are insufficiently insulated. This insulation must be effective in preventing heat transfer to the exterior. In addition, it should be capable of accommodating horizontal thermal expansion of the floor construction.

Floor surfaces

Nearly all types of floor coverings are suitable for use with heating mats or cables; however, the flooring supplier shall always be consulted prior to installation.

Where the floor covering consists

of wood or plastic, the heating cables must be covered with a minimum of 20 mm of adhesive, screed, or concrete.

The supplier's instructions must be strictly followed when installing wooden floors or thick wool carpets directly over concrete constructions with embedded floor heating. Such materials can significantly limit heat transfer from the floor. In these cases, a thermostat equipped with a floor temperature sensor shall be used. For further information regarding wooden floors, refer to the relevant section of this document or consult the flooring supplier.

Floor coverings with high thermal resistance, such as thick wool carpets, may reduce heat output. In such cases, the flooring supplier should be consulted to confirm suitability.

The total thermal resistance of the floor covering above the heating elements shall not exceed 0.125 m^2·K/W.

A minimum air gap of 3 cm shall be maintained beneath fixed objects such as cabinets, desks, and beds.

3.4.3 Wooden floor constructions

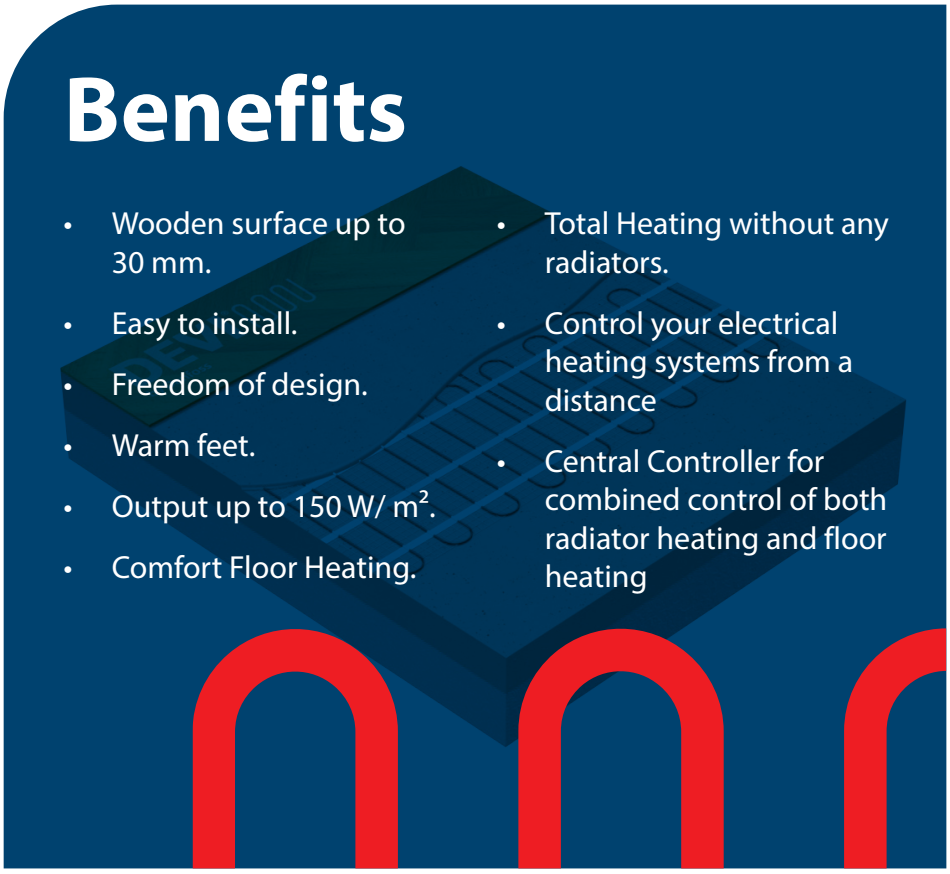
The DEVI heating system can be installed in all types of wooden floor constructions, provided that the installation requirements are observed and strictly followed. DEVI produces heating equipment such as cables, mats, heating elements, thermostats, fixing accessories, etc., for the following common wooden floor constructions:

- wooden surface on concrete or wooden subfloor;
- wooden floors on joists;
- DEVIcell™ – a heating system with heat distribution plates for dry installation under laminate and similar coverings.

All of these floor constructions and heating systems are described in the chapters below.

When heating is installed in wooden floors on concrete or on existing wooden subfloors, the surface temperature of the wooden floor shall not exceed the level recommended by the flooring manufacturer. **Typically, the maximum allowable surface temperature specified by manufacturers is 27 °C.**

It is recommended to always use a floor sensor to control the floor temperature. The floor sensor shall be connected to an electronic thermostat with a temperature-limiting function. As an additional safety measure, the thermostat should disconnect the heating system in the event of sensor failure.



According to ISO 13732-2, the comfortable floor surface temperature depends on the flooring material. However, for all wooden floor coverings, the maximum recommended comfortable surface temperature is 27 °C.

All floor temperature setpoints measured by a sensor installed

within the floor construction must be set a few degrees higher to compensate for the thermal resistance of the floor covering.

The floor temperature shall be increased gradually during the first week after installation to allow the new floor to acclimatize. This procedure is also recommended at the beginning of each heating season.

Wood naturally expands and contracts depending on the relative humidity (RH) in the room. The optimal humidity range is 30–60% RH, and it must never be allowed to fall below 30%.

The heating system shall be designed to ensure a uniform surface temperature across the entire floor area, achieved through evenly spaced heating elements (cables or mats).

There are a few limitations to be observed when installing floor heating in conjunction with wooden floors, as follows:

1. The installed output in wooden floors on joists must not exceed 80 W/m^2.
2. The installed output in tiled floors installed on wooden structures must not exceed 100 W/m^2.
3. The installed output in thin floor constructions with wooden flooring (thickness < 3 cm, e.g. heating mats in tile adhesive) must not exceed 100 W/m^2.
4. The installed output in thick concrete floor constructions with wooden flooring (thickness > 3 cm) must not exceed 150 W/m^2.

If a heating element (mat or cable) is installed on a wooden subfloor, applicable standards and regulations typically limit the maximum linear output of the heating cable to 10 W/m.

Note that such low specific outputs cannot achieve a comfortable floor temperature without overheating wooden flooring.



For direct heating systems, if the installed maximum output does not cover the specific heat loss (W/m^2), an additional heating system shall be installed to ensure the required room temperature during the coldest days of the year.

Types of floor surfaces

DEVI floor heating systems may be used with all common types of wooden floor coverings, including both plank and laminated constructions. It is essential that the manufacturer's recommendations regarding maximum allowable surface temperatures are strictly followed.

Avoid the use of beech and maple in multilayer constructions unless they are pressure-dried.

The maximum thermal resistance of the floor structure above the heating cable shall not exceed 0.125 m^2·K/W.

Regarding the thickness of wooden floor coverings, floor heating should only be installed under the following conditions:

1. The maximum thickness of softwood (density 400–600 kg/m^3, e.g. pine) is ≤ 2 cm.

Approximate thermal resistance, m^2·K/W	Examples of flooring	Details	Approx. setting/limitation for 27 °C floor surface temperature
0,05	8 mm HDF based laminate	>800 kg/m^3	30 °C
0,10	14 mm beech parquet	650 - 800 kg/m^3	33 °C
0,13	22 mm solid oak plank	>800 kg/m^3	35 °C
<0,13 max	Max. carpet thickness suitable for floor heating	Acc. to EN 1307	36 °C
0,18	22 mm solid fir planks	450 - 650 kg/m^3	37 °C

Note that the table shows the required thermostat setting temperature to achieve a floor surface temperature of +27 °C, taking into account the high thermal resistance and varying thicknesses of wooden flooring.

2. The maximum thickness of hardwood (density above 600 kg/m^3, e.g. oak) is ≤ 3 cm.

A minimum air gap of 3-5 cm shall be maintained beneath fixed objects such as cabinets, desks, and beds. Floor heating elements must not be installed under furniture that prevents air circulation beneath it.

Wooden floors shall always be protected against moisture from the subfloor. When a wooden floor is installed over underfloor heating, a vapor barrier shall be installed as close to the wooden floor as possible. If the relative humidity in the subfloor exceeds 95%, a vapor barrier is not sufficient, and a damp-proof membrane shall be used instead.

The flooring supplier shall be informed that underfloor heating is being installed to ensure the correct selection of adhesives and installation materials. The manufacturer's recommendations regarding installation of floor heating under wooden floors shall always be followed.

Temperature control requirements

The electronic thermostats with **floor sensor**, for limitation of floor temperature, must to be chosen.

DEVI thermostats are pre-set with a max. floor temperature of 35 °C.

If a higher value is necessary, and allowed to be used by a wooden floor manufacturer, get in contact with your local DEVI solution provider.

The maximum recommended wooden floor temperature setting is 27 C.

Wooden floor on joists

In wooden floors on joists, electric heating can be integrated within the existing construction height. The heating cable or mat is installed on mesh netting (e.g. chicken wire), which is placed between the joists beneath the wooden planks.

Installed Output

When heating is installed in wooden floors supported by joists, the following limitations shall be observed:

1. The installed output must not exceed 80 W/m^2.
2. The linear output of heating cables or mats must not exceed 10 W/m

Product choice

When cable heating system is installed in wooden floor on joist constructions following DEVI heating cables and mats can be recommended:

- twin conductor heating cables DEVIflex™ 10T and DEVIflex™ 6T;
- twin conductor thin heating cables DEVIcomfort™ 10T;
- single conductor heating cables DEVIbasic™ 10S;

Benefits

- Wooden planks up to 30 mm.
- No break up of the old floor.
- Easy and quick installation.
- No increasing of the floor height.
- Freedom of design.
- Warm feet.
- Output up to 80 W/m^2.
- Comfort Floor Heating.
- Total Heating without any radiators.
- Control your electrical heating systems from a distance
- Central Controller for combined control of both radiator heating and floor heating

- twin conductor heating mat DEVImat™ 70T.
- twin conductor heating mat DEVIflex™ 75T and DEVIflex™ 50T

For regulation a thermostat with floor sensor must always be used, with the ability to limit the maximum floor temperature.

Temperature control requirements

Electronic thermostats with a floor sensor for limiting the floor temperature must be selected. The floor sensor should be placed between the heating elements. Due to the distance between the wooden finished floor and the heating elements, the set temperature should be higher than the actual required temperature.

Thermal insulation

It is essential that the floor construction is properly thermally insulated (minimum compressive strength is 150 kPa) in accordance with applicable general and local building regulations and standards. This ensures that downward heat loss is minimized. Otherwise, heat loss to the subfloor must be evaluated, and an appropriate increase in heating output shall be determined.

It should be noted that **the heating cable must not be in direct contact with thermal insulation.** To avoid such contact, a separating layer such as fine mesh netting (e.g. chicken wire, reinforcement mesh, etc.) or heat-conducting foil may be installed directly on or above the insulation.

It is also important to insulate thermal bridges and limit air infiltration, for example between the floor construction and adjacent walls.

Floor surfaces

DEVI floor heating systems may be used with all common types of wooden floor coverings, both plank and laminated constructions. It is essential that the manufacturer's recommendations for wooden flooring are strictly followed.

Wood naturally expands and contracts depending on the relative humidity (RH) in the room. Multi-layer wooden floors with a surface layer of beech or maple shall not be installed over underfloor heating.

Regarding the thickness of wooden floor coverings, floor heating should only be installed under the following conditions:

1. The maximum thickness of softwood (density 400–600 kg/m^3, e.g. pine) is ≤ 2 cm.
2. The maximum thickness of hardwood (density above 600 kg/m^3, e.g. oak) is ≤ 3 cm.

The total thermal resistance of the floor covering above the heating elements shall not exceed 0.125 m^2·K/W.



3.4.4 DEVIcell™ LowCarbon insulation plates for Dry and Wet installations

When floors in flats, houses, basements or patios are renovated, floor heating can be added without using screed or without breaking up the old floor. The comfort is provided by DEVIcell™ LowCarbon heating system which is designed to be in contact with wooden sub or top floorings.

DEVIcell™ LowCarbon:

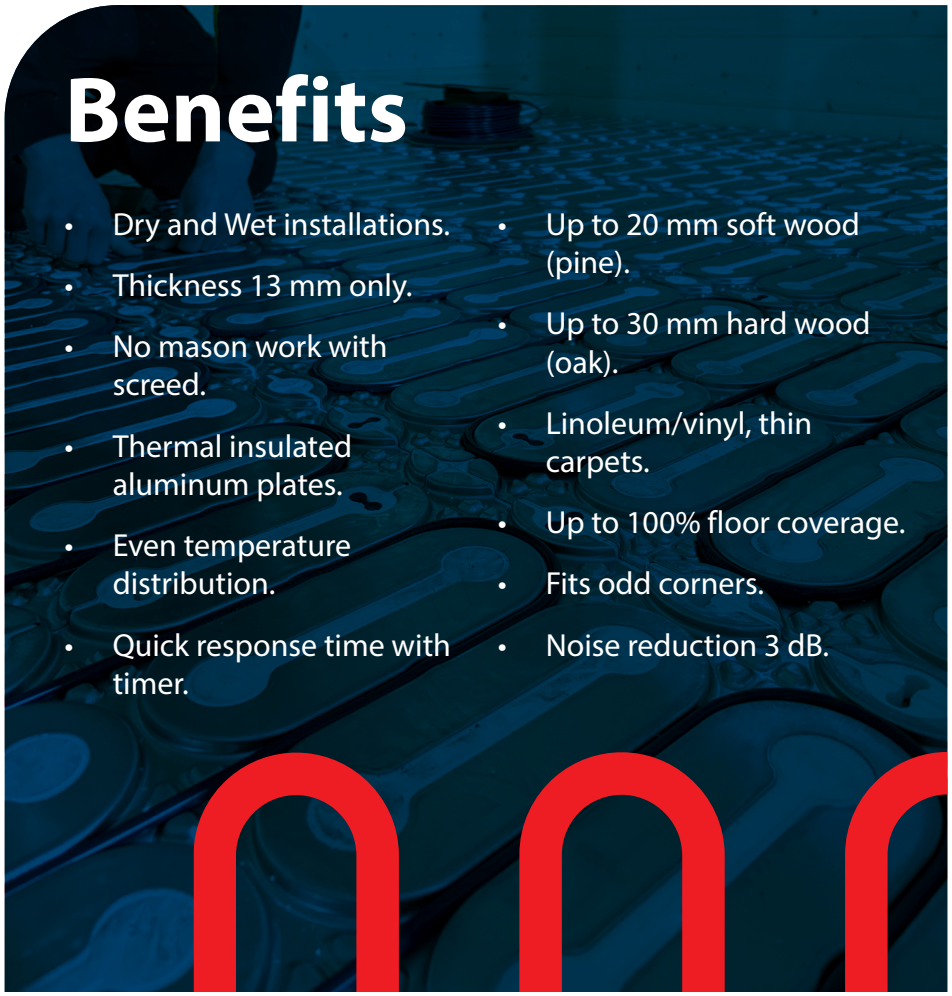
- consists of a 12 mm polystyrene plate and a 1 mm aluminum plate with cable grooves;
- is installed on the old/sub floor, right under the new top flooring e.g. timber or parquet;
- ensures fast responding floor heating and evenly distributed floor heat;
- cable grooves every 10 cm;

DEVIcell™ LowCarbon can be used for Comfort Floor Heating and for Direct Heating via Floor with output up to 100 W/m^2.

DEVIcell™ LowCarbon must only be fitted with DEVIflex™ 6T and DEVIflex™ 10T.

Do not use sharp or pointed objects while laying the cable. Observe national regulations and standards for the area.Remember to buy a DEVIflex™ heating cable, a DEVIreg™ thermostat and a DEVIcell™ LowCarbon mounting kit.

Note: Do not lay the cable outside the plates, except where covered with aluminium tape. Connection of the heating cable must be done by an authorised electrician.The cable lines must not cross each other, for more information about the heating cable installation process please refer to the Installation guide heating cables.



The DEVIcell Low Carbon can be used for Dry and Wet types of installation. For Wet installation you need to **prime the aluminium surface for better adhesion of the tile adhesive** to the surface.

See the installation manual for the DEVIcell™ LowCarbon product for further information.

Installed output

When heating is installed in wooden floors with DEVIcell™ LowCarbon few limitations should be observed:

1. The installed output must not exceed 100 W/m^2.
2. The specific output of heating cables must not exceed 10 W/m.

Product choice

When cable heating system is installed in wooden floor with DEVIcell™ LowCarbon heat distribution plates following DEVI products can be recommended:

- DEVIcell™ LowCarbon heat distribution plates: 50x100 cm, 2 or 5 m^2 package, 50 m^2 pallet;
- Mounting set for sensor: conduit pipe and end cup;
- Twin conductors heating cables DEVIflex™ 10T and DEVIflex™ 6T only.

Room thermostat with floor sensor, and with the maximum temperature limiting feature must always be used.

Thermal insulation

It is important that the floor construction is properly insulated (minimum compressive strength is 150 kPa) in accordance with applicable general and local building regulations and standards. In this way, downward heat loss is minimized. Otherwise, heat loss to the subfloor must be evaluated, and an appropriate increase in heating output shall be determined.

DEVIcell™ LowCarbon has a thermal resistance (R-value) of 0.26 m^2·K/W and provides thermal insulation below the heating system.

Floor surfaces

DEVIcell™ LowCarbon floor heating system may be used in connection with all known types of wood floorings, both in plank and laminated form. It is important that floors manufacturer's recommendations are carefully followed.

Avoid beech and maple in multi-layered constructions unless it's press dried.

Installation under carpets, linoleum or vinyl must be separated from cables by at least 5 mm of pressure distribution board. Observe the total insulation value above the pressure distribution board: R < 0,10 m^2·K/W corresponding 1 Tog or a thin carpet.

With regards to the thickness of the wooden floor, DEVIcell™ LowCarbon floor heating should only be installed if:

1. The maximum thickness of soft wood (density 400-600 kg/m^3 – pine etc.) is ≤ 2 cm.
2. The maximum thickness of hard wood (density over 600 kg/ m^3– oak etc.) is ≤ 3 cm.

For detailed information about whether a carpet can be used with floor heating, contact the carpet manufacturer.

The DEVIcell™ LowCarbon can be installed together with tiles in Wet installations.

To ensure efficient operation, the following recommendations should be followed. Before installing the tiles, the aluminium surface should be primed to improve the adhesion of the tile adhesive. The tile adhesive and primer must be compatible with installation on an aluminium plate and approved by the adhesive manufacturer.

Example.

A 28 m^2 living room has to be heated with direct electrical floor heating by DEVIcell™ heating system. The total heat loss has been calculated to 2240 W or specific heat loss is 2240 / 28 = 80 W/m^2. Power supply is 230 V.

Heated floor area is 28 m^2: 4 x 2 m^2 and 4 x 5 m^2 packages of DEVIcell™ are chosen. Mounting set for sensor (plastic pipe / conduit) has to be used too.

Calculated cable heating system output with safety coefficient of 1,3 is 80 W/m^2 · 1,3 = 104 W/m^2.

An installed heat density of 100 W/m^2 is chosen by means of DEVIflex™ 10T with 10 W/m (230 V) at DEVIcell™ with fixed C-C = 10 cm.

The power required by cables is therefore 28 m^2 · 100 W/m^2 = 2800 W.

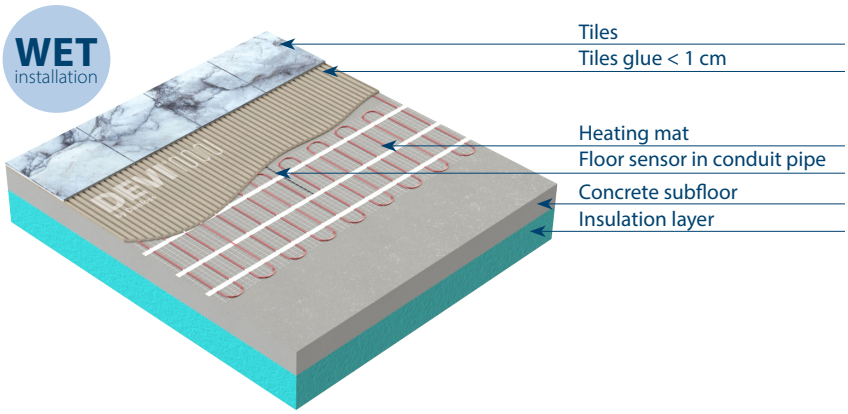
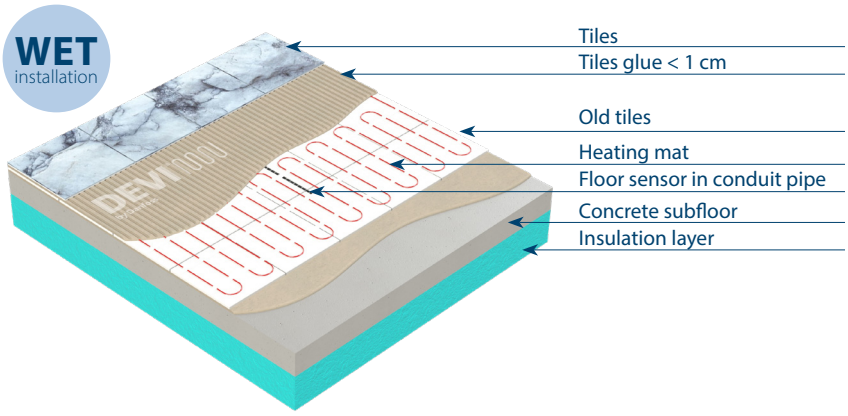
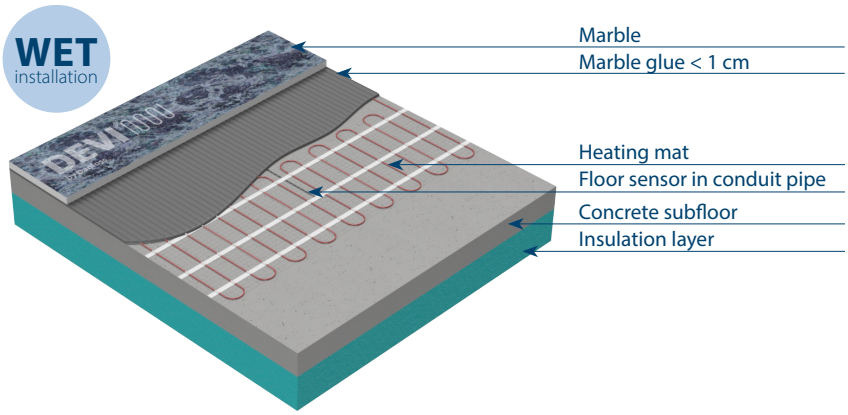
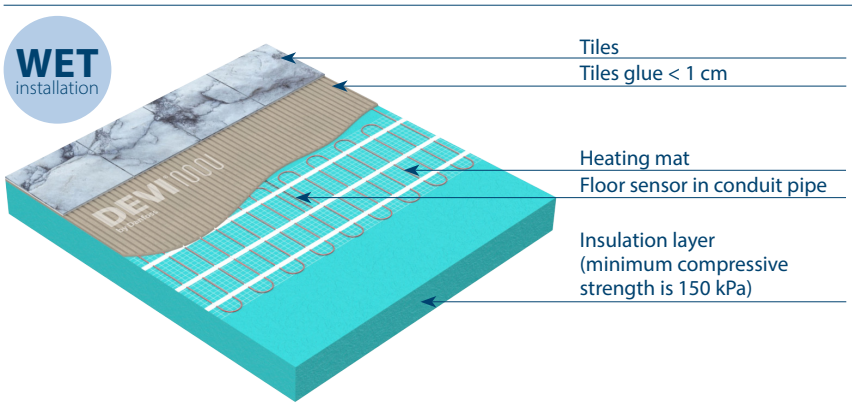
To avoid one excessive cable, 2 cables DEVIflex™ 10T of 1410 W (230 V) can be chosen and sum output is 2820 W.

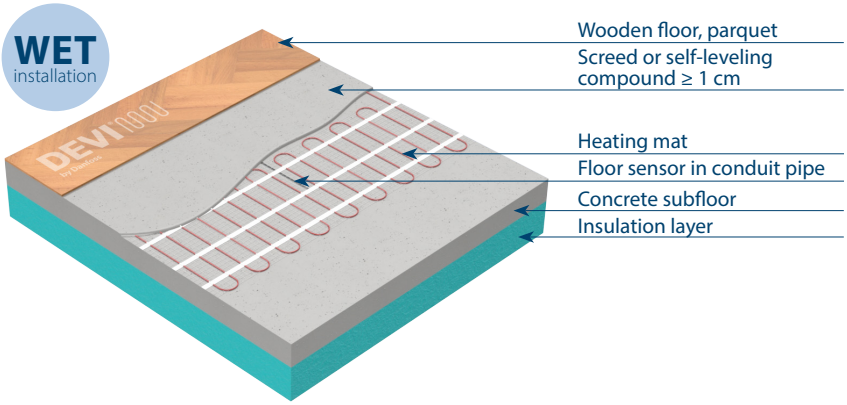
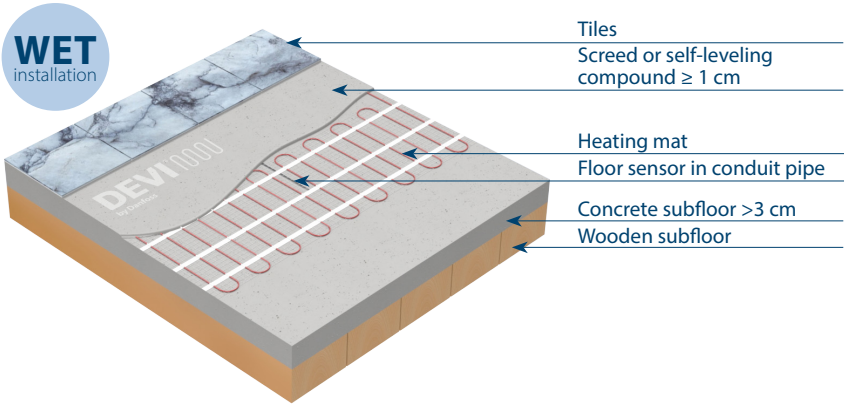
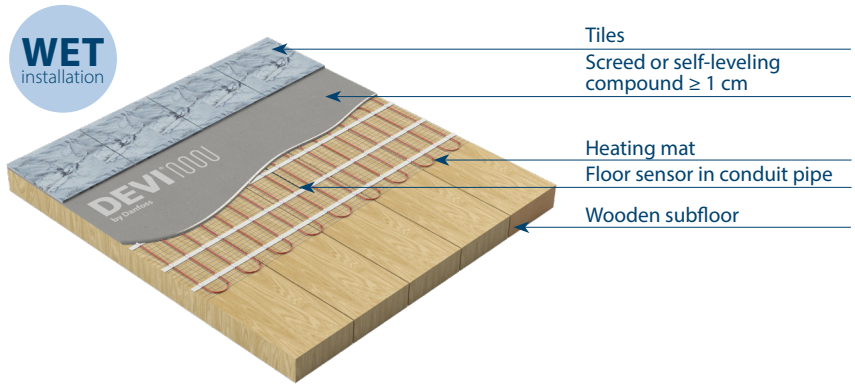
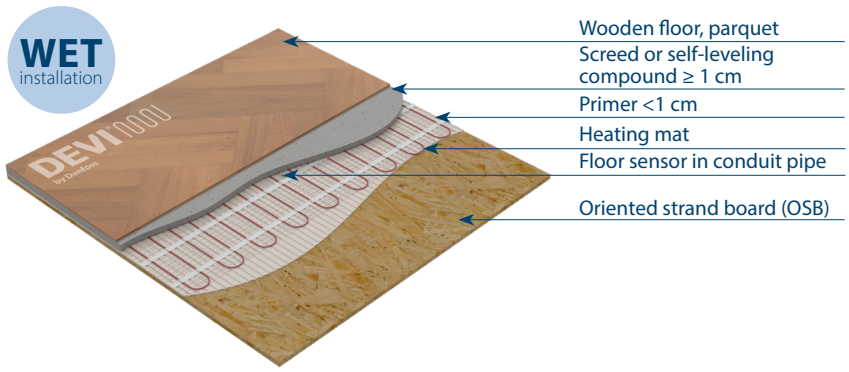
Note! Cable length is exactly equal to the installation area, e.g. cables will be installed close to its borders. This results in a danger, that the cables cannot be installed on this area, and need to cut off part of one cable could arise. However cutting the heating cable is strictly forbidden. To avoid this, you should select the cables length nearest but lesser to calculated. So if it's necessary, due to lack of space, 2 cables of 120 m with sum length of 260 m, can be chosen as an alternative.

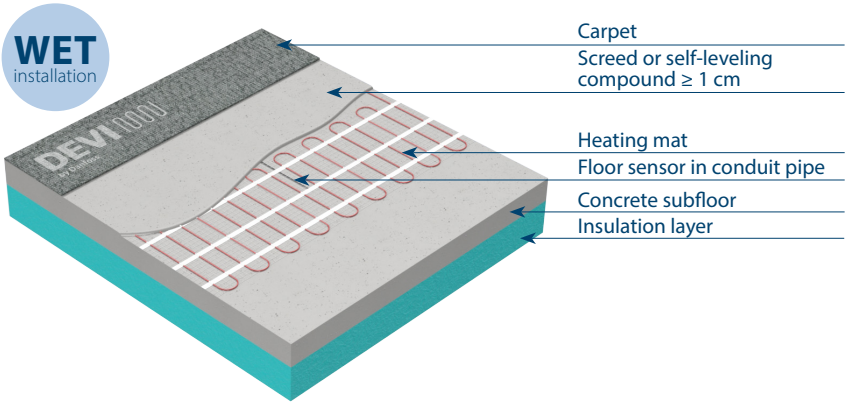
Thermostat for direct heating system and temperature limiting feature has to be selected: with a room/air sensor and floor sensor. A choice can be made: DEVIreg™ Display Connect, DEVIreg™ InControl, DEVIreg™ Touch, DEVIreg™ Room or DEVIreg™ Solo.

3.5 Tables

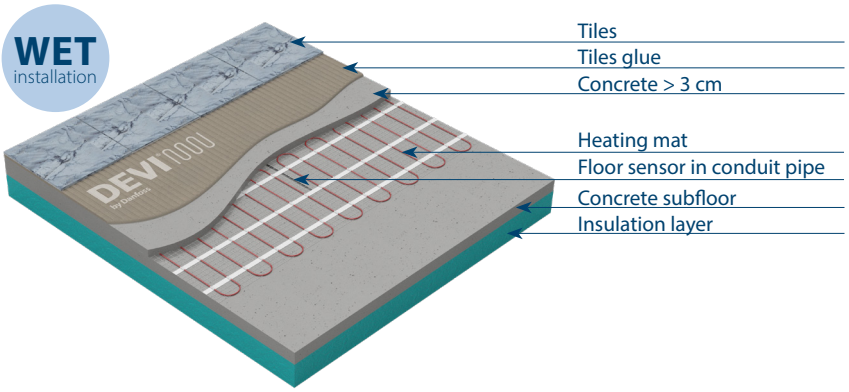
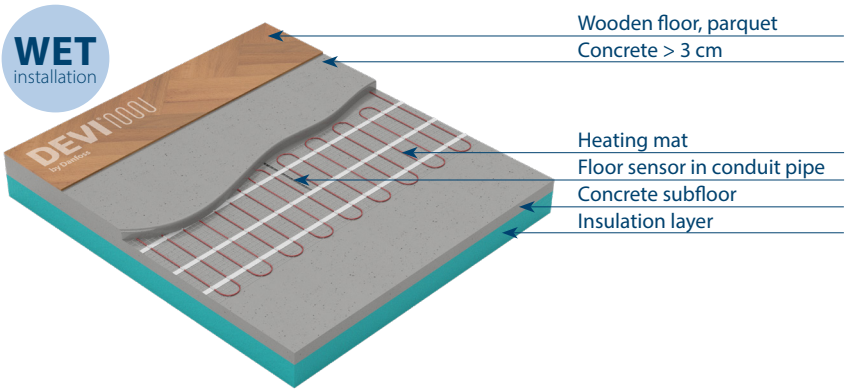
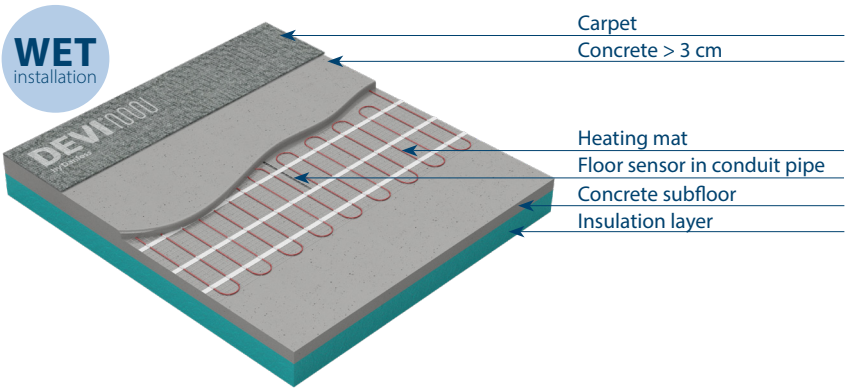
Thin heating mats

Floor construction	Specific output, W/m²	Products
	Max. 200	**Heating mats:** DEVImat™ 150T/200T DEVImat™ 70T/100T DEVIcomfort™ 100T/150T DEVIheat™ 150S **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm
	Max. 200	**Heating mats:** DEVImat™ 150T/200T DEVImat™ 70T/100T DEVIcomfort™ 100T/150T DEVIheat™ 150S **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm
	Max. 200	**Heating mats:** DEVImat™ 150T/200T DEVImat™ 70T/100T DEVIcomfort™ 100T/150T DEVIheat™ 150S **Accessories:** Floor sensor Flexpipe Ø6,7 mm, 2,5 m AstroFlex Ø8,5 mm, roll 50 m
	Max. 150	**Heating mats:** DEVImat™ 150T/200T DEVImat™ 70T/100T DEVIcomfort™ 100T/150T DEVIheat™ 150S **Accessories:** Floor sensor Flexpipe Ø6,7 mm, 2,5 m AstroFlex Ø8,5 mm, roll 50 m

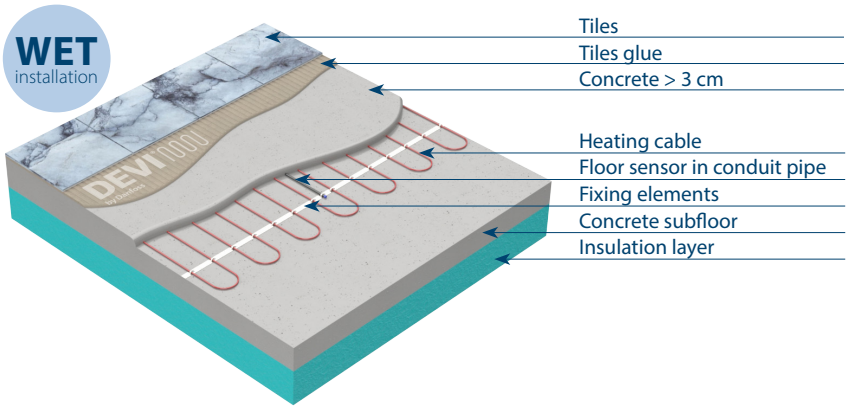
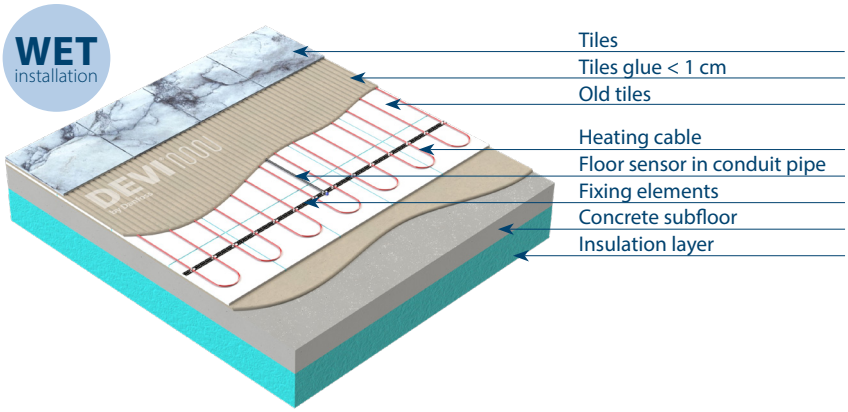
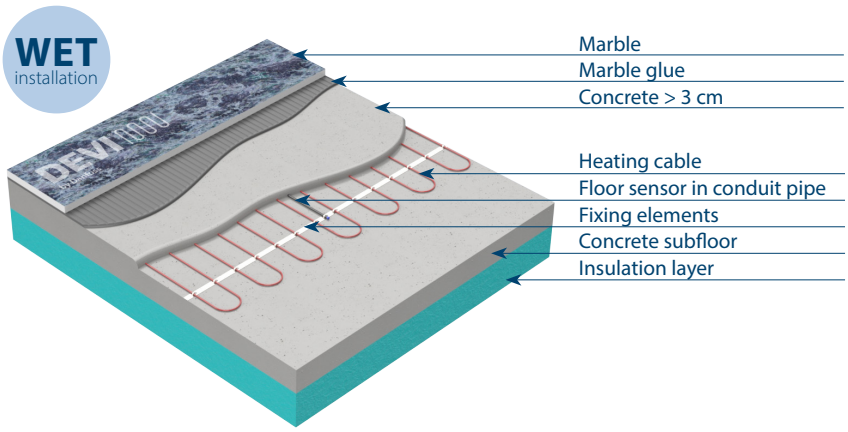
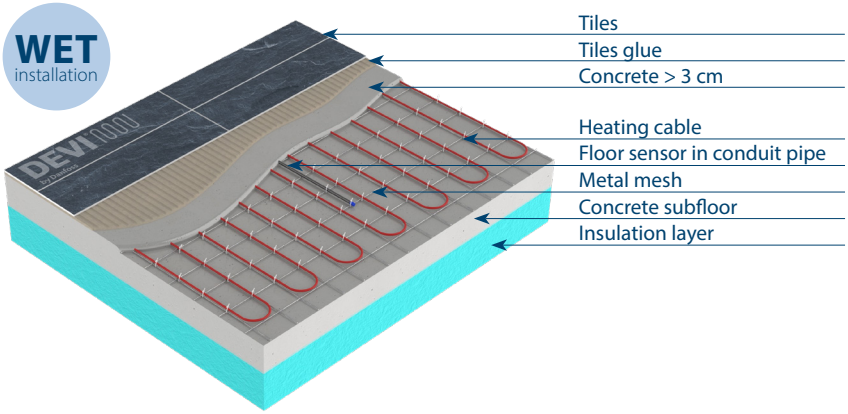
Floor construction	Specific output, W/m²	Products
	Max. 100	**Heating mats:** DEVImat™ 70T/100T DEVIcomfort™ 100T **Accessories:** Floor sensor Flexpipe Ø6,7 mm, 2,5 m AstroFlex Ø8,5 mm, roll 50 m
	Max. 150	**Heating mats:** DEVImat™ 150T DEVImat™ 70T/100T DEVIcomfort™ 100T/150T DEVIheat™ 150S **Accessories:** Floor sensor Flexpipe Ø6,7 mm, 2,5 m AstroFlex Ø8,5 mm, roll 50 m
	Max. 100	**Heating mats:** DEVImat™ 70T/100T DEVIcomfort™ 100T **Accessories:** Floor sensor Flexpipe Ø6,7 mm, 2,5 m AstroFlex Ø8,5 mm, roll 50 m
	Max. 100	**Heating mats:** DEVImat™ 70T/100T DEVIcomfort™ 100T **Accessories:** Floor sensor Flexpipe Ø6,7 mm, 2,5 m AstroFlex Ø8,5 mm, roll 50 m

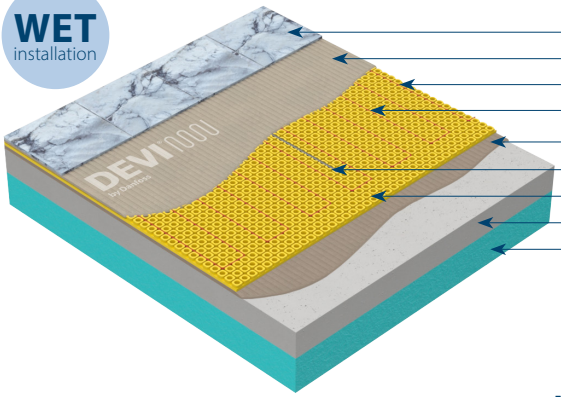
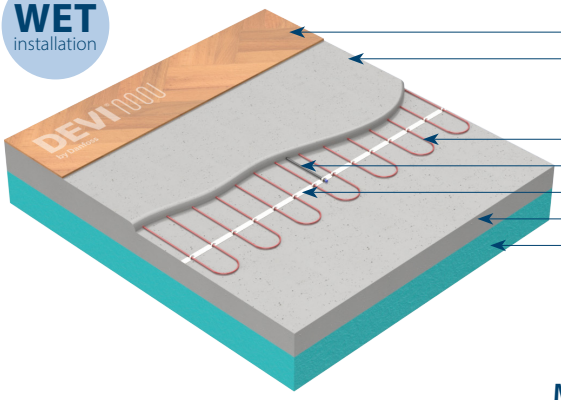
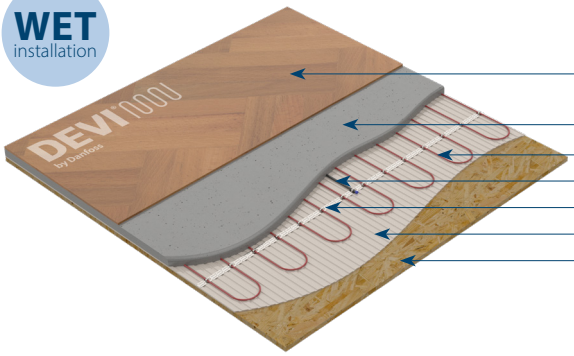
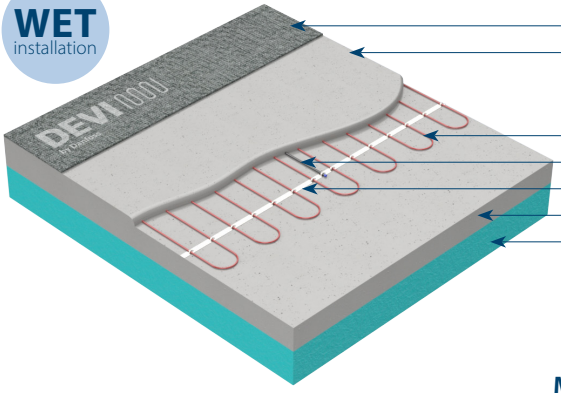
Floor construction	Specific output, W/m²	Products
	Max. 100	**Heating mats:** DEVImat™ 70T/100T DEVIcomfort™ 100T **Accessories:** Floor sensor Flexpipe Ø6,7 mm, 2,5 m AstroFlex Ø8,5 mm, roll 50 m

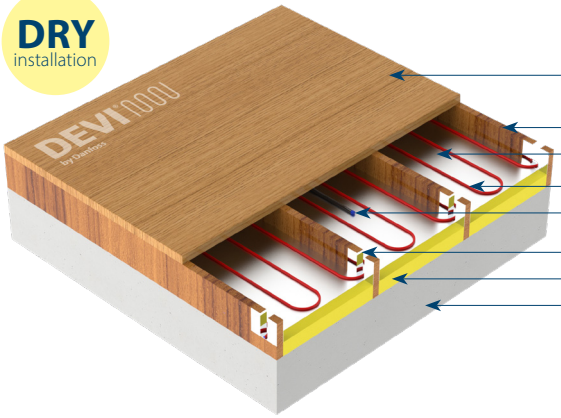
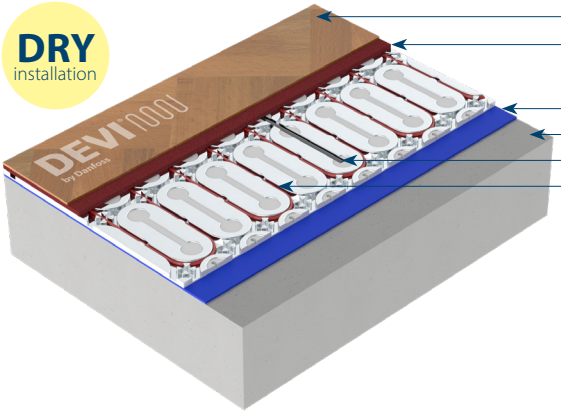
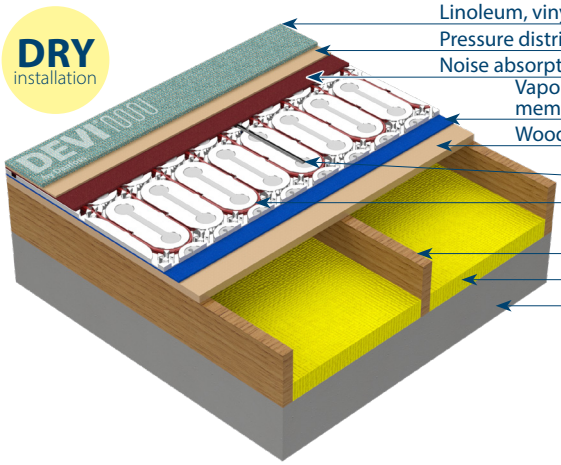
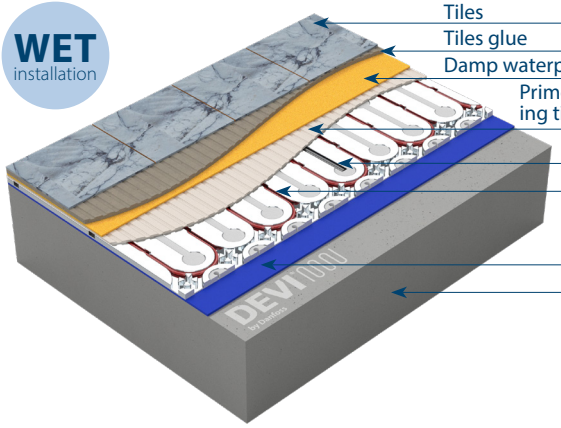
Thick heating mats

Floor construction	Specific output, W/m²	Products
	Max. 200	**Heating mats:** DEVIflex™ 75T/100T/150T/175T **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm
	Max. 150	**Heating mats:** DEVIflex™ 75T/100T/150T **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm
	Max. 100	**Heating mats:** DEVIflex™ 75T/100T **Accessories:** Floor sensor Flexpipe Ø6,7 mm, 2,5 m AstroFlex Ø8,5 mm, roll 50 m

Heating cables

Floor construction	Specific output, W/m²	Products
	Max. 200	**Heating cables:** DEVIflex™ 6T/10T/18T DEVIcomfort™ 10T DEVIbasic™ 10S/20S **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** DEVIfast™ DEVIclip™ C-C
	Max. 200	**Heating cables:** DEVIcomfort™ 10T concrete thickness above the cable can be >1 cm **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** DEVIfast™ DEVIclip™ C-C
	Max. 200	**Heating cables:** DEVIflex™ 6T/10T/18T DEVIcomfort™ 10T DEVIbasic™ 10S/20S **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** DEVIfast™ DEVIclip™ C-C
	Max. 200	**Heating cables:** DEVIflex™ 6T/10T/18T DEVIcomfort™ 10T DEVIbasic™ 10S/20S **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** Metal mesh DEVIclip™ Twisto

Floor construction	Specific output, W/m²	Products
WET installation  Tiles Tiles glue Uncoupling membrane Heating cable Adhesive Floor sensor in conduit pipe Fixing elements Concrete subfloor Insulation layer **Max linear output: 10 W/m**	Max. 100	**Heating cables:** DEVIcomfort™ 10T **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm
WET installation  Wooden floor, parquet Concrete > 3 cm Heating cable Floor sensor in conduit pipe Fixing elements Concrete subfloor Insulation layer **Max linear output: 10 W/m**	Max. 150	**Heating cables:** DEVIflex™ 6T/10T DEVIcomfort™ 10T DEVIbasic™ 10S **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** DEVIfast™ DEVIclip™ C-C
WET installation  Wooden floor, parquet Screed or self-leveling compound ≥ 1 cm Heating cable Floor sensor in conduit pipe Fixing elements Primer <1 cm Oriented strand board (OSB) **Max linear output: 10 W/m**	Max. 100	**Heating cables:** DEVIcomfort™ 10T **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** DEVIfast™ DEVIclip™ C-C
WET installation  Carpet Concrete > 3 cm Heating cable Floor sensor in conduit pipe Fixing elements Concrete subfloor Insulation layer **Max linear output: 10 W/m**	Max. 100	**Heating cables:** DEVIflex™ 6T/10T DEVIcomfort™ 10T DEVIbasic™ 10S **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** DEVIfast™ DEVIclip™ C-C

Floor construction	Specific output, W/m²	Products
DRY installation  Wooden floor Wooden joists Metal mesh or foil Heating cable Floor sensor in conduit pipe Fixing elements Insulation layer Concrete subfloor **Max linear output: 10 W/m**	Max. 80	**Heating cables:** DEVIflex™ 6T/10T DEVIcomfort™ 10T DEVIbasic™ 10S **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** Tape
DRY installation  Parquet Noise absorption layer Vapor barrier or damp-proof membrane Concrete subfloor Floor sensor in conduit pipe Heating cable **Max linear output: 10 W/m**	Max. 100	**Heating cables:** DEVI flex™ 6T/10T **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** DEVIcell™ Tape aluminum Connective clips Edge plates
DRY installation  Linoleum, vinyl or carpet Pressure distribution board, min. 5 mm Noise absorption layer Vapor barrier or damp-proof membrane Wooden subfloor Floor sensor in conduit pipe Heating cable Wooden joists Insulation layer Concrete subfloor **Max linear output: 6 W/m**	Max. 60	**Heating cables:** DEVIflex™ 6T **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** DEVIcell™ Tape aluminum Connective clips Edge plates
WET installation  Tiles Tiles glue Damp waterproof membrane Primer (must be suitable for installing tiles on an aluminum plate) Floor sensor in conduit pipe Heating cable Vapor barrier or damp-proof membrane (applicable for ground floor) Stable subfloor (e.g. concrete) **Max linear output: 10 W/m**	Max. 100	**Heating cables:** DEVIflex™ 6T/10T **Accessories:** Floor sensor Flexpipe Ø6,7 mm AstroFlex Ø8,5 mm **Fixing elements:** DEVIcell™ Tape aluminum Connective clips Edge plates

4. Product selection

Electrical floor heating system consists of two main components:

- Heating element (cable, thin heating mat, or heating element for laminate floors, etc.);
- Thermostat with air or/and floor temperature sensors.

4.1 Heating cables

Heating cables are usually installed in thick/concrete floor constructions. The main feature of a thin heating mat is its low thickness. This gives the possibility for it to be installed in a thin layer of tile glue avoiding considerable increase of floor level.

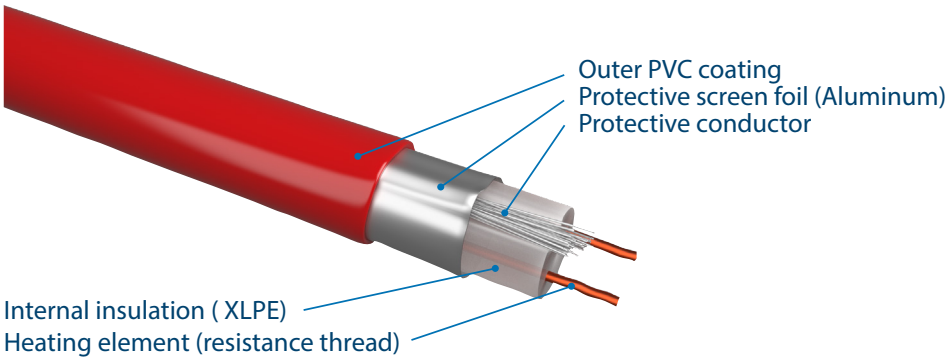
DEVI heating cable (e.g. DEVIflex™) is designed for installation in thick concrete floor constructions. Usual thickness of top/finish floor layer is at least 3 cm. Heating cables used in floor constructions are serial resistive cables, preferably twin conductor, but also a limited range of single conductor cable is available. Cables are manufactured as ready-to-install heating elements with specific length (i.e. 7, 10, 15, up to approx. 410 m), with a power supply cable (cold tail) and hermitically closed connections (muffs or end terminations).

Output of heating cables for installation in floor constructions is limited to 20 W/m and DEVI cables are available with 6, 10, 18 and 20 W/m for 230 and 400 V. Most DEVI cables are manufactured and approved in accordance with the latest version of IEC 60800:2009, with mechanical strength class M2 (for rough concrete constructions). The main type of DEVI heating cables for installation in the floor construction is DEVIflex™.

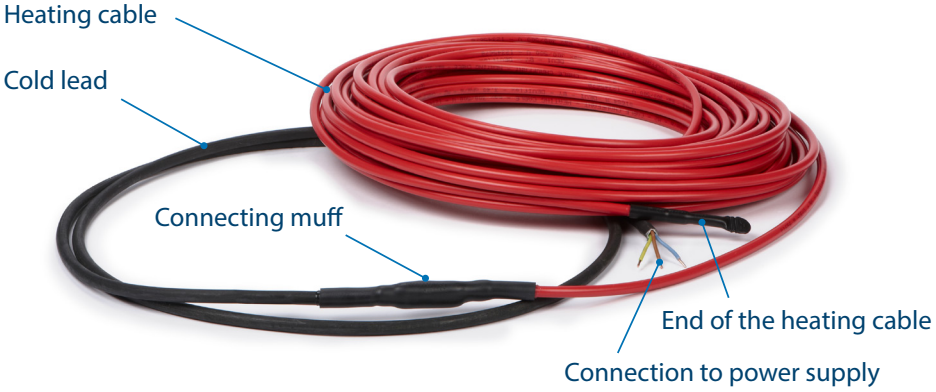
Internal and external design of modern DEVIflex™ cable is shown in the figures below.

Products:

- **Twin conductor**
  DEVIflex™ 6T,
  DEVIflex™ 10T and
  DEVIflex™ 18T;
- DEVIcomfort™ 10T
  (can be used in thin floor constructions);
- **Single conductor**
  DEVIbasic™ 10S;
  DEVIbasic™ 20S (230/400 V);



DEVIflex™ twin conductor heating cable construction



DEVIflex™ 6T/10T/18T heating cable

4.2 Heating mats

The thin heating mat is designed for installation in a thin tile glue layer adhesive, self-leveling mixture or alike. The standard minimum thickness of the floor layer is 5-8 mm while the thickness of DEVI mats is 3-4,5 mm. It allows minimizing the floor level increase.

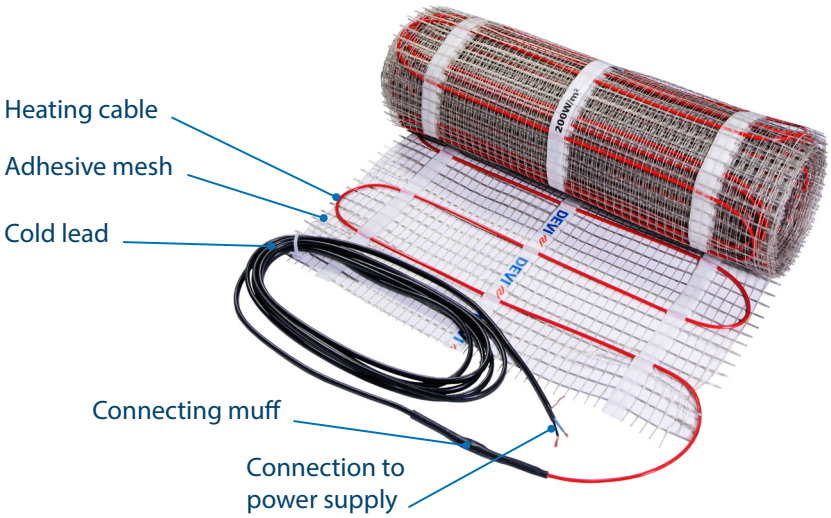
DEVI thin heating mats consist of a thin cable fixed on self-adhesive glass-fiber mesh usually of 50 cm width. Thin heating cables are serial twin or single conductor resistive cables. Thin heating mats are manufactured as ready-made heating sections with a specific area (i.e. 0,5, 1, 1,5 … 12 m^2) including a power supply cable (cold tail) and hermetically sealed connections.

Thin heating mats are available with various outputs, for example: 70 W/m^2, 100 W/m^2, 150 W/m^2 and 200 W/m^2. DEVI thin heating mats comply with IEC 60335-1 & IEC 60335-2-96.

Products:

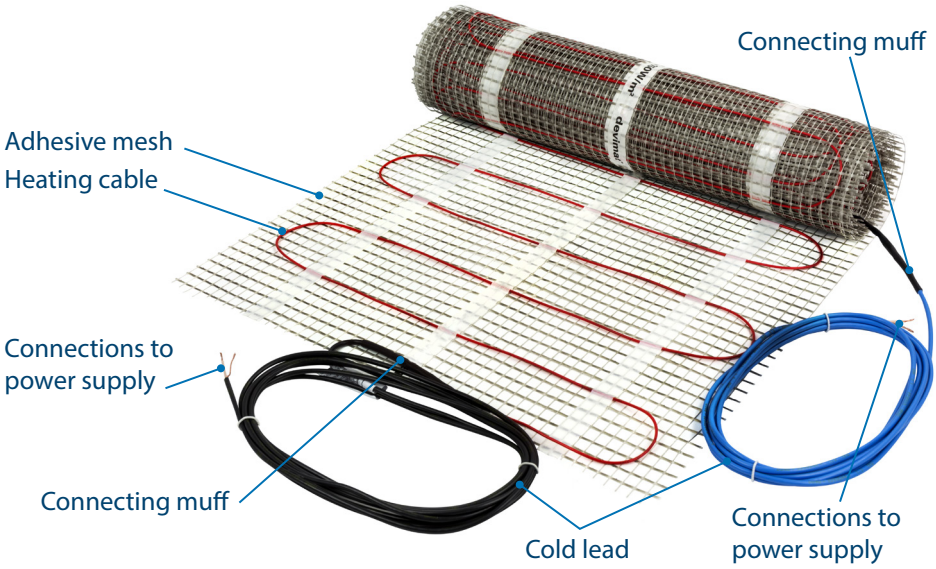
- **Thin twin conductor heating mats:**
  DEVImat™ 70T,
  DEVImat™ 100T,
  DEVImat™ 150T and
  DEVImat™ 200T,
  DEVIcomfort™ 100T,
  DEVIcomfort™ 150T;
- **Thick twin conductor heating mats:**
  DEVIflex™ 50T,
  DEVIflex™ 75T,
  DEVIflex™ 100T,
  DEVIflex™ 150T and
  DEVIflex™ 175T (should be used in thick floor constructions, more than 3 cm of screed);
- **Single conductor heating mats:**
  DEVIheat™ 150S;

Twin conductor heating mat



DEVImat™ 70T/100T/150T/200T heating mat

Single conductor heating mat



DEVIheat™ 150S heating mat

4.3 Other heating elements

DEVI heating cables and thin heating mats mentioned above are the most used floor heating elements. DEVI also produces other floor heating elements, i.e. DEVIcell™ Low Carbon heat distribution panels for heating constructions with wooden surface (laminate, multi-layer boards, parquet, etc.) or/and on wooden subfloors.

DEVIcell™ LowCarbon combines floor heating with integrated thermal insulation, providing a thermal resistance (R-value) of 0.26 m^2·K/W. DEVIcell™ LowCarbon Insulation plate covered with aluminum and readymade groves for easy and fast installation of DEVIflex™ 6T, 10T heating cables. The full covering **75% recycled aluminium**



effect ensures faster reaction time and an even heat distribution for the top floor.

DEVIcell™ LowCarbon a special system for new floor installed on top of all existing floors or sub floors.

For further information please refer to the DEVI Product Catalogue and data sheets.

4.4 Thermostats

DEVI offers specialized thermostats for electrical floor heating systems. All thermostats are electronic devices allowing precise control of the floor surface or air temperatures. In general three types of thermostats are available:

- for air/room temperature control and limitation of floor temperatures – with room sensor and floor sensor;
- for floor temperature control – with floor sensor only;

DEVI offers thermostats that are:

- Intelligent and PWM regulated (Pulse Width Modulation);
- Simple (hysteresis regulated).

Intelligent thermostats provide state-of-the-art wireless control system for control of heating and electrical units in private houses. Some thermostats are fitted with Wi-Fi allowing remote control of heating systems via mobile application.

Simple thermostats are electronic control units with or without display allowing setting the heating system type, adjustment of control parameters and timer mode.



DEVI Connect

DEVI Connect Zigbee gateway and app make it easy to manage your Zigbee-enabled devices. DEVI Connect is designed for the end user to access the most important features from anywhere at any time.

Suitable for **DEVIreg™ Display Connect** and **DEVIreg™ InControl**.

Think of the app as a remote control for your smart home, allowing you to adjust settings and monitor devices from anywhere. The gateway acts like a translator, helping your devices communicate with the app smoothly. The gateway only needs to be plugged into the users internet router, where it will then be possible to add to the app.



Bluetooth zigbee certified product

DEVIreg™ Display Connect

DEVIreg™ Display Connect is an intuitive programmable timer thermostat, with both Bluetooth and Zigbee connectivity option for combined, room or floor temperature control, complying with Eco design Lot 20, used for controlling electrical floor heating elements. The thermostat is designed for fixed installation only. Due to the special designed 2-part construction it fits a wide range of frames. The thermostat features a dial and display feature enabling intuitive control.

DEVIreg™ Display Connect is fast and intuitive to setup using the wizard in the Bluetooth app. It has an energy saving program - including an optimum start (pre-heat) control ensuring the desired temperature, with a wide range of floor sensors, at the correct time and thereby may help reduce costs depending on operating conditions.

Among others, the thermostat has the following features:

- Ecodesign LOT20 compliance
- In App setup for specific flooring and room types.
- Support for 55x55 like frame systems.
- Simple knob operation for temp. control and features.
- Bluetooth connectivity on 2.4GHz frequency at a maximum power of 10 dBm.
- Access to thermostat via App for settings for easy access, setup, or remote troubleshooting. Firmware update via DEVI Control App.
- Works out of box with default parameters as thermostat.
- Ecodesign class TW(f4)



Bluetooth zigbee certified product

DEVIreg™ InControl

DEVIreg™ InControl is an intuitive programmable timer thermostat, with both Bluetooth and Zigbee connectivity option for combined, room or floor temperature control, complying with Eco design Lot 20, used for controlling electrical floor heating elements. The thermostat is designed for fixed installation only. The thermostat features a dial and display feature enabling intuitive control.

DEVIreg™ InControl is fast and intuitive to setup using the wizard in the Bluetooth app. It has an energy saving program - including an optimum start (pre-heat) control ensuring the desired temperature, with a wide range of floor sensors, at the correct time and thereby may help reduce costs depending on operating conditions.

Among others, the thermostat has the following features:

- Ecodesign LOT20 compliance
- In App setup for specific flooring and room types.
- Support for Danish frame systems.
- Simple knob operation for temp. control and features.
- Bluetooth and zigbee connectivity on 2.4GHz frequency at a maximum power of 10 dBm.
- Display for ease of use.
- Access to thermostat via App for settings for easy access, setup, or remote troubleshooting. Firmware update via Bluetooth using DEVI Control or Zigbee using DEVI Connect App.
- Works out of box with default parameters as thermostat.



DEVIreg™ Touch

DEVIreg™ Touch is a thermostat fitted with a display and an intelligent timer. It is designed for flush-mount installation into a standard wall installation box. It operates with two sensors – floor wire and built-in room sensor. It allows control setting for one of 3 heating systems: with wire floor temperature sensor, with built-in room sensor or with built-in room sensor and wire floor sensor for limitation of floor temperature. The touch screen menu and intuitive user friendly interface allow easy use and quick service. The thermostat has four original colors – polar white, pure white, ivory and black. It can be installed in complex frames of different manufacturers.

DEVIreg™ Touch is fast and intuitive to setup using the built-in wizard. It has an energy saving program – including optimum start/end control ensuring the desired temperature at the correct time and thereby reducing heating costs.



Bluetooth

DEVIreg™ Room

DEVIreg™ Room Polar white is an intuitive programmable timer thermostat, for combined, room or floor temperature control, complying with Eco design Lot 20, used for controlling electrical floor heating elements, according to the room temperature. The thermostat is designed for fixed installation only. Due to the special designed 2-part construction it fits a wide range of frames. The thermostat features a dial for manual temperature setting, feature enabling and intuitive control.

DEVIreg™ Room Polar white is fast and intuitive to setup using the in app wizard. It has an energy saving program - including an optimum start (pre-heat) control ensuring the desired temperature, with a wide range of floor sensors, at the correct time and thereby may help reduce costs depending on operating conditions.

Among others, the thermostat has the following features:

- ECO design LOT20 compliance
- In App setup for specific flooring and room types.
- Support for 55x55 like frame systems.
- Simple knob operation for temp. control and features.
- Bluetooth connectivity on 2.4GHz frequency at a maximum power of 10 dBm.
- Access to thermostat via App for settings for easy access, setup, or remote troubleshooting. Firmware update via DEVI Control App.
- Works out of box with default parameters as thermostat.



DEVIreg™ Solo

DEVIreg™ Solo is an intuitive, programmable timer thermostat for combined room or floor temperature control, compliant with EcoDesign Lot 20. It is used to control electrical floor heating elements based on the room temperature.

The thermostat is designed for fixed installation only. Due to its specially designed two-part construction, it fits a wide range of frames. The thermostat features a color touchscreen display, providing intuitive control.

DEVIreg™ Solo is quick and easy to set up using the Setup Wizard, directly from the screen. It includes energy-saving programs such as PWM regulation, a weekly schedule, and open window detection, along with a wide range of compatible floor sensors, significantly reducing heating costs.

If a floor temperature sensor is not available, you can use the thermostat's power regulation mode.



Bluetooth

DEVIreg™ Basic

DEVIreg™ Basic Polar white is an intuitive programmable timer thermostat, for floor temperature control, complying with Eco design Lot 20, used for controlling electric floor heating elements. The thermostat is designed for fixed installation only. Due to the special designed 2-part construction it fits a wide range of frames in the 55 mm x 55 mm. The thermostat features a dial for manual temperature setting, feature enabling and intuitive control.

DEVIreg™ Basic Polar white is fast and intuitive to setup using the in app wizard. It has an energy-saving program - including an optimum start (pre-heat) control ensuring the desired temperature, at the correct time and thereby may help reduce costs depending on operating conditions.

Among others, the thermostat has the following features:

- ECO design LOT20 compliance
- In App setup for specific flooring and room types.
- Support for 55x55 like frame systems.
- Simple knob operation for temp. control and features.
- Bluetooth connectivity on 2.4 GHz frequency at a maximum power of 10 dBm.
- Access to thermostat via App for settings for easy access, setup, or remote troubleshooting. Firmware update via DEVI Control App.
- Works out of box with default parameters as thermostat.



DEVIreg™ Multi

DEVIreg™ Multi is 7 channel electronic programmable controller to be installed on DIN rail. Every channel can be individually set up with three control modes – with temperature sensor, time proportional power regulation without sensor and manually on/off with time limitation. Channels inputs can be selected via software between 8 types of temperature sensors including NTC 15 kOhm at 25°C. Modbus RS485 opto-insulated serial interface gives possibility for BMS control.

DEVIreg™ Multi has some special functions which can be programmed for every channel: relay status - opened or closed correspondently to 'Heating On' mode, channel activation or deactivation, sensor failure alarm, min and max temperatures alarm, cable failure monitoring, relay test, channel on/off, relay cycles calculator, etc.

More information about DEVI thermostats you can find further in this document and in the DEVI Product Catalogue and data sheets.

4.5 Fixing elements

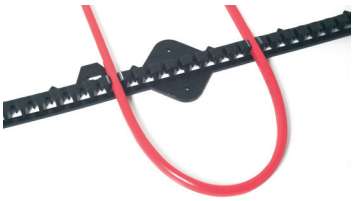
In case of heating cables application,it is recommended to use fittingbands to fix the cable to the base, e.g. DEVIfast™ metal galvanized fixing elements. It should be attached to the basement (e.g. nailed down) in parallel lines usually at intervals of 50 cm or using 2 meters of fixing elements per each square meter of cable installation. The same applies to DEVIclip™ C-C and Montagestege™ plastic bands. For quick cable fixing to reinforced mesh DEVIclip™ Twist plastic fixing is recommended.



Montagestege™



DEVIfast™



DEVIclip™ C-C



DEVIclip™ Twist

If we want to calculate the length of fixing elements (e.g. DEVIfast™, DEVIclip™ CC, Montagestege™), we first have to determine the distance between the fixing elements.

For concrete floors, where the cable is covered with 3 cm of concrete or more, and the cable's C-C distance is more than 10 cm, the distance between fixing elements can be recommended 0,5-0,75 m.

For thin floors where the cable is covered with 1-2 cm of self-levelling compound and the cable's C-C distance is 10 cm or less, the max. distance between fixing elements is recommended to 25 cm.

Below is a calculation formula for C-C distance.

$$\text{Length of fixing elements [m]} = \frac{\text{Heated floor space [m}^2\text{]}}{\text{Distance between fixing elements [m]}} + L_w \text{ [m]}$$

L_w is the length of the wall parallel to fixing elements installation.

Example.

The heated floor space is 1 m x 2 m = 2 m^2.

If we install DEVIfast™ fixing elements in parallel to a 1 m wall (see fig. 1) and the distance between the DEVIfast™ fixing elements is 0,5 m, a fixing elements with the following length is required:

$$\frac{2\ m^2}{0{,}5\ m} + 1\ m = 5\ m.$$

If we install DEVIfast™ fixing elements in parallel to a 2 m wall (see fig. 2) and the distance between the DEVIfast™ fixing elements is 0,5 m, a fixing elements of the following length is needed:

$$\frac{2\ m^2}{0{,}5\ m} + 2\ m = 6\ m.$$

As we can see from this example, the fixing elements length may vary although the area and the distance between fixing elements remain the same.

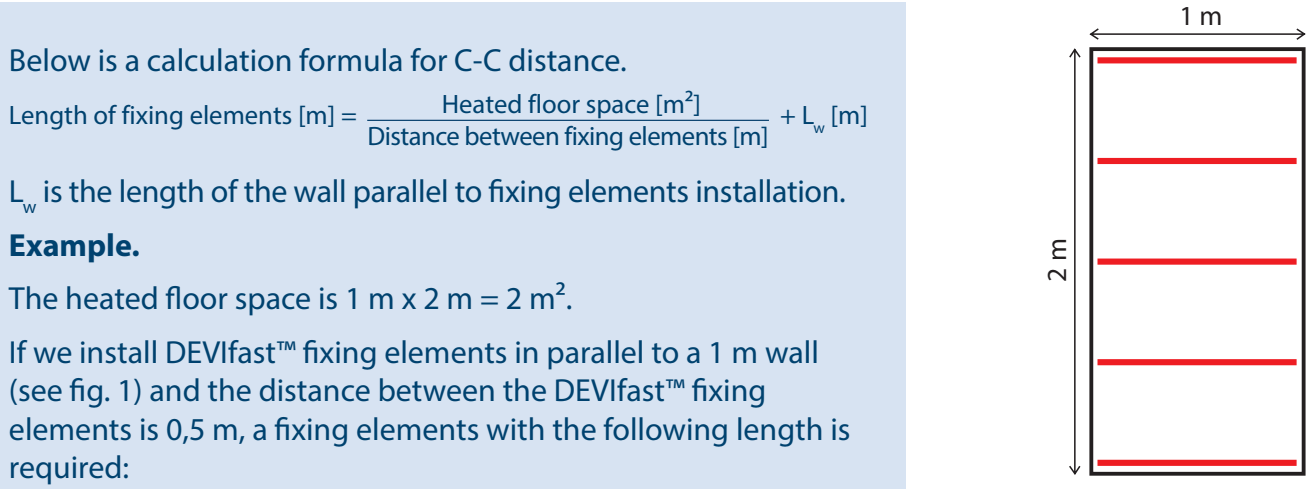


Fig. 1 - Fixing elements installed in parallel to a 1 m wall.

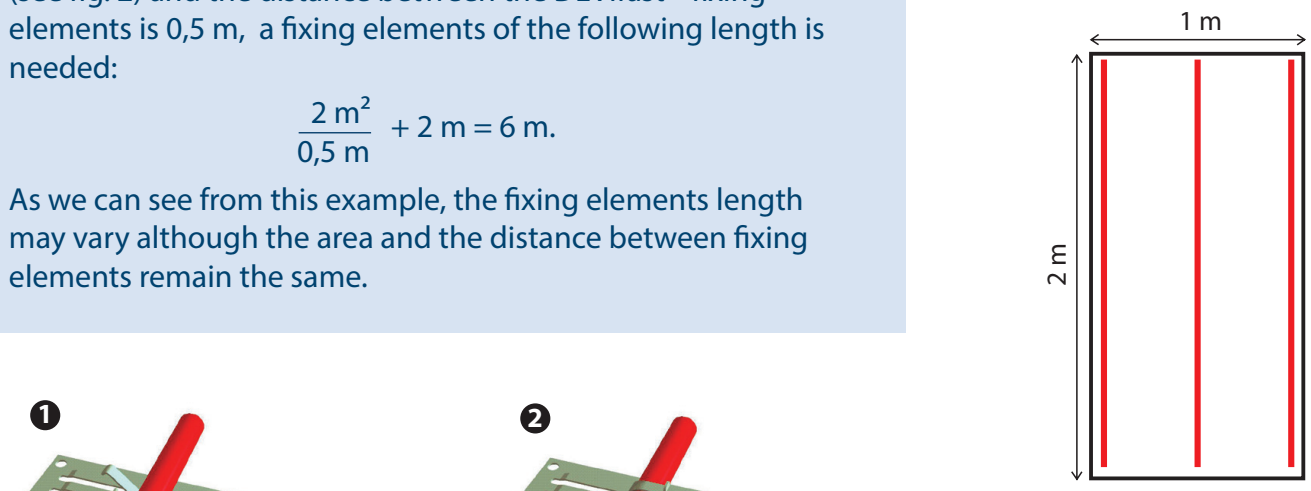
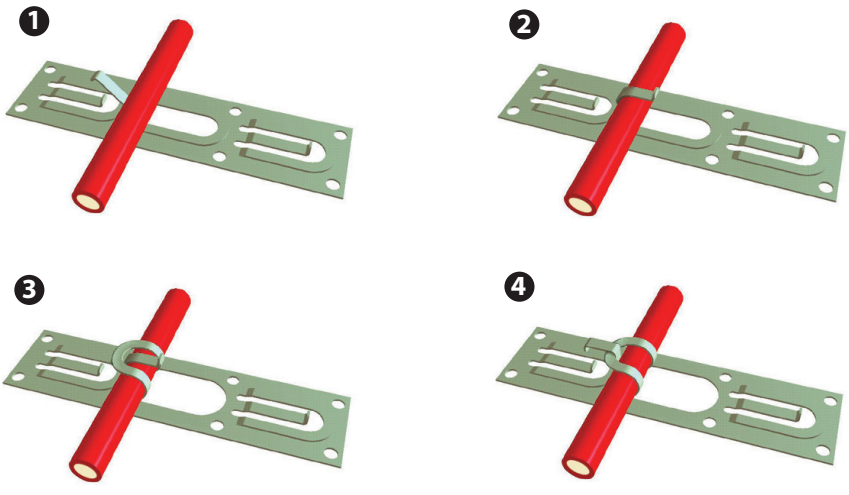


Fig. 2 - Fixing elements installed in parallel to a 2 m wall.



Fixing of the heating cable on the DEVIfast™ fixing elements

5. Installation process

5.1 Installation instructions

5.1.1 Installation of heating cables in thick floor constructions

Installation and floor construction

Floor construction has to be done according to the building standards. Generally a floor construction with electrical heating element (cable or mat), installed in a concrete layer, does not have any special demands and restrictions.

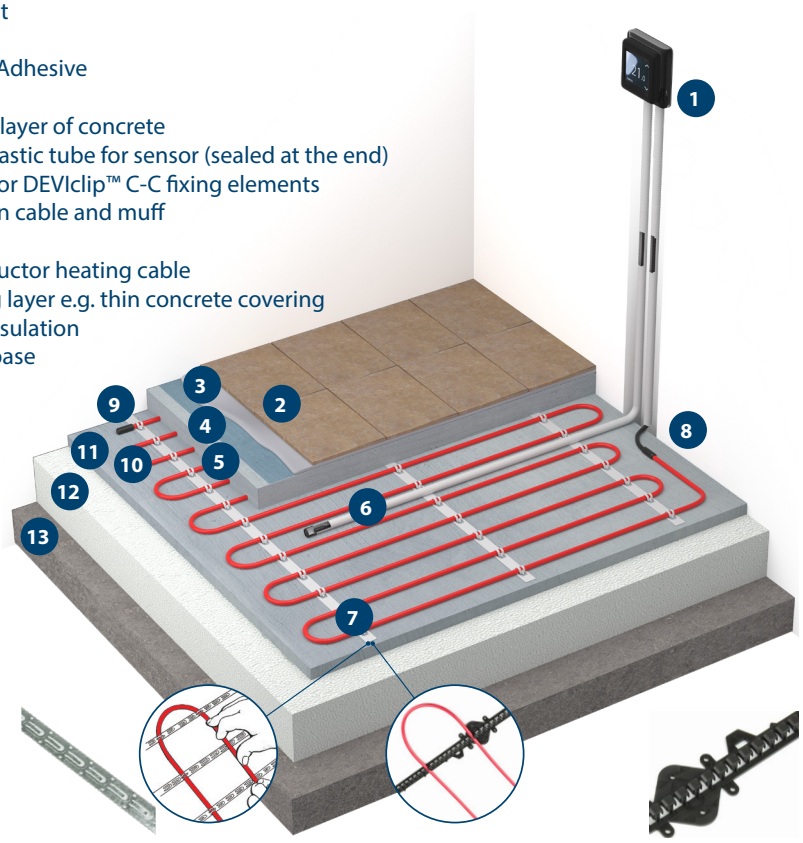
It is advisable however to install a dampening layer in vertical parts of floor slab, adjacent to walls (and especially external walls), of e.g. soft tape min. 5 mm thick, thin thermal insulation (minimum compressive strength is 150 kPa) or alike. It gives possibility to respond to the horizontal expansibility of the floor construction and to prevent cracking of the floor.

The need for reinforcement of floor construction should be fulfilled according to local building norms.

Minimum cable-to-cable distance is based on cables outer diameter, and it is 6x its diameter. Practically it means ~5 cm between any two cable lines.

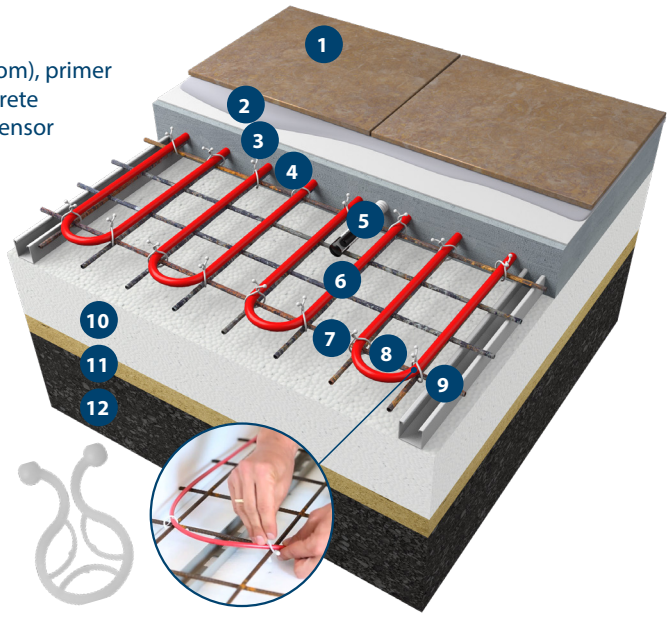
Concrete floor constructions with cable heating system and different types of fixing are shown on figure.

1. Thermostat
2. Tiles
3. Tiles glue/Adhesive
4. Primer
5. Finish/top layer of concrete
6. Conduit plastic tube for sensor (sealed at the end)
7. DEVIfast™ or DEVIclip™ C-C fixing elements
8. Connection cable and muff
9. End muff
10. Twin conductor heating cable
11. Separating layer e.g. thin concrete covering
12. Thermal insulation
13. Concrete base



Cable heating in concrete floor with cable fixed by DEVIfast™ or DEVIclip™ C-C fixing elements

1. Tiles
2. Tiles glue/Adhesive
3. Damp proofing (wet room), primer
4. Finish/top layer of concrete
5. Conduit tube for floor sensor
6. DEVI heating cable
7. Reinforcing mesh
8. DEVIclip™ Twist fastening
9. Spacer for reinforcing mesh
10. Thermal insulation
11. Leveling layer
12. Concrete base

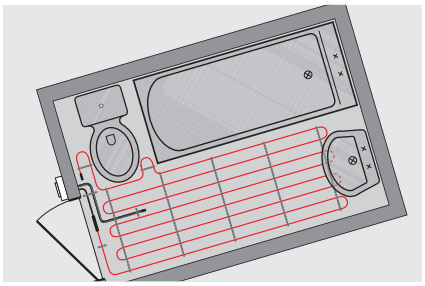


Cable heating in concrete with cable fixed to reinforcement mesh by DEVIclip™ Twist

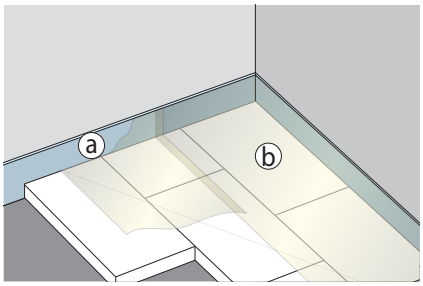
Installation steps for cable heating system in concrete



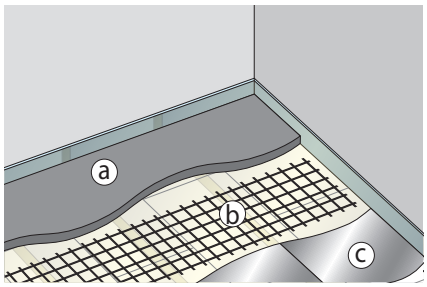
1. Cable heating system: heating cable, thermostat with floor temperature sensor, fixing elements, conduit pipe.



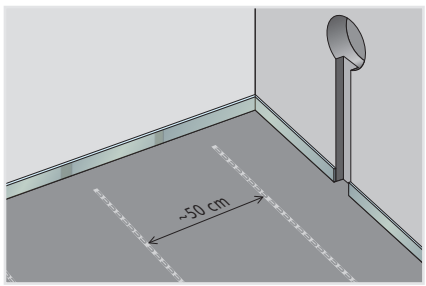
2. Draw a plan in order to position heated area, cable, cold tail, floor sensor, thermostat and connection box, if any.



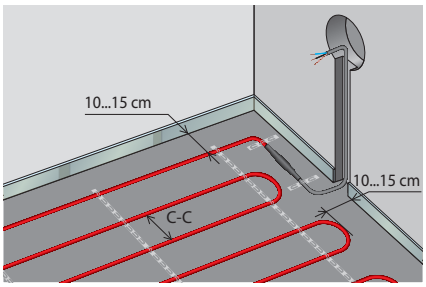
3. Install insulation: deformation tape (a), thermal insulation (b).



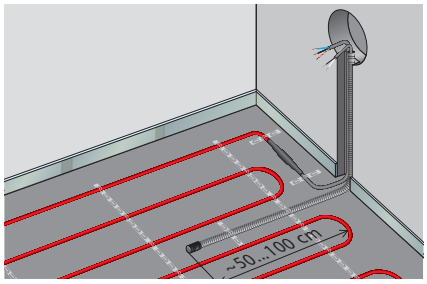
4. Install separating layer, e.g. concrete (a), metal mesh (b) or aluminum foil (c).



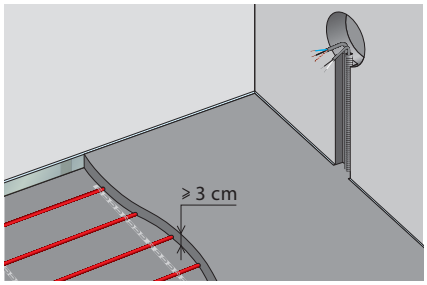
5. Fasten DEVIfast™ fixing elements in 50 cm distance (by nails, screws, dowels, hot melt glue etc.).



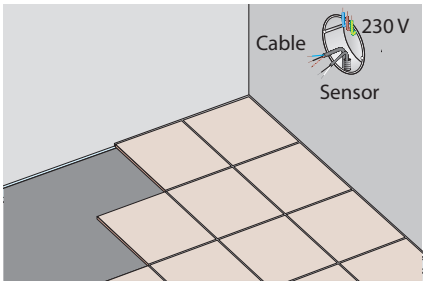
6. Check resistance and insulation values of cable. Install heating the heating cable: app. 10-15 cm from the walls. For comfort heating preferred C-C = 7,5 cm.



7. Install conduit pipe for floor sensor (must be sealed at the end installed in concrete). Check resistance of sensor before installing in pipe.



8. Check resistance and insulation values of cable and sensor. Apply concrete.



9. Check resistance and insulation values of cable and resistance of sensor. Install flooring and connect thermostat.

Additionally, refer to the installation instructions supplied with each component of the heating system (heating cable, mat, and thermostat).

The heating cable must be securely fixed to the floor substrate to prevent movement during the installation of the concrete screed. The formation of air voids around the cable during the screed installation must be avoided.

Heating cable runs must not touch or cross each other. Failure to comply with this requirement may result in cable overheating and could lead to system failure at a later stage.

5.1.2 Installation of heating mats inside thick floor constructions

Installation and floor construction

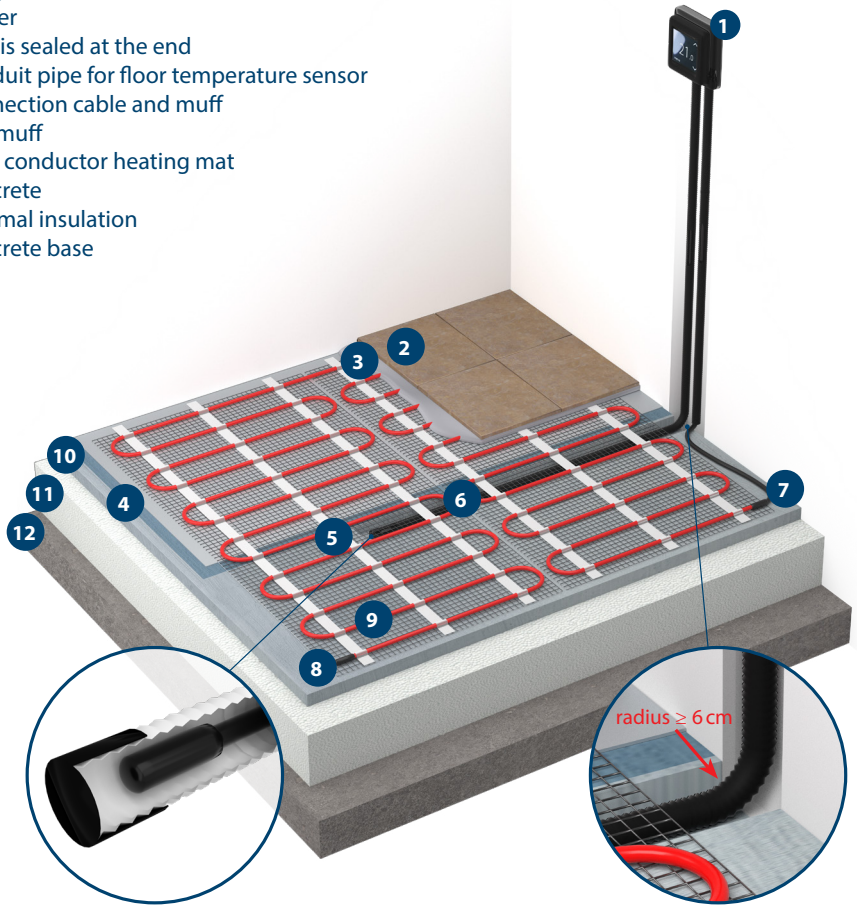
Floor construction has to be done according to the local building standards. In thin floor construction with heating element placed into glue, adhesive, or alike, no special demands and restrictions are needed. The glue, adhesive, or alike has to be designed by the manufactured for use with heated floor construction.

As damping layer installed in vertical parts (ends) of floor slab it is advisable to install a special soft tape minimum 5 mm, e.g. thin thermal insulation (minimum compressive strength is 150 kPa) or alike. It gives possibility to respond to the horizontal expansibility of the floor construction and to prevent its cracking.

Distance of min. 3-5 cm between any two cable lines or nearby mats is recommended.

It is very important to choose a mat with the right dimensions, little smaller than available floor installation area, since the mat cannot be shortened.

1. Thermostat
2. Tiles
3. Tile glue/adhesive
4. Primer
5. Pipe is sealed at the end
6. Conduit pipe for floor temperature sensor
7. Connection cable and muff
8. End muff
9. Twin conductor heating mat
10. Concrete
11. Thermal insulation
12. Concrete base



Thin floor construction with twin conductor thin heating mat

Installation steps – thin heating mat in tile glue on the existed flooring



1. Heating system with thin mat: heating mat, thermostat with floor temperature sensor, conduit pipe.



2. Check/draw a plan in order to position heated area, mat, cold tail, floor sensor, thermostat and connection box, if any.



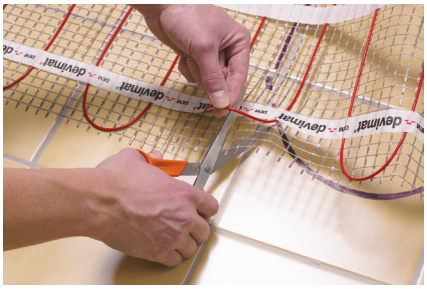
3. Make a groove for the sensor conduit pipe and cold cable.



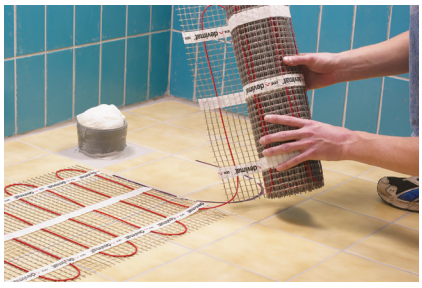
4. Install conduit pipe for floor sensor (must be sealed at the end). Check resistance of sensor before installing in pipe. Install wire sensor in pipe.



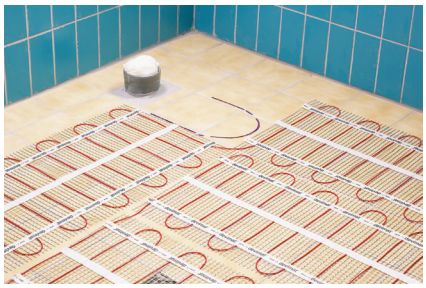
5. Check resistance and insulation values of the m at. Roll out the heating mat from thermostat position. Attach it to the sub floor.



6. Cut and turn the mat mesh when meeting walls or obstacles. DO NOT CUT the cable.



7. Install the heating mat avoiding obstacles, future objects fixed to the floor, etc. Min. 3 cm between any two cable lines.

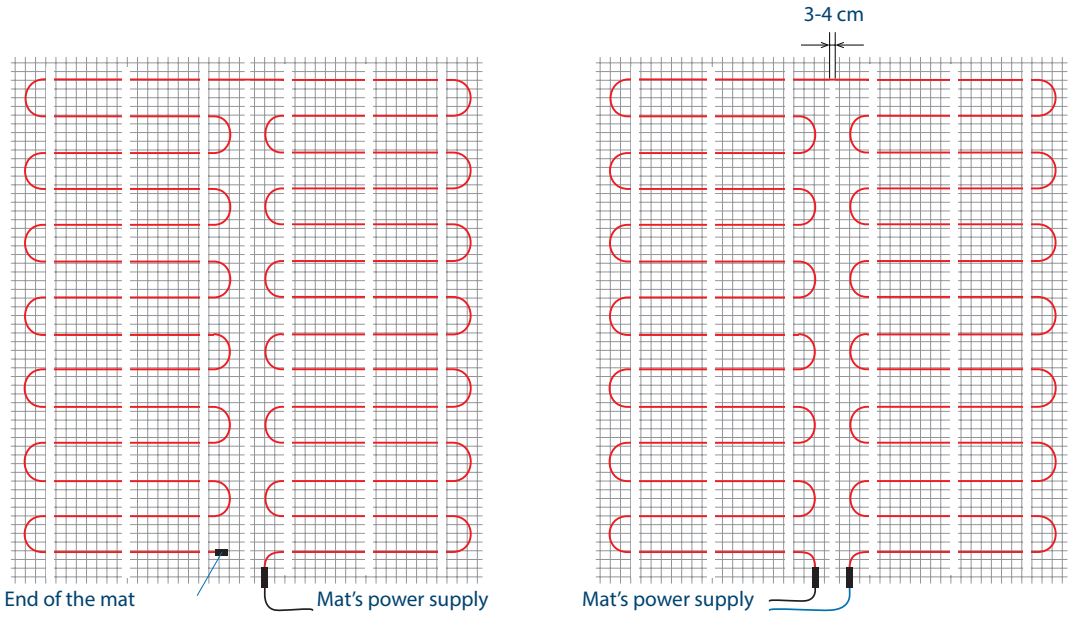


8. Install mat on the entire surface. App. 3-4 cm between nearby mats. Check resistance and insulation values of mat and resistance of sensor.

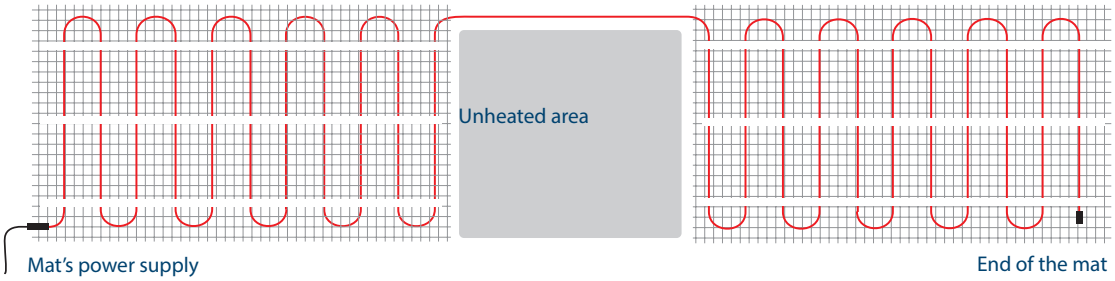


9. Apply tile glue and Install tiles. Check resistance and insulation values of mat and resistance of sensor.

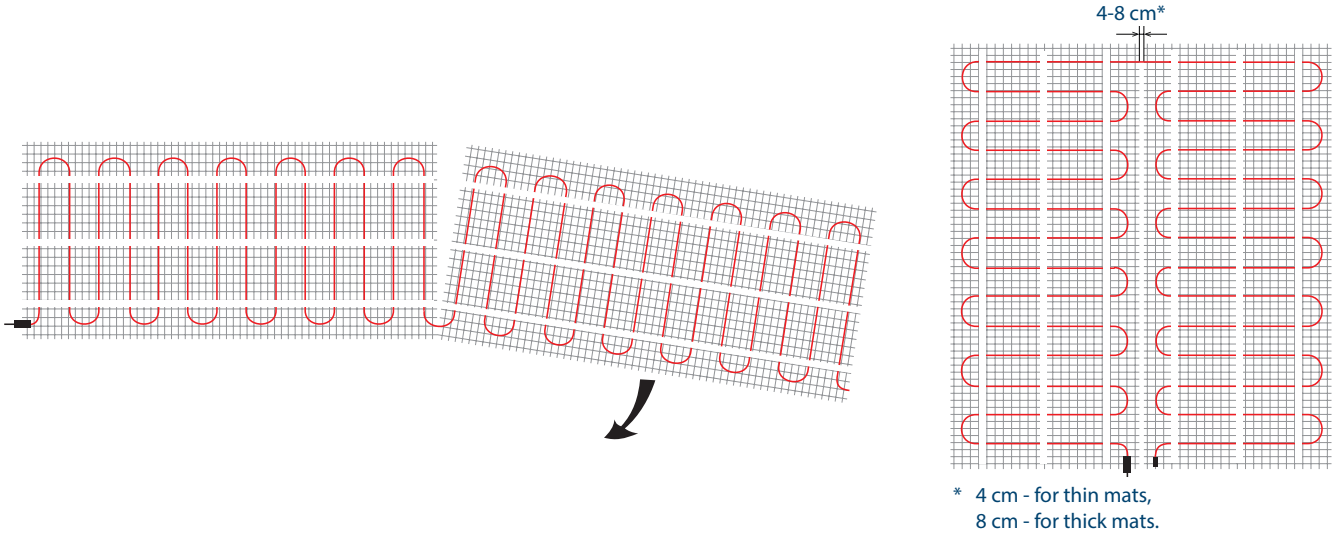
Additionally: follow Installation Instruction for heating cable/mat and thermostat, included with every product.



Example of layout of a twin and single conductor heating mat

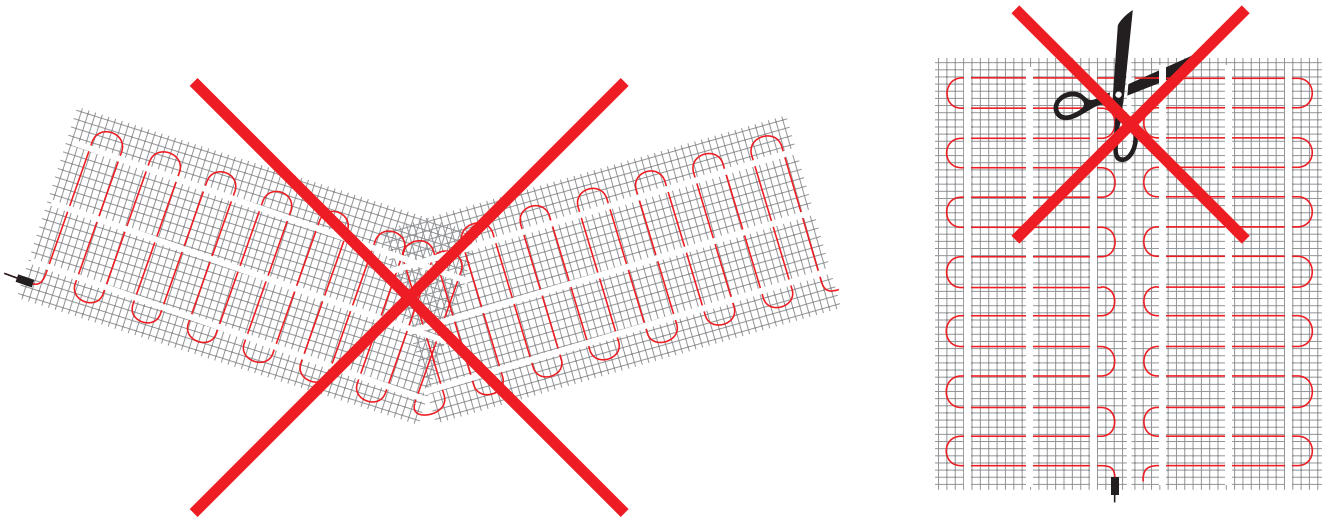


Layout for a mat around an unheated area / obstacle



* 4 cm - for thin mats,
8 cm - for thick mats.

**The heating mats can be very easily adapted to the shape of the heated surface.
Example above: placing DEVImat™ 150T 50 x 300 cm on 100 x 150 cm**



Never cross or cut cable on the heating mat

5.1.3 Installation process in wooden constructions

Installation and floor construction

Ensure that the temperature in the floor construction and chosen output [W/m^2] always corresponds to the tolerance level that the manufacturer of the floor surface has recommended (see 3.5 Tables).

Always install a floor sensor to limit the floor surface temperature.

Some suppliers have certain requirements regarding the start up of a heating system under wooden floors. For example before the wooden floor is laid:

- The floor heating system must have been switched on for at least 3 weeks.
- The system must have been working under max. output for 4 days.
- After the wooden floor has been installed, the concrete temperature must be below 18 °C.
- The floor temperature must be increased slowly during the first week. This is also recommended in the beginning of a heating season.

It is always advisable to train the end-user or daily supervisor in the operation of the heating system.

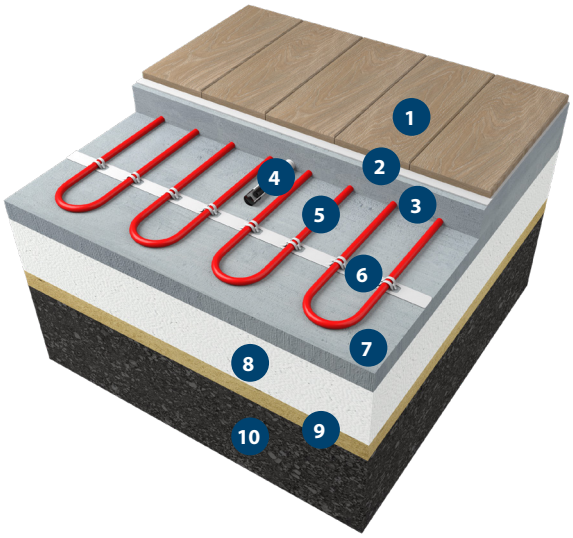
Floor surfaces

DEVI floor heating systems may be used in connection with all known types of wood floorings, both in plank and laminated form. It is important that the wooden floors manufacturer's recommendations are carefully followed.

With regards to the thickness of the wooden floor, floor heating should only be installed/used if:

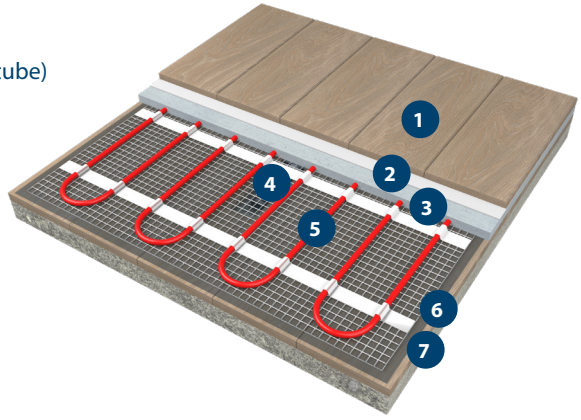
1. The maximum thickness of soft wood (density 400-600 kg/m^3: pine etc.) is ≤ 2 cm.
2. The maximum thickness of hard wood (density over 600 kg/ m^3: oak etc.) is ≤ 3 cm.

1. Wooden floor, parquet, laminate
2. Noise insulation + vapor barrier
3. Concrete >3 cm
4. Conduit pipe with wire sensor
5. Heating cable
6. Fixing elements DEVIfast™
7. Concrete separating layer
8. Insulation
9. Capillary-breaking layer, concrete, etc.
10. Soil



Wooden floor on concrete

1. Wooden floor, parquet, laminate
2. Noise insulation + vapor barrier
3. Self-leveling compound
4. Temperature sensor (in a sealed tube)
5. Heating mat
6. Damp proof membrane/primer
7. Floor base



Wooden floor on thin floor

5.1.4 Installation of heating cables in wooden floors on joists

Installation and floor construction

Floor construction has to be done according to the general and local building norms and standards.

The distance between the heating cable and the joists should be at least 3 cm.

The distance between the heating cables and the underside of the wood floor covering should be at least 3 cm.

The heating cables are installed on mesh netting (chicken wire), which is fastened to the sleepers (joists). The mesh netting is installed so there is a minimum distance of 3,5 cm between the netting and the underside of the floor surface.

The heating cable must be fastened to the mesh or foil at max. 30 cm intervals.

Heating cables may cross a joist through 3 x 6 cm recess, covered with metal (e.g. aluminum tape). Make sure the cable is never in contact with bare wood. There must never be more than one cable in each recess.

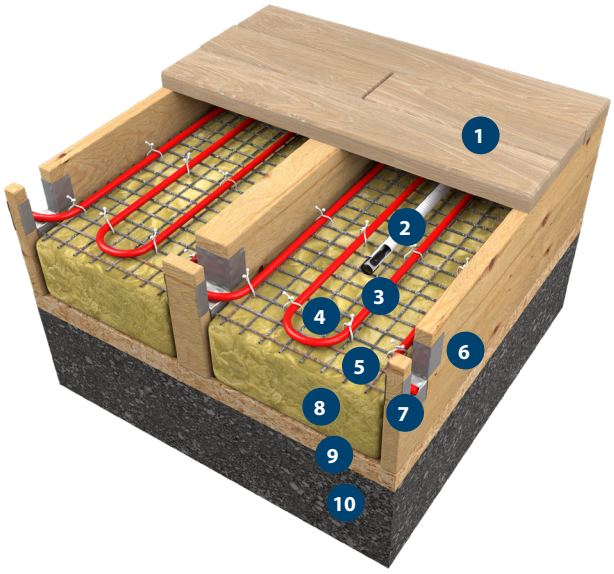
The bending diameter of the cables must not be less than 6 times the cable diameter. Minimum distance is: 5 cm between any two cable lines.

A floor sensor for the thermostat regulating the room temperature has to be installed inside the space below the wooden floor. Like shown on the adjacent picture.

The heating cable must be installed evenly in the spaces between the joists.

For additional information about installation, please refer to the relevant heating cable/mats/ elements installation instructions.

1. Wooden floor covering
2. Conduit pipe with sensor
3. Heating cable
4. Fixings
5. Mesh or aluminum foil
6. Floor joists
7. Aluminum self-adhesive tape
8. Insulation
9. Vapor barrier
10. Leveling layer / Floor base



Wooden floor on joists

Example.

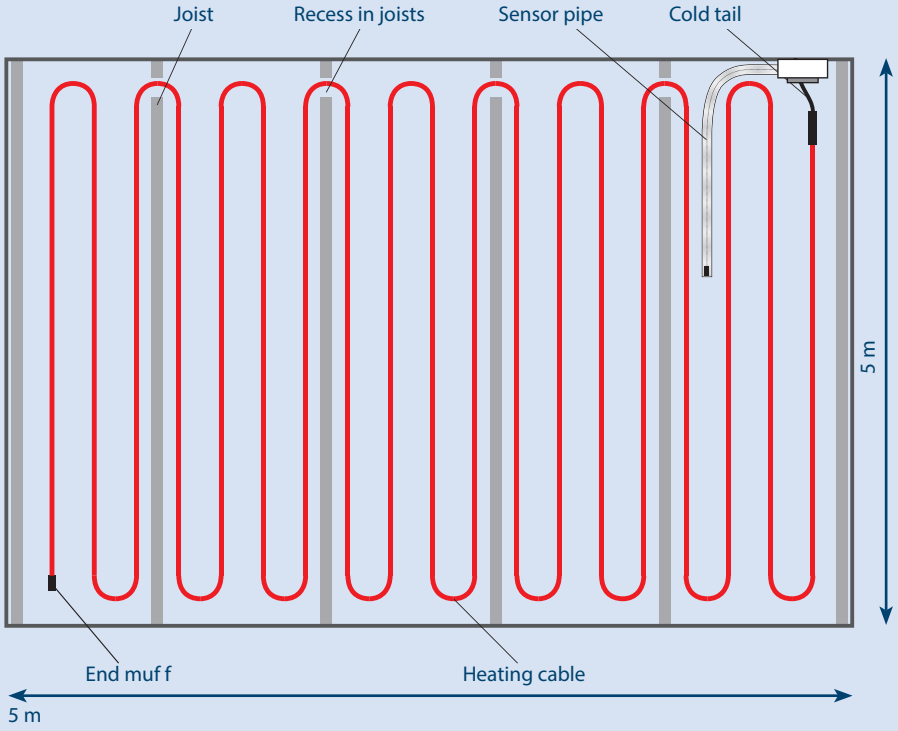
A 20 m^2 (4 x 5 m) well insulated kitchen has to be heated with direct electrical floor heating. The floor type is wooden floor on joists. The usable floor area is only 15 m^2. The total heat loss has been calculated to 800 W (specific heat loss is 800/20 = 40 W/m^2). Power supply is 230 V.

1. The calculated total required output for cable heating system should be 30% higher than heat loss (safety coefficient 1,3): 800 W · 1,3 = 1040 W.
2. Specific output, which is corresponding to 15 m^2 of usable floor: 1040 W / 15 m^2 = 69 W/m^2.

   This is appropriate for floor heating underneath wooden floor on joists: max. 80 W/m^2.
3. Choice of DEVIflex™ 10T cable with the nearest larger output: 1220 W, 120 m.
4. Total installed output per m^2 with chosen cable: 1220 W / 15 m^2 = 81 W/m^2.

   This is appropriate choice for floor heating underneath wooden floor on joists: max. ~80 W/m^2 (higher only by 1 W/m^2).

   If is not appropriate, a cable with the nearest smaller output has to be chosen.
5. Calculation of C-C distance: as this cable covers up to 15 m^2, the calculated C-C distance is 15 m^2 x (100 cm/m)/(120 m) = 12,5 cm.
6. Choice of thermostat, e.g. DEVIreg™ Display Connect or DEVIreg™ Room.



Wooden floor on joists

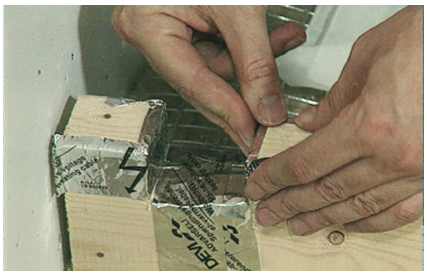
Installation steps - wooden floor on joists



1. Cable heating system: DEVIflex™ heating cable, thermostat with floor sensor and max temperature limit, fixing elements, conduit pipe, aluminum tape.



2. Cut 3x6 cm recess in joists. Check C-C to do minimum number of recess (best on one side / end of joists).



3. Recess has to be covered with metal or aluminum tape etc.



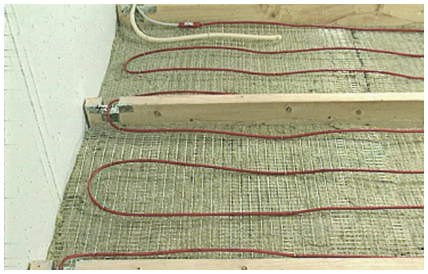
4. Apply mesh or foil onto the insulation. Fasten it to the joists.



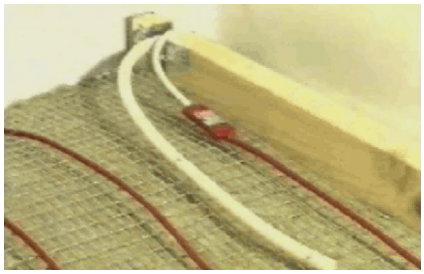
5. Install cable with chosen C-C distance. Max. 80 W/m^2 and cable output max. 10 W/m. Min. 3 cm distance to wood.



6. Fasten cable at max 30 cm intervals. E.g. DEVIclip™ Twist can be used. Secure that the heating cable does not rest in insulation.



7. Install the heating cable evenly over the whole floor area.

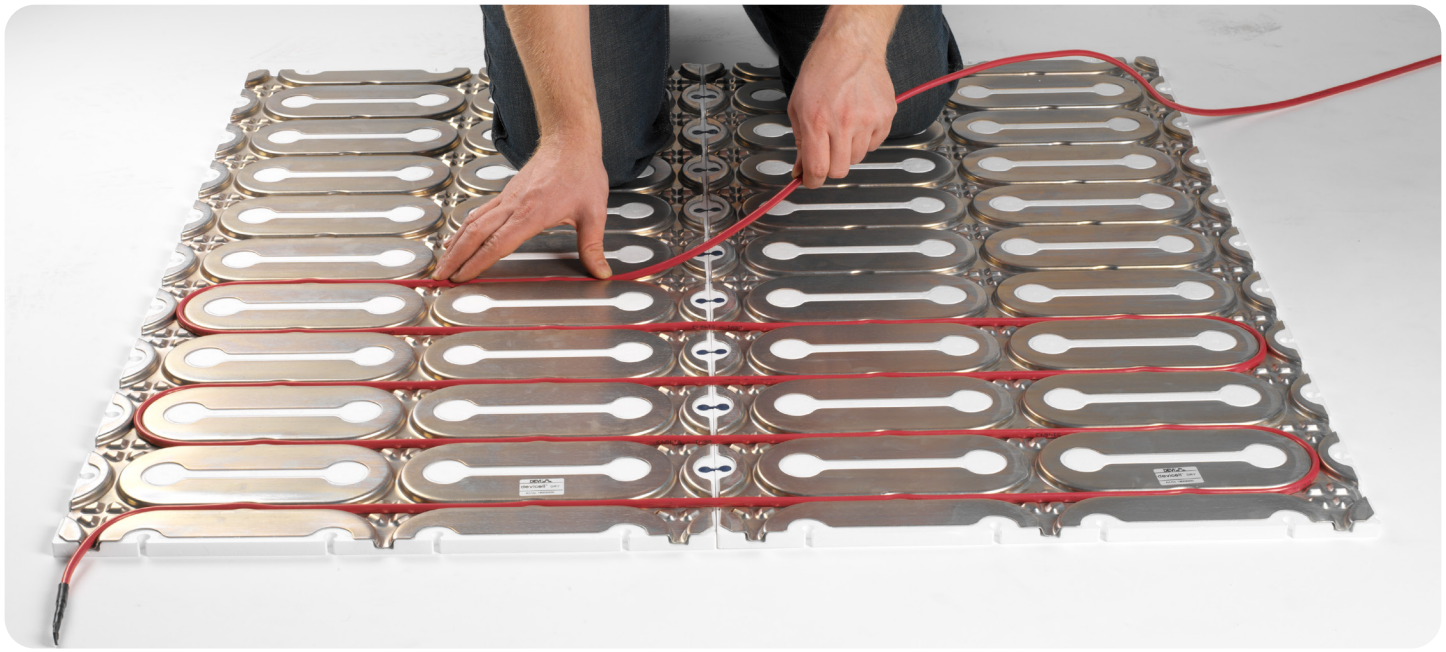


8. Install sensor pipe and wire sensor. Seal/close the end of pipe. Check resistance and insulation value of cable and sensor's resistance.



9. Install wooden surface. Check resistance and insulation value of cable and resistance of sensor and connect the thermostat.

5.1.5 Installation of heating cables with DEVIcell™ LowCarbon



Mounting method for heating cable into DEVIcell™ LowCarbon

Installation and floor construction

Floor construction has to be done according to the general and local building norms and standards.

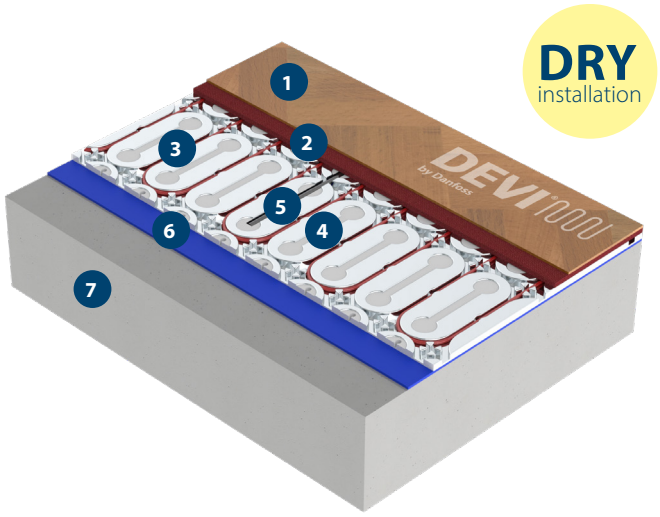
DEVIcell™ plate has cable grooves for every 10 cm and only two cables can be used: DEVIflex™ 10T and DEVIflex™ 6T. There are four possible heat densities that can be installed with C-C 10 and 20 cm (at @230 V):

DEVIflex™ 10T:
100 W/m^2 and 50 W/m^2;

DEVIflex™ 6T :
60 W/m^2 and 30 W/m^2.

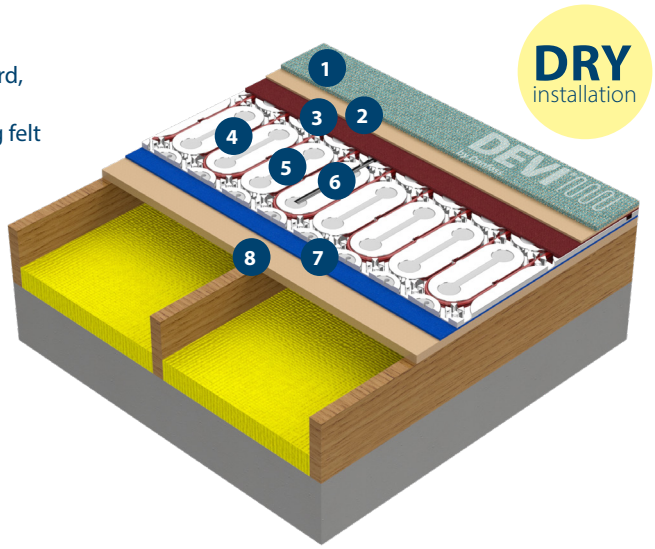
The bending diameter of the cables must not be less than 6 times the cable diameter. Min. 5 cm between any two cable lines.

1. Timber, parquet or laminate
2. Noise absorption mat / rag felt
3. Heating cable DEVIflex™
4. DEVIcell™ Low Carbon
5. Floor sensor in plastic conduit pipe
6. Vapor barrier or damp proof membrane
7. Existing floor construction (e.g. concrete, gypsum, polystyrene)



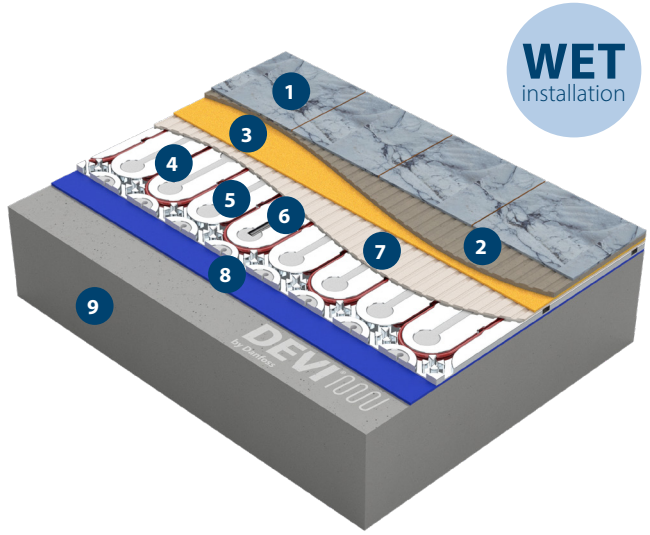
Floor heating with DEVIcell™ Low Carbon on concrete floors

1. Linoleum/vinyl or carpet
2. Pressure distribution board, min. 5 mm
3. Noise absorption mat/rag felt
4. Heating cable DEVIflex™
5. DEVIcell™ Low Carbon
6. Floor sensor in plastic conduit pipe
7. Vapor barrier
8. Existing wooden floor construction



Floor heating with DEVIcell™ Low Carbon on existing wooden floors

1. Tiles
2. Tiles glue
3. Damp waterproof membrane
4. Heating cable DEVIflex™
5. DEVIcell™ Low Carbon
6. Floor sensor in plastic conduit pipe
7. Primer
8. Vapor barrier
9. Stable subfloor (e.g. concrete)

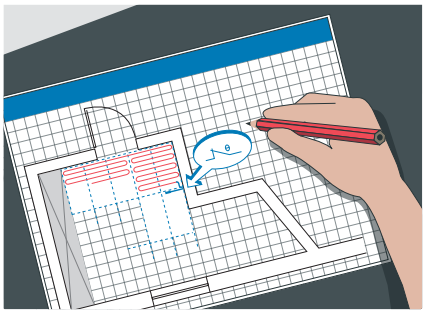


Floor heating with DEVIcell™ Low Carbon with tiles

Installation steps. Preparation and Dry installation



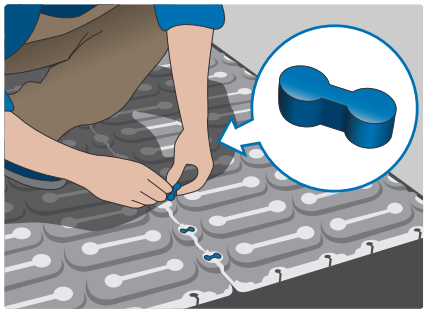
1. Make sure that the sub floor is reasonably level, firm and stable. New concrete needs to dry out for 30 days before installation.



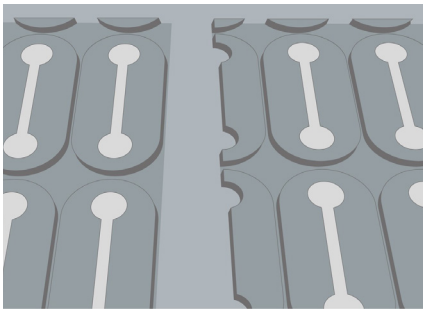
2. Draw a plan positioning cable, cold tail, floor sensor, thermostat and connection box, if any. Avoid all present and future objects fixed to the floor. The DEVIcell™ LowCarbon plates should be laid out so as to cover the entire floor. Ensure the plates are laid in the same direction, and lay them closely together with the grooves aligned to each other. If possible, displace the plates with ½ plate length, for better cohesivenes of this layer.



3. Cut out a wall groove and fix cable ducts and connection box. Clean the sub floor and lay out a vapor barrier or damp proof membrane (if required)

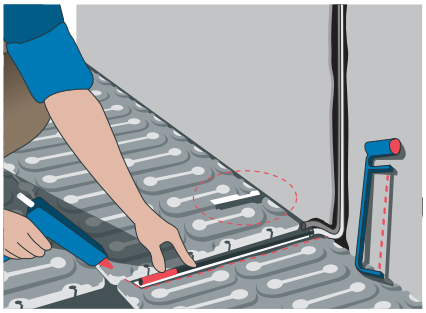


4. The plates are easily adapted to any room size, e.g. by use of a jig saw with an aluminium blade. Sharp edges should be smoothed and rounded. Use the enclosed locks to lock the plates together, three at each side and two at each end.

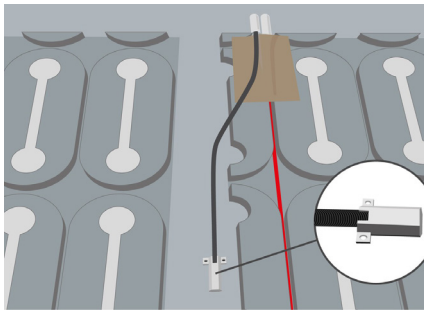


5. The thermostat can be placed anywhere in the room. Where the cable exits the wall, use a jig saw to make room in the plate for the cold tail cable connector and the floor sensor. Smooth and round any sharp edges, and pay particular attention to places where the cable is resting on a cut edge.

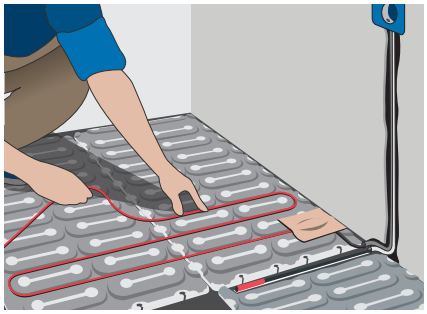
   Apply a piece of aluminium tape to the sub floor and the edges of the plate where the heating cable splice will be laid.



6. Install the cold lead and the flex pipe in the wall. The connection of the cable and the thermostat must be carried out by an authorised electrician.

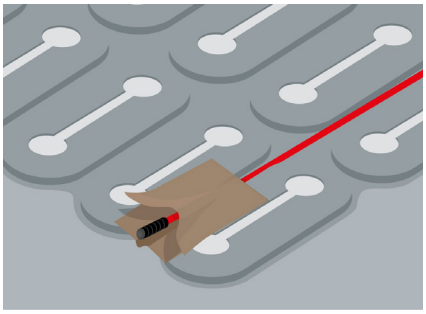


7. Cover the cold tail cable connector with another layer of aluminium tape, and mount the sensor casing on the floor by either screws or glue and glue it in the end of the flex pipe.



8. Now lay the cable out over the entire floor. Do not lay the cable outside the plates.

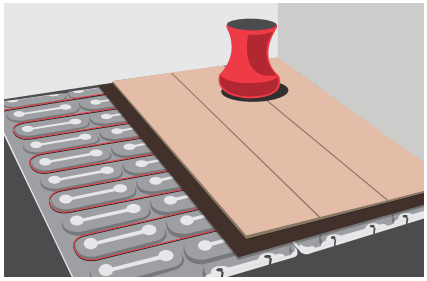
   Press the cable into the grooves. Do not try to hammer or beat the cable into place, it might cause damage to the cable.



9. When the entire cable has been laid out, a hole is cut in the plate to make room for the cable end. Saw the plate with e.g. a jig saw with an aluminium blade. Smooth and round any sharp edges. Subsequently, place the cable end between two pieces of aluminium tape with contact to the aluminium plate.



10. Check the insulation resistance and resistance (Ohm) rating of the heating cables. Plaster the wall groove and connect the cold tail, sensor and thermo-stat. Check resistance of sensor.



11. When the cable has been laid out and tested (see instructions for the DEVIflex™ heating cable), lay out a step damping and the wooden flooring.

Wet installation

Please follow the instructions below:

- Glue the DEVIcell™ LowCarbon plates to the physically and moisture-stable floor base;
- After laying the heating cables, **prime the aluminium surface for better adhesion of the tile adhesive** to the surface.

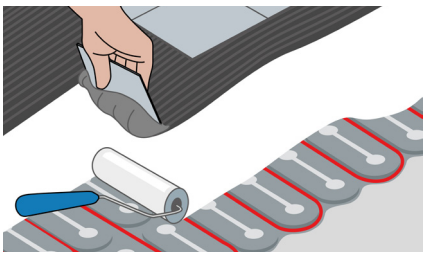
IMPORTANT:
The tile adhesive and primer must be suitable for installing tiles on an aluminium plate and approved by the adhesive supplier.

As example, following materials can be used:

- Glue (cement based type C2S1): i.e. ARDEX X78™, tiles to DEVIcell™ LowCarbon and DEVIcell™ LowCarbon to stable underconstruction;
- Primer: i.e. ARDEX P82™;
- Grout (between tiles; flexible): i.e. ARDEX G8S™;

In connection with wet rooms (bathrooms etc.) a damp proof membrane should always be used in order to prevent moisture from entering the floor construction.

If the floor is built on the ground, a damp proof membrane is needed to prevent moisture from moving upwards and into the floor construction.



Always follow country building laws (in accordance with floor building regulation), when establishing a floor construction.

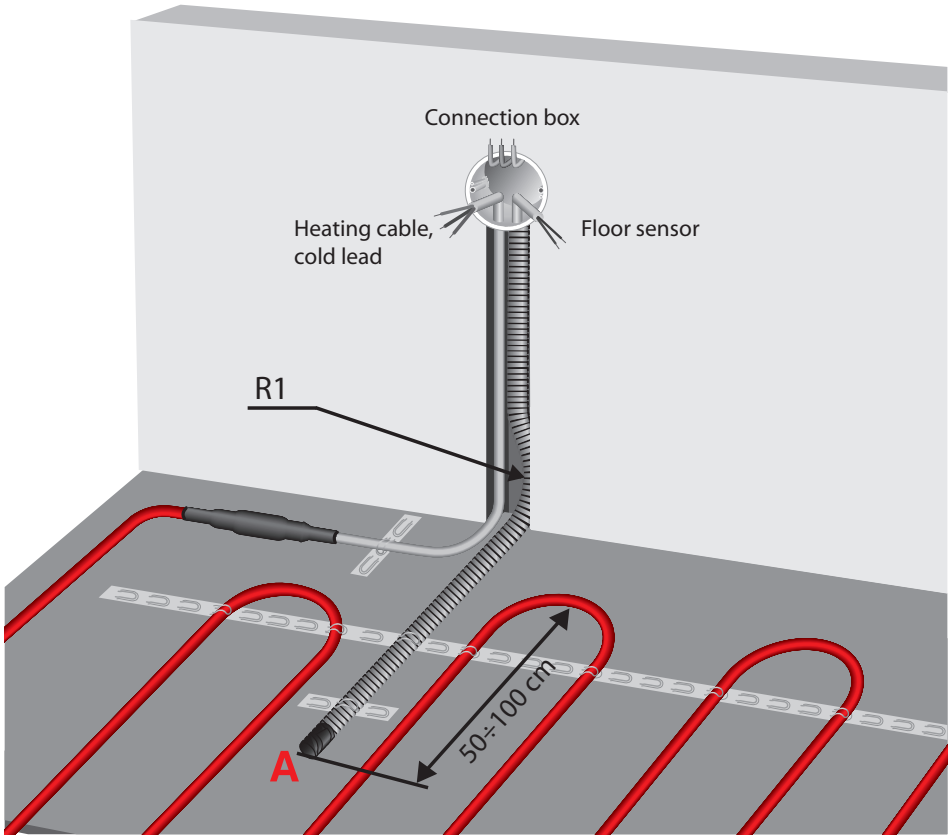
5.2 Floor sensor installation

Before installation of the heating mat or cable, determine where to install the thermostat and make a recession in the wall for the mounting box. Cut out the wall groove from the thermostat's place down to the floor to install the connection cable (cold lead) of the heating cable and temperature sensor conduit. It is recommended, regardless of the system type, always to install floor sensor (wire sensor).

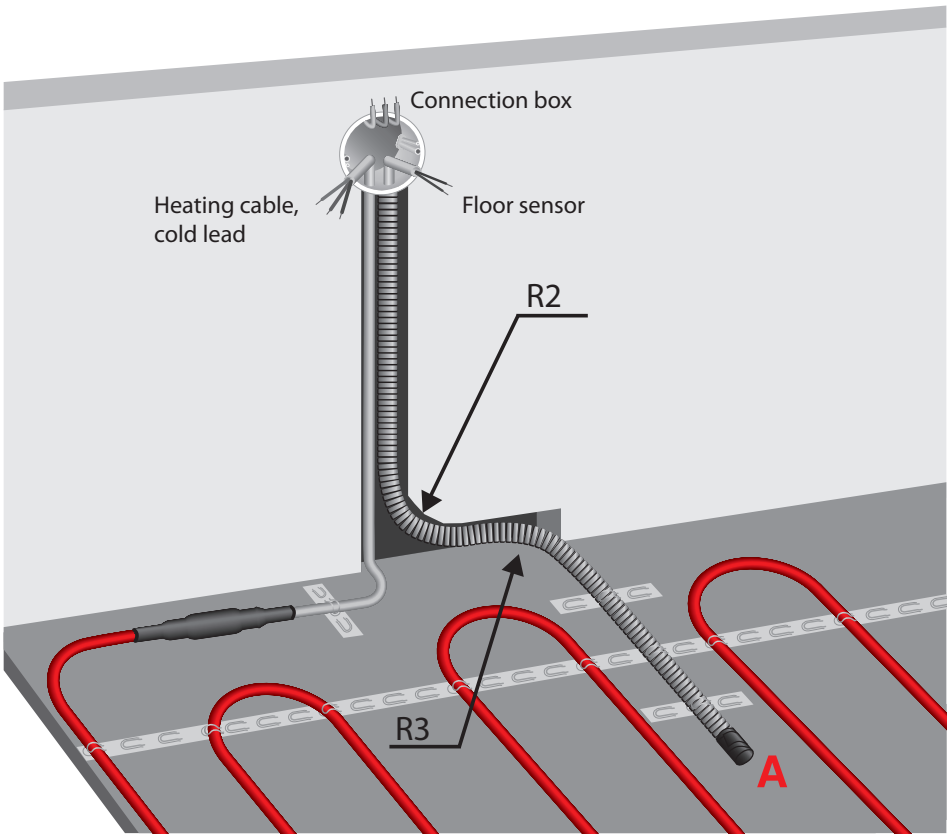
Floor sensor is usually mounted in the corrugated plastic pipe with a diameter of 10-20 mm. Pipe is laid in the wall grove starting from the mounting box and then along the flooring underlay to the heating area. It must be installed in the heating cable zone, at least 0,5-1 m inside (see included picture). Pipe should provide free replacement of wire sensor (remove-insert) through the hole in the mounting box.

Where the pipe is bent between the floor and the wall, the minimum bending radius is 6 cm. It is necessary to make a smooth bend of corrugated pipe when going from the wall to the floor. You can run one bend with large radius R1. As an option of a smooth bend, can be recommended making two big radius of tube in two planes R2 and R3 when going from the wall to the floor (where R2 > R1, and R2 ≈ R3).

The pipe has to be sealed at the end so the concrete does not enter it (marked A on pictures). The pipe/sensor must be positioned in the centre at



Sensor has to be installed between two heating cabels and, preferabely, slighlty above their level.



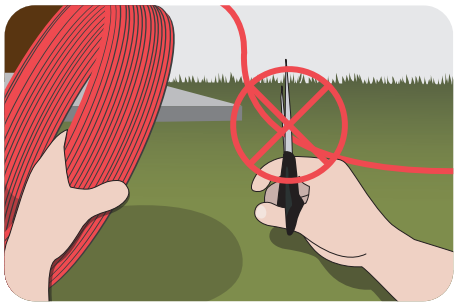
an open end of a cable loop and usually on the same level, or slightly above, the heating cables.

If thin heating mat is installed, conduit pipe has to be laid in a groove, so it does not to overhang above the surface. Groove in the floor is also required for the cold lead and muff for the same reason.

Sensor cable can be extended to any reasonable length, using a cable min 0,75 mm^2. After the wire temperature sensor is installed it is recommended to measure resistance.

6. Safety instruction

6.1 General safety instructions

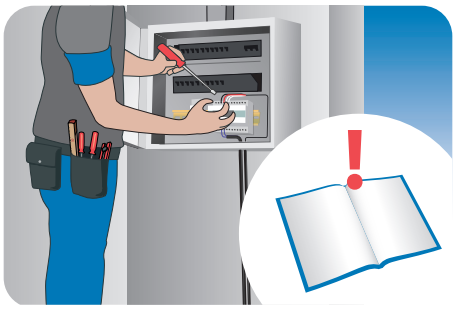


Never cut or shorten the heating element.

- Cutting the heating element will void the warranty.
- Cold leads can be shortened to suit requirements.

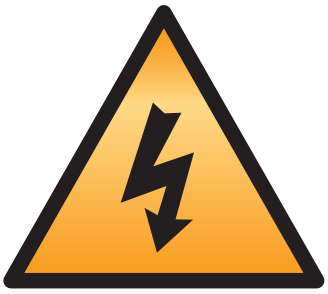
Elements must always be installed according to local building regulations and wiring rules as well as the guidelines in proper installation instructions and this manual.

- Any other installation may hamper element functionality or constitute a safety risk, and will void the warranty.
- Make sure that elements, cold leads, connection boxes, and other electrical components do not come into contact with chemicals or flammable materials during or after installation.



Elements must always be connected by an authorized electrician using a fixed connection.

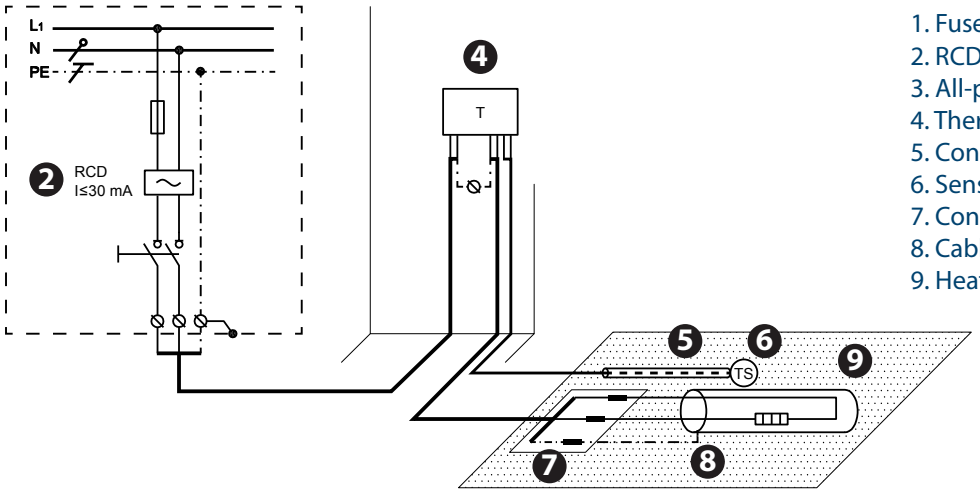
- De-energize all power circuits before installation and service.
- The connection to the power source must not be directly accessible to the end user.
- Each heating cable screen must be earthed in accordance with local electricity regulations and connected to a residual current device (RCD).
- Recommended RCD trip rating is 30 mA, but may be up to 300 mA where capacitive leakage may lead to nuisance tripping.
- Heating elements must be connected via a switch providing all pole disconnection.
- The element must be equipped with a correctly sized fuse or circuit breaker, e.g. 10/13 A for a 1,5 mm^2 cold lead and 16/20 A for a 2,5 mm^2 cold lead.



The presence of a heating element must

- be made evident by affixing caution signs or markings at the power connection fittings and/or
  frequently along the circuit line where clearly visible
- be stated in any electrical documentation following the installation.

Never exceed the maximum heat density (W/m^2 or W/m) for the actual application.



1. Fuse
2. RCD
3. All-pole switch
4. Thermostat
5. Conduit pipe
6. Sensor
7. Connection muff
8. Cable screen
9. Heating cable

6.2 DO's

- For installation of cable and thermostat/controller, always refer to the local regulations/ legislations and respective manuals;
- Remember to fill out the warranty certificate with the required information as this will not be valid otherwise;
- Carefully complete the installation, the cable can break when overloaded;
- If any doubt arises consult you manual or local DEVI department;
- Ensure that the cable is sufficiently fixed and mounted according to the manual;
- Ensure that warning labels and stickers (potentially tape) with warning text is used to inform about the heat traced cable;
- Install sensors where the temperature is estimated to be representative for the whole installation, where 2 sensors are needed for the thermostat/ controller please install at the estimated extreme points (coldest and hottest);
- To get the best performance of the system and avoid failures it is necessary to follow the installation descriptions;
- To get the best performance of the system it is strictly necessary to calculate the correct heat losses. Using this knowledge the cable with right output can be chosen;
- It is important that the floor construction is well insulated according to the building standards so the downward heat loss is kept to a minimum.
- Rim zone insulation, along the walls, which should be efficient in order to prevent heat from being transported to the foundation walls or adjoining rooms, and allowing for a thermal expansion of the concrete.
- The foundation must be clean and free of sharp objects.
- Concrete must be lain out in such way, that air pockets inside it are avoided.
- In connection with wet rooms (bathrooms etc.) a damp proof membrane should always be used in order to prevent moisture from entering the floor construction.
- If the floor is built on the ground, a damp proof membrane is needed to prevent moisture from moving upwards and into the floor construction.
- Keep a min. 3-5 cm air gap beneath permanent objects like desks and beds, and floor surface with installed floor heating.
- Thermostat fitted with air (room) temperature sensor should always be placed on inner wall, away from doorway or other large openings, and not in direct sunlight.
- Thermostat fitted with air (room) temperature sensor should be placed above the floor at ~1,5 m (0,8 - 1,8 m) height.
- To ensure an accurate and easy installation of the cables, DEVIfast™ fixing elements can be used.

6.3 DON'Ts

- Heating elements may not touch or cross themselves or other heating elements and must be evenly distributed on areas.
- **Never cut or shorten the heating element.**
- Do not wind excess cable onto itself at the end of a run, as this can cause overheating and may damage the cable. Instead, distribute the excess cable evenly within the adjacent area (secondary loop/section).
- Never make an installation without thermostat/controller;
- Never install cables where the heat can't be dissipated, even with a self-limiting cable the output will never become zero and the cable can overheat;
- Never let unauthorized personnel install controllers/thermostats or heating elements;
- Never use unauthorized accessories;
- Never use our products (cables, controllers, sensors, etc.) outside provided temperature range.
- The floor heating must not be turned on before the concrete has fully set. It takes approximately 30 days for concrete and usually 10-15 days for moulding compound, tile glue etc. (it is important carefully followed to manufacturer's recommendations).

7. Cases

Paderewski Park estate, Zawiercie, Southern Poland

Total electric heating

This case story presents an efficient electric heating solution designed for modern multifamily houses using DEVI products. The system provides comfortable indoor temperatures, individual room control, and reliable heating performance for residents.

Project size:
11 Multifamily houses – 102 apartments.

Products:
Heating cables:
- 26617 m of DEVIflex™ 18T

Thermostats:
- 324 pcs. DEVIreg™ Touch
- 32 pcs. DEVIreg™ Smart







Family house in Stavanger, Stavanger, Norway

Comfort floor heating

This case story presents the renovation of an existing house built in 1963, where the DEVIcell™ LowCarbon system was installed as part of the floor heating system, incorporating thermal insulation below the heating elements. The low-profile electric floor heating solution enabled easy integration into the existing floor structure with minimal impact on the building renovation process.

Project size:
10 m^2.

Products:
- DEVIflex™ 10T – 70 m
- DEVIcell™ Low Carbon – 10 m^2

Thermostats:
- DEVIreg™ Smart





For more case stories for electric indoor heating visit www.devi.com.

8. Technical support

The Electric Heating team supports professionals with reliable expertise and proven solutions.

We offer:

- Precise calculation and design of electric heating systems
- Development of project drawings
- Preparation of a complete Bill of Materials (BoM)
- Practical recommendations for installation and system operation
- Professional technical training

Our experience enables us to provide practical guidance on the selection and application of electric heating systems.

In order to clarify the project data for different applications use the following technical request forms, fill in with your specifications and send it to:
EH@danfoss.com

https://devi.com/en/service-and-support/global-technical-support



Follow our global **channels**

140F9007 & AB213486470188en-010201 | 28.09.2026

DEVI® by Danfoss

Make it easy, **make it DEVI**

Danfoss A/S
DEVI • devi.com • +45 7488 2222 • EH@danfoss.com

Any information, including, but not limited to information on selection of product, its application or use, product design, weight, dimensions, capacity or any other technical data in product manuals, catalogues descriptions, advertisements, etc. and whether made available in writing, orally, electronically, online or via download, shall be considered informative, and is only binding if and to the extent, explicit reference is made in a quotation or order confirmation. Danfoss cannot accept any responsibility for possible errors in catalogues, brochures, videos and other material. Danfoss reserves the right to alter its products without notice. This also applies to products ordered but not delivered provided that such alterations can be made without changes to form, fit or function of the product.
All trademarks in this material are property of Danfoss A/S or Danfoss group companies. Danfoss and the Danfoss logo are trademarks of Danfoss A/S. All rights reserved.

devi.com