

Installation Guide

DEVImat™ and DEVIflex™ Indoor Heating Applications
DSVF DTIF DTIR DTCE



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1 Introduction

In this installation manual, the word "element" refers to both heating cables and heating mats.

If the words "heating cable" or "heating mat" are used, the instruction in question applies only to this type of element.

All dimensioning, product selection, installation and commissioning of any given application are the responsibility of an **authorized installer**.

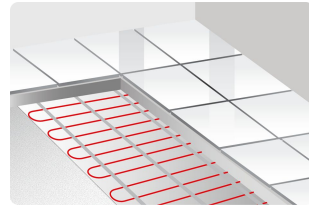
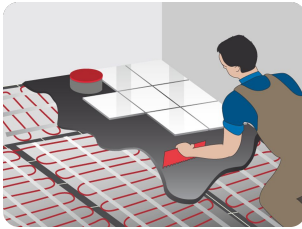
Any application using heating elements or thermostats **purchased by end user** must be approved by an **authorized electrician** prior to commissioning.

- Including type, size, installation and connection of the heating element
- Including type, size, connection and settings of the thermostat controlling the heating element

The intended use of the heating elements covered by this installation manual is floor heating, only.

- The elements may not be installed in a metallic floor or storage heating application.
- Elements shall be fully embedded and at least 5 mm in concrete, screed, tile adhesive or similar.



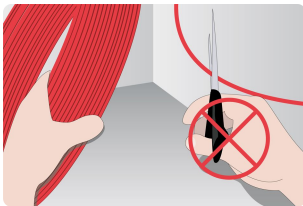


Floor heating in thin beddings (<3 cm)
See section 4.1.

Floor Heating in Concrete Floors (>3 cm)
See section 4.2

For other applications please contact your local DEVI sales office.

1.1 Safety Instructions



Never cut or shorten the heating element.

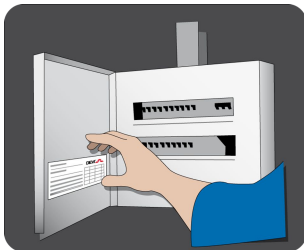
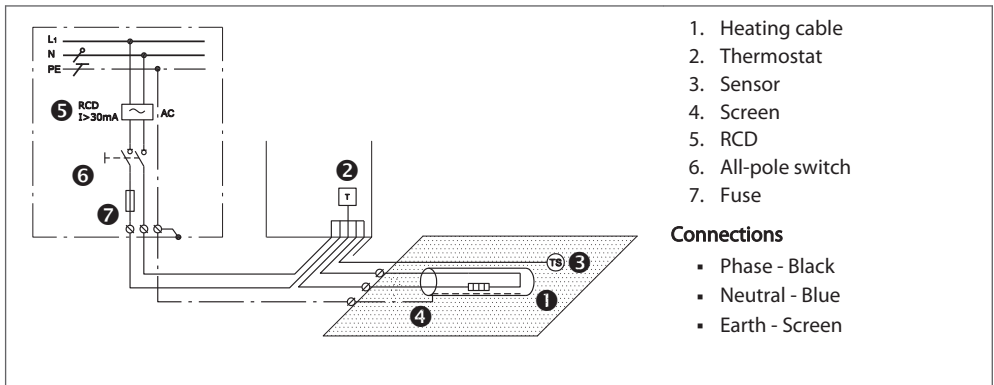
- Cutting the heating element will void the warranty.
- Cold leads can be cut or shortened to suit requirements, only.

Elements must always be installed according to local building regulations and wiring rules as well as the guidelines in this installation 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 authorised 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 mm² cold lead and 16/20 A for a 2.5 mm² 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 installation.

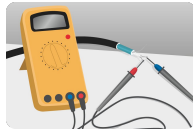
Never exceed the maximum heat density (W/m²) for the actual application.

1.2 Installation Guidelines

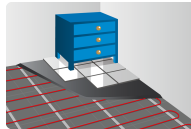
- The product does not contain harmful substances.
- Store in a dry, warm place at temperatures between +5 °C to +30 °C.



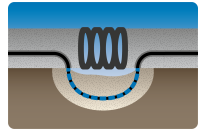
Prepare the installation site properly by removing sharp objects, dirt, etc.



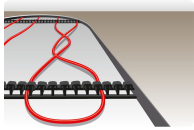
Regularly measure ohmic resistance and insulation resistance before and during installation.



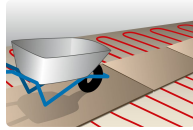
Do not lay heating elements under walls and fixed obstacles. Min. 6 cm air is required.



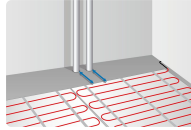
Keep elements clear of insulation material, other heating sources and expansion joints.



Elements may not touch or cross themselves or other elements and must be evenly distributed on areas.



The elements and especially the connection must be protected from stress and strain.



The elements shall be installed minimum 30 mm away from conductive parts of the building, e.g. water pipes.



A floor sensor is mandatory and shall be connected to a thermostat limiting the floor temperature to maximum 35°C.

1.3 System Overview

DEVIflex™	DSVF	DTIR	DTIF	DTCE
Mechanical Class (IEC 60800)	M1	M1	M1	M2
Floor heating in thin beddings (<3 cm)	D	P	P	A
Floor heating in concrete floors (>3 cm)	A	A	A	P

M1 For use in applications with **low risk of mechanical damage**, e.g. installed on even surfaces and embedded in screeds with no sharp objects.

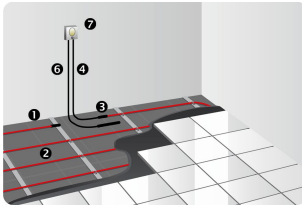
M2 For use in applications with **higher risk of mechanical damage**.

P Primary recommendation for this application.

D Designed and approved for this application.

A Applicable but there are better options.

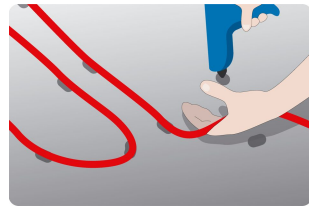
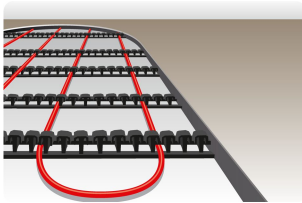
1.4 Functional Overview



1. Element
2. C-C distance
3. Cold lead connection
4. Cold lead
5. Connection box (if any)
6. Sensor
7. Thermostat

2 Installation Step by Step

2.1 Fastening Methods



DEViclip™ CC

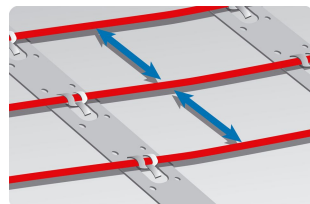
For keeping exact C-C distance (1 cm steps) on even surfaces, UV resistant.

Tape or hotmelt glue

For fixing elements to hard, dry, even surfaces.

2.2 Calculating C-C Distance

For areas, the C-C distance is the distance in centimetres from the centre of one cable to the centre of the next.



$$C - C [cm] = \frac{\text{Area [m}^2]}{\text{Cable length [m]}} \times 100 \text{ cm}$$

or

$$C - C [cm] = \frac{\text{Cable output [W/m]}}{\text{Heat density [W/m}^2]} \times 100 \text{ cm}$$

Max. C-C distance

Thin beddings (<3 cm) 10 cm

Concrete floors (>3 cm) 15 cm

W/m ² @ 230V/400V			
C-C [cm]	20 W/m	25 W/m	30 W/m
5	400	500	-
7,5	267	333	400
10	200	250	300
12,5	160	200	240
15	133	167	200
20	100	125	150
25	80	100	120

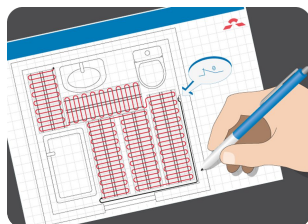
W/m ² @ 220V/380V			
C-C [cm]	20 W/m	25 W/m	30 W/m
5	366	457	-
7,5	244	305	366
10	183	229	274
12,5	146	183	220
15	122	152	183
20	91	114	137
25	73	91	110

W/m ² @ 240V/415V			
C-C [cm]	20 W/m	25 W/m	30 W/m
5	436	544	-
7,5	290	363	436
10	218	272	327
12,5	174	218	261
15	145	181	218
20	109	136	163
25	87	109	131

2.3 Planning the Installation

Draw a sketch of the installation which shows

- element layout
- cold leads and connections
- junction box/cable well (if applicable)
- sensor
- connection box
- thermostat



Save the sketch

- Knowing the exact location of these components makes subsequent troubleshooting and repair of faulty elements easier.

Bear in mind the following:

- Observe all guidelines in section 1.1 .
- Observe correct C-C distance (heating cables only) - see section 2.2.
- Observe required installation depth and possible mechanical protection of cold leads.
- When installing more than one element, never wire elements in series but route all cold leads in parallel to the connection box.
- Two or more elements may be installed in the same room but a single element is not to be installed across two or more rooms.
- All heating elements in the same room must have the same heat density (W/m^2) unless they are connected to separate floor sensors and thermostats.
- For single conductor cables, both cold leads must be connected to the connection box.

2.4 Preparing the Installation Area



- Remove all traces of old installations, if applicable.
- Ensure that the installation surface is even, stable, smooth, dry and clean.
 - If necessary, fill out gaps around pipes, drains, or walls or apply foil covering
- There must be no sharp edges, dirt or foreign objects.

3 Installing Elements

It is not recommended to install elements at temperatures below $-5^{\circ}C$.

At low temperatures, heating cables can become rigid. After rolling out the element, briefly connect it to the mains supply to soften the cable before fastening.

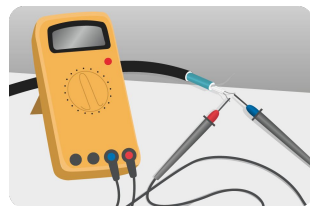
Measuring Resistance

Measure, verify and record element resistance during installation.

- After unpacking
- After fastening the elements
- After the installation in finalized

If ohmic resistance and insulation resistance are not as labelled, the element must be replaced.

- The ohmic resistance must be within -5 to $+10$ % of the value labelled.
- The insulation resistance should read $>20 M\Omega$ at min. 500 V, preferably 2.5 kV.

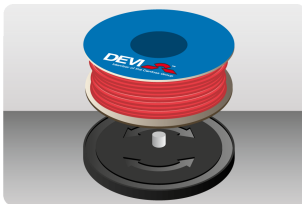


3.1 Installing Heating Elements

Observe all instructions and guidelines in section 1.1 and 1.2.

Heating Elements

- Position the heating element so that it is at least half the C-C distance from obstacles.
- Elements must always be in good contact with the heat distributor (e.g. concrete). See section 4 for details.



Heating Cables

- Observe correct C-C distance - see section 2.2.
- Heating cable bending diameter must be at least 6 times cable diameter.
- The actual cable length may vary +/- 2 %.

Heating Mats

- Always roll out heating mats with the heating cables facing up.
- When the heating mat reaches the area boundary, cut the liner/net and turn the mat before rolling it back.
- Actual mat length may vary within following tolerances:
 - +/- 1 loop for 5 to 10 m mats.
 - +/- 2 loops for mats longer than 10 m.

Extending cold leads

- Avoid extending cold leads if possible. Wire cold leads to e.g. junction boxes or cable wells.
- Max. 5 % loss of potential power in the whole length of the cold cable.
- Extra length of cold lead will increase capacitive leakage current which means that RCD trip rating may need to be higher.


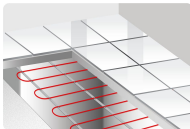
Sensors

- Sensors are live (230 V) components and must be wired inside plastic conduit
- Sensors can be extended using installation cable.
- See section 4 for specific applications.

Floor sensors

- Mandatory under wooden floors or in wooden sub floors.
- Shall be placed in an appropriate place.
 - Where not exposed to sunlight or draft from door openings
 - In between >2 cm from two heating cables
 - The conduit should be flush with the floor surface.
 - It may be necessary to countersink the conduit to achieve this.
- Route the conduit to the connection box.

4 Indoor Applications

		
Sub floor	Thin beddings* (<3 cm)	Concrete floors* (>3 cm)
Wood	Max. 10 W/m and 100 W/m ²	
Concrete	Max. 20 W/m and 225 W/m ²	
Floor covering		
Wood, parquet, laminate	Max. 100 W/m ²	Max. 150 W/m ²
Carpet, vinyl, linoleum, etc.	Max. 100 W/m ²	Max. 150 W/m ²
Tiled floors in bathrooms, conservatories, cellars, etc.	100 - 200 W/m ²	100 - 200 W/m ²
Tiled floors in kitchens, living rooms, halls, etc.	100 - 150 W/m ²	100 - 150 W/m ²

* May be up to 225 W/m² in rim zones e.g. under large windows

- On concrete sub floors and under tiles, only
- If connected to a separate floor sensor and thermostat

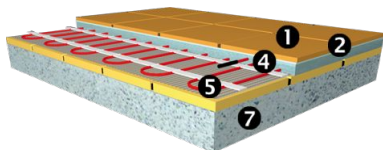
Wooden floor coverings

Wood shrinks and swells naturally depending on the relative humidity (RH) in the room. The optimal range is 30-60% RH.

- Avoid beech and maple in multilayered floor coverings unless press dried.
- Install a vapour barrier for sub floors <95% RH and a damp proof membrane >95%.
- Ensure 100% contact between element and floor materials above (no air pockets).
- Install the heating system in the whole floor area at 15°C surface temperature.
- Always install a floor sensor to limit the floor temperature. See section 6.1 for further information.

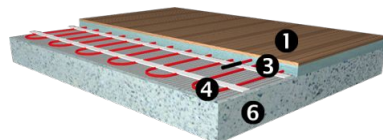
4.1 Floor Heating in Thin Beddings

New tiles floor in wet rooms



1. New tiles
2. Tile adhesive
3. Damp proof membrane (in wet rooms)
4. Self-levelling compound
5. DEVImat™ or DEVIflex™ heating cable
6. Primer
7. Existing tiles or concrete floor

New floor covering in dry rooms



1. New tiles, wooden floor, laminate, or carpet
2. Vapour barrier and noise absorption mat (wooden floor / laminate)
3. Latex based compound/tile adhesive
4. DEVImat™ or DEVIflex™ heating cable
5. Primer
6. Existing concrete or wooden floor

Wooden sub floors must be properly anchored

- Apply floor plaster before laying the heating element if necessary.

Additional insulation (tile backer boards)

- Can be applied between existing sub floor and heating element.
 - Polystyrene (XPS) with high compressive strength >300 kN/m².
 - Concrete or foil faced without cracks.
- Must be installed as prescribed by the manufacturer.
- Floor sensor must be installed above insulation.
- Output max. 10 W/m and 150 W/m².

Damp proof membrane

- Apply in wet rooms above the heating cables.
- Apply only if not already installed in existing floor.
 - Be careful not to damage the membrane when working with self-adhesive mats.

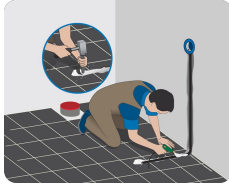
Tile adhesive or self-levelling compound

- Prime the sub floor as specified by the supplier.
- The heating element should be securely fastened before applying.
- The heating element must be fully embedded and at least 5 mm.

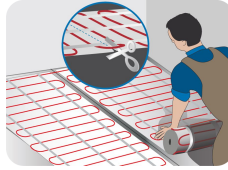
Required tools

- Hammer.
- Chisel.
- Glue gun.
- Knife or scissor

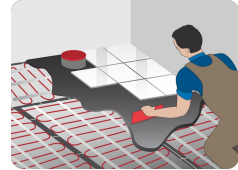
Installation summary



Cut out a wall groove and fix cable ducts and connection box. Chisel off a groove for the sensor conduit and cold cable. Fix the sensor conduit e.g. with a glue gun.



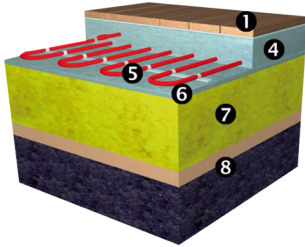
Roll out the element. Attach it to the sub floor. Cut and turn the mat mesh when meeting walls or obstacles. Do NOT cut the cable.



Apply flexible self-levelling compound, damp proof membrane, and/or tile adhesive, depending on the floor finish.

4.2 Floor Heating in Concrete Floors

New floor in dry rooms



1. Wooden floor, laminate or carpet.
2. Noise absorption mat / rag felt (under wood).
3. Vapour barrier.
4. Concrete.
5. DEVImat™ or DEVIflex™ heating cable.
6. Concrete slab or foil.
7. XPS insulation.
8. Sand and soil.

The heating cables may not touch the insulation

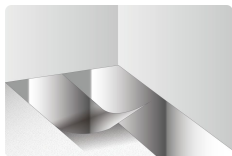
- The heating cable must be separated by concrete slab or foil.

Embedding in concrete, mortar or screed

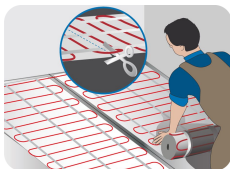
- The bedding must not contain sharp stones
- Must be sufficiently wet, homogeneous, free of air voids

- Pour at a moderate delivery speed to avoid displacement of the element
- Avoid excessive use of rakes, shovels, vibrators, and rollers
- The heating element must be fully embedded and at least 5 mm
- Allow a drying time of approximately 30 days for concrete and 7 days for moulding compounds.

Installation summary



Apply concrete slab or foil onto the insulation.

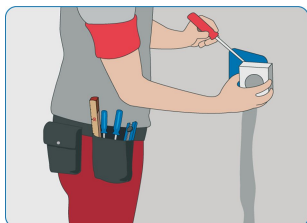


Roll out the element. Attach it to the sub floor. Cut and turn the mat mesh when meeting walls and obstacles. Do NOT cut the cable.



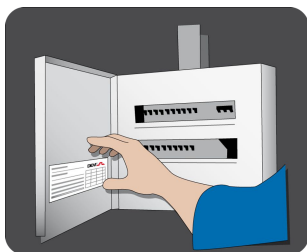
Pour at a moderate delivery speed to avoid displacement of the element.

5 Finalizing the Installation



Connecting cables

- See the installation manual for the thermostat.
- See wiring diagram and other important information in section 1.1.
- Observe that the total Amps do not exceed the capacity of the thermostat. Otherwise install a contactor.



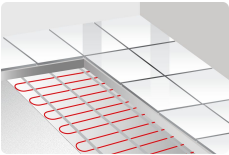
Final check and documentation

- After installing the elements and testing resistance, finish the installation.
 - The total insulation value R above cables must be max. 0.2 m²K/W which equals 20 mm pine or 30 mm oak.
- Make sure that the heat distributor (e.g. floor) can withstand the heat from the element. This is particularly important if the element is connected to a thermostat that does not allow configuration of maximum temperature. See section 4 for details.
 - This is particularly important if the element is connected to a thermostat that does not allow configuration of maximum temperature.
- Document the following using text, drawings, or photos:
 - cable type, spacing, depth, layout, circuit ID, sensors.
 - location of connections between cold lead and heating element.
 - location of end caps (twin conductors only).
 - location of expansion joints, if any.
- Complete the warranty form.
 - Fill out the DEVImat™ warning label and put it in the distribution board.

- Instruct the end-user or the daily supervisor in the operation and maintenance of the heating system.
- Before every period of continuous use, check for faults in the distribution board, thermostat, and sensors.
- Re-check and compare the ohm rating and insulation resistance.

6 Optional Settings

If the element is connected to a thermostat such as a DEVIreg[™], configure basic settings according to the table below and as described in the thermostat installation manual.

Thermostat	Max. load	 <p>Floor heating in general</p> <p>Room temp. 20-22 °C</p> <p>Floor Temp.: see section 6.1</p> <p>Max. floor temperature limit: 35°C</p>
DEVIreg [™] 13x	16 A	
DEVIreg [™] 330/610	16/10 A	
DEVIreg [™] 53x	15A	
DEVIreg [™] 550	16A	
DEVIlLink [™]	15A (FT)	

If applicable, adjust the temperature limit in accordance with the manufacturer's recommendations in order to prevent damage to e.g. the floor.

- For most wooden floor products, the temperature is usually around 27°C.

6.1 Floor Temperature Settings

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

Concrete floor (tiles)	26 - 28,5°C
Soft wood (pine)	22,5 - 28°C
Hard wood (oak)	24,5 - 28°C
Textiles (rugs, carpets)	21 - 28°C

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

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

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

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