ELEKTRA®

electric
heating systems

SOLUTIONS FOR EVERYONE

ELEKTRA®

electric
heating systems

Index

Headquarters

ELEKTRA Leading Brand

ELEKTRA specializes in electric heating systems for both residential and commercial buildings. Established in 1985, the company is currently the largest and most reputable producer of floor heating systems in Central Europe. From the beginning product quality has been the first priority for the company. This is the only way to satisfy all customers and achieve and maintain leadership in the market.

ELEKTRA Stock Availability

Throughout the EU and around the world, ELEKTRA products are readily available through a network of approved and authorized distributors, installers and even dedicated websites.

Distribution in dozens of countries across Europe, Asia, North America and Australia

1

Know-how & Experience

Many years of continuous operation combined with the latest technology ensures the expert ELEKTRA engineers constantly develop new and innovative solutions. ELEKTRA products remain at the forefront, providing the highest level of quality and customer satisfaction.

2

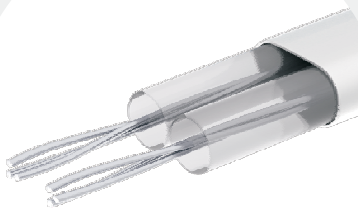
Raw Material Control

The rigorous selection, approval and use of an established and qualitative raw material supply chain including: Isabellenhütte, Sandvik, 3M & Borealis, ensures the quality and integrity of ELEKTRA products.

Multi-wire Construction

3

The heightened mechanical durability and flexibility of ELEKTRA heating cables is achieved through the use of multi-stranded wire construction of the cores.



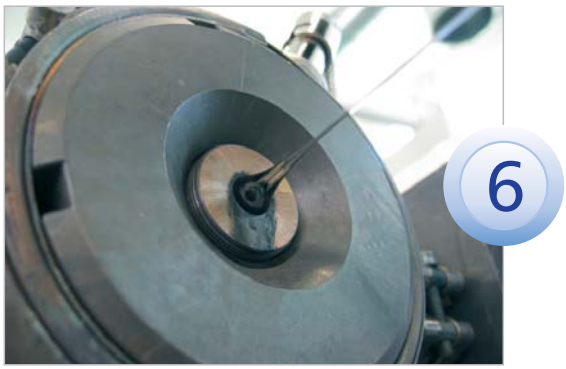
4

Dual Heating Cores

Both cores are heating, allowing equal power distribution of 50% to each core.
This significantly lowers the actual operating temperatures of the heating cores which prolongs the life span of the products.

Double-layer Insulation

The use of double-layer insulation in products especially designed for extremely demanding operating conditions ensures superior thermal and electric features, thus significantly enhancing durability of the products.



Precise Extrusion

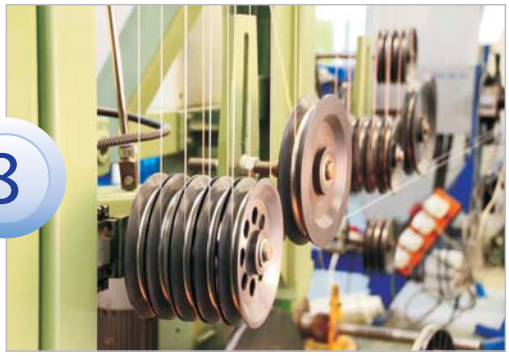
Precise parameter settings are achieved with computer controlled extrusion processes, ensuring correct structure and necessary quality of the extruded insulation and outer sheath.

Laser Measurement

Laser measurement equipment in extrusion lines guarantees insulation and outer sheath thickness to within a tolerance of 0.05mm, and maintains uniform cable centricity.

Uniformity of Resistance

The necessary maintenance of uniform cable tension and therefore stability of resistance is achieved through the use of modern production machines at each stage of the production process. This uniformity and stability is confirmed with 6 individual measurements of heating wire resistance during production.

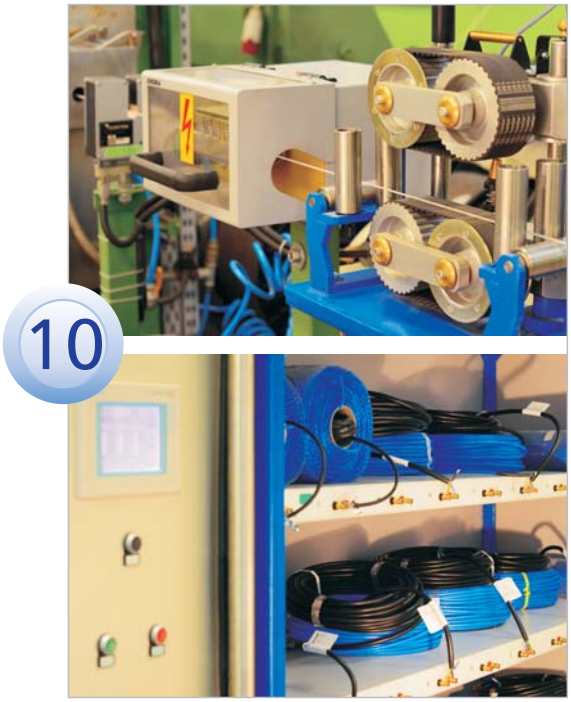


Faultless Joint

Only modern precision calibrated pneumatic devices guaranteeing adequate uniform force of joint clamping are used. The material and construction of joints to the level of IPX7 minimum, guarantees the protection of connections in products.

High Voltage Control

Production defects are wholly eliminated by rigorous high voltage control monitoring in the production line, and an additional final high voltage test of every single product, not random testing.



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Unique Code

The marking of each product with a unique production code, means the history of the entire production process and materials used in manufacture can be traced.

CERTIFICATE

No. J - 151/11/2021

ELEKTRA
Włodzimierz Nyc, Witold Nyc Spółka Jawna
ul. Kazimierza Kamińskiego 4, 05-850 Ożarów Mazowiecki
and
Locations
listed in Annex to the certificate

is in conformance with
PN-EN ISO 9001:2015-10

in the following scope of activities:
production, design, consulting and distribution of heating systems as well as distribution of ventilation systems and electrical equipment

The audit carried out by the Polish Centre of Testing and Certification has offered evidence of the above.
This Certificate shall remain valid provided that above standard are respected by the Organization.

This certificate is valid:
From 04.09.2021 to 03.09.2024

Issued under the Contract No. 01/RL/B/2021
Date of certification decision: 01.09.2021
Certificate bears a qualified signature.
Warsaw, 08.09.2021

PCA IAF

Member of the Board

Polish Centre For Testing and Certification

ANNEX TO THE CERTIFICATE

VALID ONLY IN CONNECTION WITH THE CERTIFICATE

No. J - 151/11/2021

This is to certify that the following Locations:

- ELEKTRA Włodzimierz Nyc, Witold Nyc Spółka Jawna
  ul. Kazimierza Kamińskiego 4, 05-850 Ożarów Mazowiecki
  In the following scope of activities:
  production, design, consulting and distribution of heating systems as well as distribution of ventilation systems
- ELEKTRA Oddział Ursus - Hurtownia
  ul. Dzieci Warszawy 13, 02-495 Warszawa
  In the following scope of activities:
  sale of heating systems and ventilation systems, power cables and electrical equipment as well as production of heating mats
- ELEKTRA Magazyn - Panattoni Park Konotopa II
  ul. Rajdowa 9, 05-850 Konotopa
  In the following scope of activities:
  storage, completion and shipment of heating and ventilation systems

meet the requirements of the standard listed on the certificate.

Issued under the Contract No. 01/RL/B/2021
Date of certification decision: 01.09.2021
Certificate bears a qualified signature.
Warsaw, 08.09.2021

PCA IAF

Member of the Board

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Polish Centre For Testing and Certification

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IQNet
THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

PCBC as an IQNet Partner hereby states that the organization:

ELEKTRA
Włodzimierz Nyc, Witold Nyc Spółka Jawna
ul. Kazimierza Kamińskiego 4, 05-850 Ożarów Mazowiecki
and Locations
listed in the Annex to the certificate

has implemented and maintains a
Quality Management System

for the following scope:
production, design, consulting and distribution of heating systems as well as distribution of ventilation systems and electrical equipment

which fulfils the requirements of the following standard:
PN-EN ISO 9001:2015-10

Issued on: 04.09.2021
Expires on: 03.09.2024

This attestation is directly linked to the IQNet Partner's original certificate and shall not be used as a stand-alone document

Registration Number: PL - J - 151/11/2021

Alex Stoichitoiu
President of IQNet

Member of the Board

IQNet Partners*:
AENOR Spain, AFNOR Certification France, APCER Portugal, CCC Cyprus, CQC Italy, CQM China, CQS Czech Republic, Cro Cert Croatia, DQS Holding GmbH Germany, FCAV Brazil, FONDONORMA Venezuela, ICONTEC Colombia, Inspecta Sertifiointi Oy Finland, INTECO Costa Rica, IRAM Argentina, JQA Japan, KFQ Korea, MIRTEC Greece, MSZT Hungary, Nemko AS Norway, NSAI Ireland, PCBC Poland, Quality Austria Austria, RR Russia, SII Israel, SIQ Slovenia, SIRIM QAS International Malaysia, SQS Switzerland, SRAC Romania, TEST St Petersburg Russia, TSE Turkey, YUQS Serbia

* The list of IQNet partners is valid at the time of issue of this certificate. Updated information is available under www.iqnet-certification.com

IQNet
THE INTERNATIONAL CERTIFICATION NETWORK

Annex to IQNet Certificate Number PL - J - 151/11/2021

ELEKTRA Włodzimierz Nyc, Witold Nyc Spółka Jawna
ul. Kazimierza Kamińskiego 4, 05-850 Ożarów Mazowiecki
for the following scope:
production, design, consulting and distribution of heating systems as well as distribution of ventilation systems

ELEKTRA Oddział Ursus - Hurtownia
ul. Dzieci Warszawy 13, 02-495 Warszawa
for the following scope:
sale of heating systems and ventilation systems, power cables and electrical equipment as well as production of heating mats

ELEKTRA Magazyn - Panattoni Park Konotopa II
ul. Rajdowa 9, 05-850 Konotopa
for the following scope:
storage, completion and shipment of heating and ventilation systems

meet the requirements of the standard listed on the certificate.

This annex is valid in connection with the above-mentioned certificate.

Page 1 of 1

Alex Stoichitoiu
President of IQNet

Member of the Board

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* The list of IQNet partners is valid at the time of issue of this certificate. Updated information is available under www.iqnet-certification.com

Quality Confirmed

ELEKTRA quality confirmed by the research results and certificates of VDE and EAC, as well as certificates issued by, among others, UL (Underwriters Laboratories), ETL, Predom OBR, BBJ, Bureau Veritas and PZH.

1. Room Heating

1.1 General Information

Heating systems can operate on the physical process of convection or alternatively apply the principles of thermal radiation.

Radiation heating
– thermal radiation directly heats up objects located within its reach (walls, furniture, home appliances, etc.), is transferred via the air (the air not being part of the physical process and not heating up).
The air then increases its temperature indirectly, coming into contact with surfaces previously heated with radiation. In rooms heated with radiation air temperature is lower from the average radiation temperature of all surfaces, thus creating the perception of thermal comfort.

Humans generally feel more comfortable in rooms of warmer building components and cooler air – rather than opposite.

Convection heating
– radiators heat up the air which then increases its temperature and lifts, later cools down and drops. The process of air circulation repeats until the air temperature achieves one level. Radiators warm up the air in the first place, and the temperature of the building components (walls, floor, ceiling) is lower, especially for external walls.

In surface heating – floor, wall and ceiling heating – heat transfer occurs mostly through radiation.
In traditional heating applying conventional radiators, heat transfer occurs mostly via convection.

1.1.1 Thermal Comfort

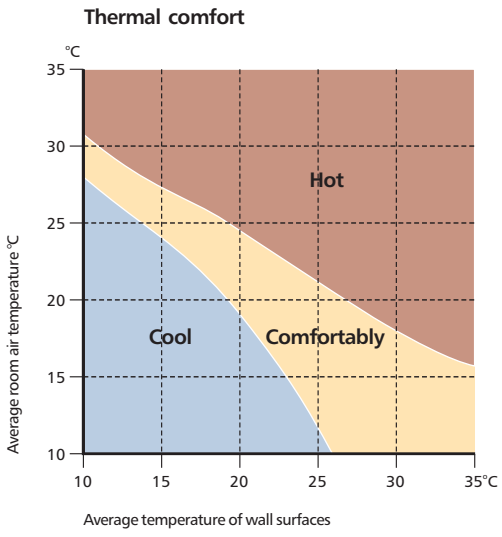
One of the most crucial aspects of the comfort of room use is thermal comfort. This is a state in which users feel that their organisms are in the condition of even thermal balance, i.e. they do not feel excessive heat or cold. Thermal balance is influenced by the heat generated by human bodies when physically active or wearing clothes, as well as the parameters of the environment:

- air temperature,
- the temperature of the surfaces of building components,
- air flow velocity,
- air humidity.

The total of external parameters influences the thermal perception of humans. Their average value constitutes ambient temperature as felt by humans. The relationships can be viewed in the following chart.

Relatively low air temperatures are compensated by thermal radiation of building components (walls, floors, ceiling), thus ensuring required thermal comfort. Lowering room temperature with 1-2°C for underfloor heating, and 3-4°C for wall heating respectively, allows maintaining thermal comfort with simultaneous drop in energy costs:

- for underfloor heating: 4-8%,
- or wall heating: 12-16%.

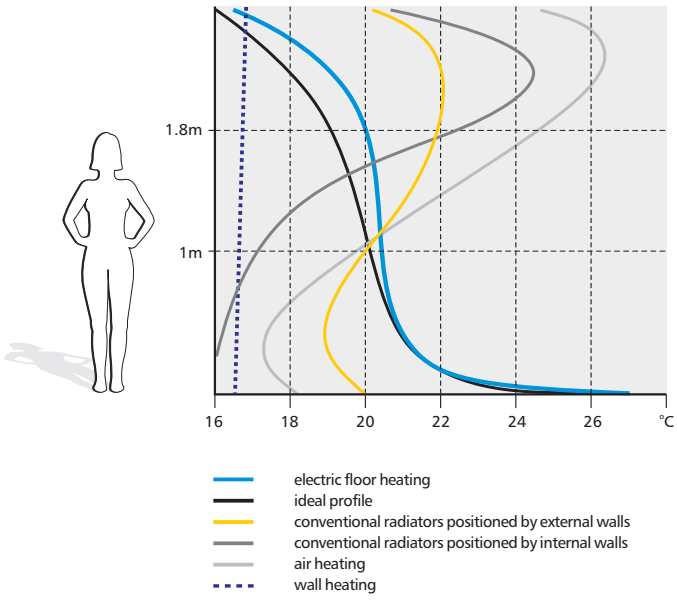


Vertical distribution of room temperature also influences the perception of thermal comfort.

Vertical temperature distribution for underfloor heating most closely follows the ideal profile.

Ideal conditions of thermal comfort can only be provided by heating systems which heat up rooms through thermal radiation, not convection (meaning the air flow).

Vertical temperature distribution depending on the type of the heating system



1.1.2 Health and Hygienic Conditions

Air ionisation
Air with the excess of negatively charged ions positively influences well-being of living organisms, also generating the much-desired feeling of freshness. For conventional radiator heating, the amount of positively charged ions increases, negatively influencing our health and well-being. Pumping air through metal ventilation ducts and heating coils causes reduction of negatively charged ions proportionally to the air flow velocity.

Surface heating does not cause any disturbances in ionic balance in the room air.

Allergies
For room air temperature above 23-24°C the risk of irritation of mucous membranes increases. There is a confirmed relationship between increased indoor air temperature and the occurrences of the so called Sick Building Syndrome. Surface heating allows decreasing the room temperature still maintaining thermal comfort.

Dry distillation of dust particles
The process of decomposition of organic dust particles via their scorching (the so called dry distillation of dust) occurs in temperatures above 60°C – and this is the temperature level of conventional on-wall radiators. Surface heating is a low temperature heating (24-28°C), where the entire floor, wall or ceiling surface is the heater.

Air flow – draughts
In convection heating, dust and allergens are carried with the air around rooms. In surface heating there is no air circulation, therefore the dust is not dispersed into the air.

Air humidity
Optimal level of air humidity should amount to 40-60%, still heating systems usually decrease it down to approx. 30%. Dry air causes drying up of mucous membranes and dry cough. This is particularly troublesome for people with allergic tendencies. Surface heating creates beneficial microclimate – not drying up the air.

Low temperature surface heating is the most healthy type of the heating system, especially recommended for allergy sufferers.

2. Underfloor Heating

2.1 General Information

Electric underfloor heating is a low temperature surface heating, and besides featuring all the advantages of such a heating, can also be characterised with:

- low investment costs,
- retaining room aesthetics – not introducing any disturbing foreign elements, such as visible radiators,
- no requirement of providing a separate boiler room and flue gas ducts,
- possibility of warming up selected rooms in intermediate heating periods, with no requirement to start up the entire heating system,
- reliability and high durability,
- simplicity of operation and maintenance,
- prevention of environmental pollution.

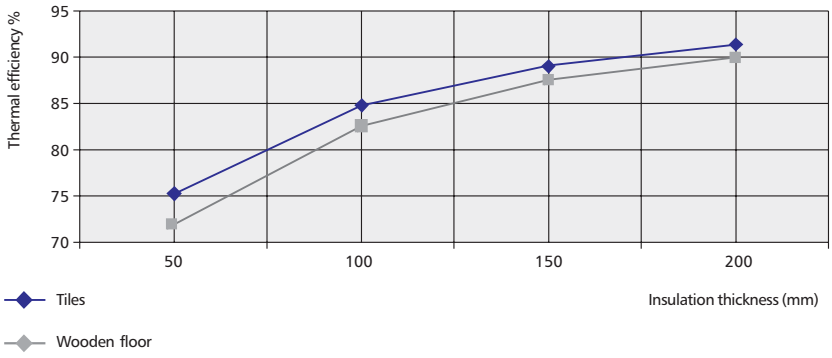
2.1.1 Thermal Insulation

Floor heating is a radiant form of heating, with the whole floor surface acting like a heater. The effectiveness of the heating depends, to a high degree, on the quality of the floor's thermal insulation. This especially relates to ground floor areas and rooms with unheated basements below. The quantity of heat which will be retained in the heated room depends on the quality & thickness of insulation.

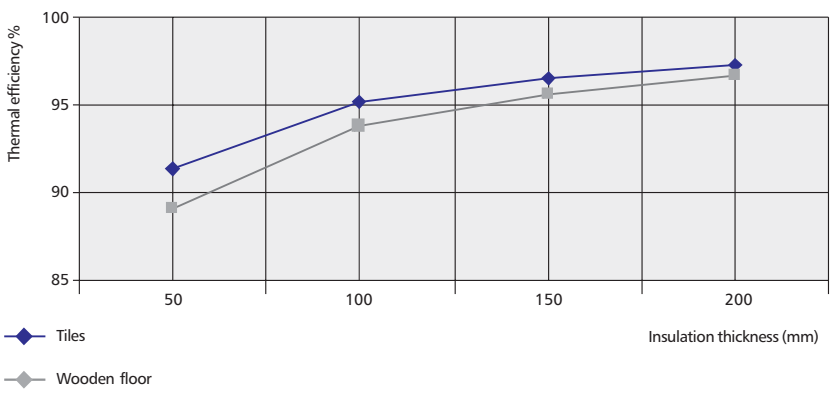
The thickness of the floor insulation on the upper levels of a building is less important than the ground floor insulation (see the adjacent chart).

Good thermal insulation of the floor, walls, roofs, and windows will decrease the demand for heat and reduces the running costs of the heating system.

Efficiency of electric floor heating for different thickness of insulation (floor directly at ground)



Efficiency of electric floor heating for different thicknesses of insulation (floor structure between levels)



2.1.2 Floor Coverings

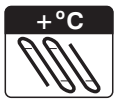
Floor heating requires coverings with a thermal resistance below 0.15 m^2K/W.

Suitable floor finishes, which can be used with floor heating systems include:

- Ceramic tiles and stone floors
- Carpet
- Vinyl
- Parquet and other wooden flooring (the moisture content should be below 9%)

Carpet and Vinyl should be certificated and marked:

Carpet



Vinyl

Approximate thermal properties of exemplary floor finish materials:

Floor Finish	Thickness	Thermal Conductivity	Thermal Resistance
	[mm]	λ [W/m·K]	R [m^2K/W]
Ceramic tile	9.0	1.050	0.009
Marble	25.0	2.150	0.012
Carpet	7.0	0.090	0.150
Linoleum	2.5	0.170	0.015
Vinyl floor tile	2.0	0.200	0.010
Vinyl floor tile on felt	5.0	0.070	0.086
Vinyl floor tile on cork	5.0	0.070	0.071
Oak-wood parquet	25.0	0.220	0.114
Cork parquet	11.0	0.090	0.122
Laminate floor	8.0	0.114	0.070*

*) Heat resistance for laminate floors is calculated by adding the heat resistance for the laminate flooring and the insulating underlay.

2.1.3 Concrete Slab (screed)

In floor heating, two types of floor coverings can be used:

- Anhydrite coverings have short drying time (approx. 7 days) and have small linear shrinking. This method allows the execution of jointless large areas (up to 300m^2). Thanks to the low porosity, this covering has got high heat transfer properties, and therefore features shorter floor warm-up time than regular cement slab.
- Cement coverings have high temperature and humidity resistance. Due to a large linear shrinking factor, for surfaces over 30m^2 with the length of one side over 6m, is necessary to incorporate expansion joints. The approximate setting time: 28 days.

The coverings should be separated from side walls by expansion tape. To avoid heat loss to the base or outer walls, screeds used for heated floors can not be directly connected to the base or walls (floating floor).

2.1.4 Floor Temperature

The recommended temperature of the floor is 26°C. Higher temperatures could cause conditions that would bring discomfort.
For bathrooms and areas with a lot of glazing, such as conservatories, winter gardens & shop fronts, a higher temperature is recommended (approx. 29-30°C).

Technical parameters	Anhydrite slab covering	Cement slab covering
Slab's thickness	35 - 60 mm	50 - 80 mm
Heat transfer coefficient	2.0 W/m·K	1.0 - 1.1 W/m·K
Dry-out time	7 days	28 days
Max jointless area	300 m^2	30 m^2
Porosity	8%	15 - 20%

2.1.5 Designing a Floor Heating System

Electric floor heating is basically used to obtain warm floors. In energy-efficient houses, where the seasonal heat load is

$$E_A < 70 \ \frac{kWh}{m^2 \ year}$$

floor heating can be efficiently applied as primary heating. The lower the E_A, the more economical floor heating costs in comparison with costs associated with other types of heating systems.

In heating systems designed to obtain warm floors, it is recommended to apply temperature controllers measuring floor temperature. For floor heating systems used as primary heating, temperature controllers should be applied measuring air temperature in rooms.

Heating cable's heat output [W/m]
Amount of heat, is expressed in Watts, emitted by 1m of heating cable.

Heating mat's heat output [W/m²]
Amount of heat, expressed in Watts, emitted by a heating cable installed on the heating mat's surface area of 1m².

Heat output [W/m²]
Amount of heat, expressed in Watts, for every 1m² of the room's surface area, to balance heat losses and heat up the room to the required temperature.

Warm floor
Warm floor influences the heat comfort of rooms, and its temperature depends on personal preferences of users.

Floor heating used to obtain warm floors that also requires primary heating, it only acts as supplementary heating. Warm floors can be obtained by installing heating mats or cables directly under floor in the layer of adhesive or self-levelling screed/compound, on which ceramic tiles are then laid, stone, PVC or wood flooring glued to the floor.

Laminate flooring or engineered wood flooring can be warmed up with heating mats designed for dry installation, laid on the insulation layer.

Controllers equipped with floor temperature sensors allow to maintain floor temperature required by users, continously or only during determined time periods.

Heat output required to obtain warm floors depends on:
- type of the flooring,
- method of temperature control.

Solid floor boards, vinyl boards and panels or PVC flooring allow heat output not exceeding 100W/m², the restriction for laminate or engineered wood flooring is 140W/m², ceramic or stone flooring even 170W/m².

If possible, it is recommended to use programmable temperature controllers with temperature setback during determined time periods, as well as for cases when the heating is not continously on, e.g. in hotel rooms or offices.

Higher heat output of heating mats or smaller spacing of heating cables will shorten the time required to achieve warm floor after temperature setback periods.

Application of higher heat output does not influence energy consumption, still it speeds up obtaining set floor temperature.

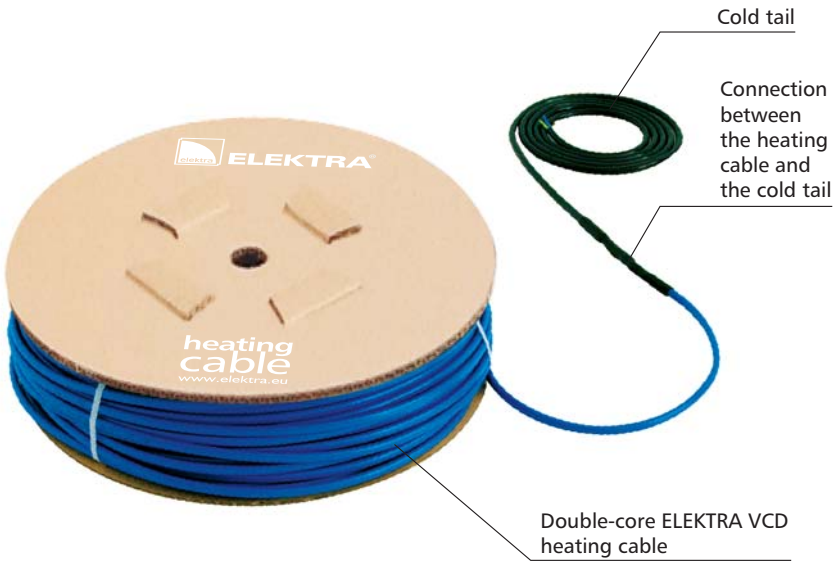
In transition periods of autumn and spring, when the primary heating system is not on yet, floor heating normally dedicated to obtain warm floors can be easily used to heat entire rooms.

2.2 In-Screed Floor Heating

This type of heating is installed in rooms which are under construction and floors are not finished yet.
It generally serves as primary heating and is the only source of heat in rooms.

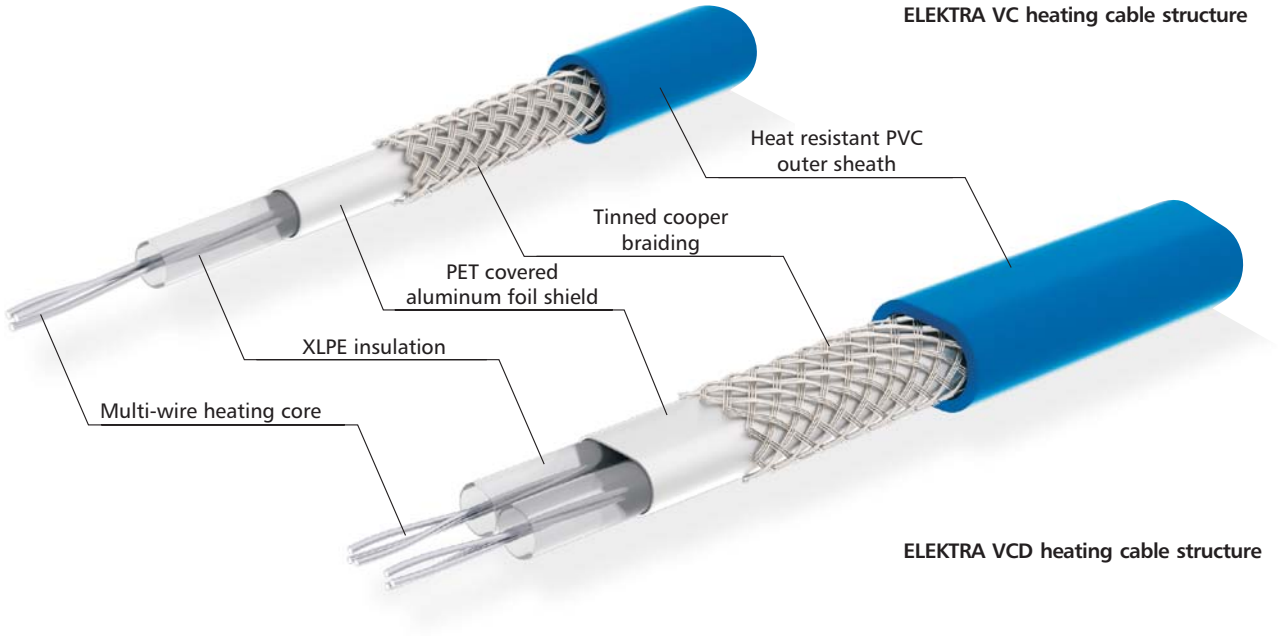
2.2.1 ELEKTRA VC/VCD Heating Cables

With sand/cement or anhydrite screed floors, ELEKTRA VC or VCD heating cables are used.



ELEKTRA VCD heating cables are double-core with a 2.5m ("cold tail") power lead at one end and a joint at the other.

ELEKTRA VC heating cables are one-core with a 2.5m ("cold tail") power lead at both ends.



ELEKTRA VC heating cable structure

ELEKTRA VCD heating cable structure

Installing the proper type of heating cable

Type of Room	Type of Heating Cable
Housing	VCD
Industrial, basement, and/or garage space	VC or VCD

Heating cables are supplied in various power ratings. The power rating of the heating cables (W/m), is the ratio of watts per 1 metre of cable.

When choosing the correct type of heating cable, it is necessary to consider:
- the kind of space
- the kind of floor
- the minimum acceptable distance between cables

Min. acceptable distance between heating cables

Floor Type	Unit Power of Cable [W/m]		
	10	15, 17	20
	min. distance [mm]		
Tiles	70	100	100
Panel floor PVC	80	120	–
Carpet Wood	100	–	–

The maximum distance between cables can not exceed 200mm to ensure that cold spots do not occur.

2.2.2 Planning

When starting to plan floor heating, it is necessary to:
- assess the design heat load of the building
- assess the type of the flooring
- assess the heating cable's unit heat output for the given type of flooring

In order to calculate the required heating cable's spacing, draw the planned layout of the heating cable or apply the following formula:

$$a\text{-}a = \frac{S}{L+0.5P}$$

where:
- a-a – spacing between cables
- S – floor surface area for the floor heated with the heating cable
- L – heating cable's length
- P – floor surface perimeter for the floor heated with the heating cable

To determine spacing between heating cables, only take into consideration space free from fixed furnishing such as furniture without support, bathtubs, toilets, etc.

Selection of ELEKTRA VCD heating cables.
Design heat load of 100m^2 the building: 3630W (Example value).
Total heat output of the heating cables to install (after taking into consideration safety factor 30%):
3630W x 1.3 = 4719W
Average unit heat load:

$$\frac{4719W}{100m^2} = 47.19W/m^2$$

assumed for further calculations: 47W/m^2

Bedroom: 16m^2
Heat load:
47W/m^2 x 16m^2 = 752W

For carpet flooring in the current example, 10W/m heating cables are recommended. The heating cable of the close heat output is ELEKTRA VCD 10/910, 92m long. Cable spacing:

$$a\text{-}a = \frac{S}{L+0.5P} = \frac{12{\cdot}5m^2}{92m+7.8m} =$$

$$= 0.13m = 13cm$$

Bedroom: 28m^2
Heat load: 47W/m^2 x 28m^2 = 1316W
For ceramic tiles flooring in the current example, no restrictions on the heating cable's unit heat output are applied. The heating cables of the heat output close to 1316W is ELEKTRA VCD 10/1450, 144m long, or ELEKTRA VCD 17/1430, 85m long. Selection should then be made basing on more optimal cable spacing values. For ELEKTRA VCD 10/1450, 144m long, the cable spacing would be 15cm, whereas for ELEKTRA VCD 17/1430, 85m long, the cable spacing would be 24cm. Cable spacing should not exceed 20cm, to prevent creating under-heated areas (cold spots) – therefore the cable ELEKTRA VCD 10/1450 has been chosen.

Bathroom: 9m^2
Heat load: 47W/m^2 x 9m^2 = 423W
To cover heat losses and maintain required temperature inside of the rooms as adopted in the initial assumptions, it is enough to install the heating cable ELEKTRA VCD 17/480.
However, in practice, higher temperatures are adopted for bathrooms than for other types of rooms. Therefore, the next cable type will be selected from the range – ELEKTRA VCD 10/570, 57m long.
Cable spacing:

$$a\text{-}a = \frac{6.5m^2}{57m+5.7m} = 0.10m = 10cm$$

Installation example of heating cables

Selection of ELEKTRA VCD heating cables

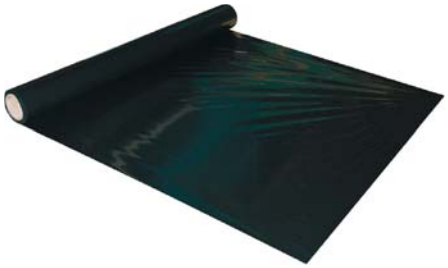
Living Space	Type of Floor Finish	Total Space	Unfurnished Heated Space	Half of the perimeter, for the area heated	Required Heating Power	ELEKTRA VCD Heating Cable	Fixed Power	Cable Length	Cable spacing $a\text{-}a=\frac{S}{L+0.5P}$
			S	0.5P				L	
		[m^2]	[m^2]	[m]	[W]		[W]	[m]	[mm]
Bedroom I	Carpet	16.0	12.5	7.8	752	10/910	910	92.0	130
Bedroom II	Carpet	14.0	11.5	7.0	658	10/700	700	70.0	150
Living room	Tiles	28.0	23.0	11.0	1316	10/1450	1450	144.0	150
Kitchen	Tiles	14.0	10.0	6.5	658	10/700	700	70.0	130
Hall	Tiles	11.0	10.0	10.3	517	10/570	570	57.0	150
Bath	Tiles	9.0	6.5	5.7	423	10/570	570	57.0	100
Toilet	Tiles	3.0	2.0	3.4	141	10/170	170	16.5	100
Lobby	Tiles	5.0	3.0	4.0	235	10/265	265	27.0	100

2.2.3 Installation

Materials required for installing floor heating systems:

- Thermal insulation
  for floor insulation applications
  – foamed polystyrene boards with compressive stress level at 10% relative deformation lower than 60kPa (EN 13163)
  – hard mineral wool boards with 120÷180 kg/m^3 density (compressibility level CP2≤2mm for utility load on levelling layer ≤5 kPa EN 12431)

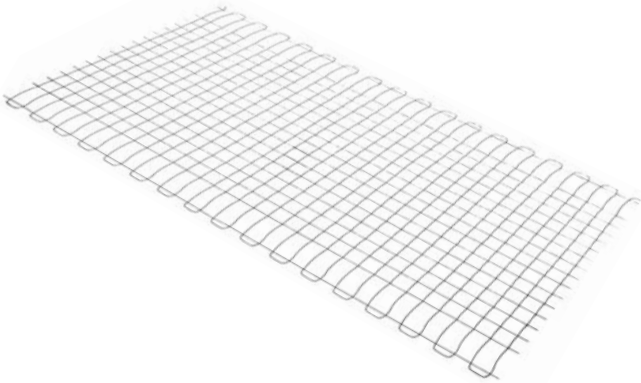
- PE foil



- An ELEKTRA TME
  installation tape on concrete floor or ceiling, initial screed, adhesive mortar

alternatively:

- A steel wire mesh on thermal insulation and damp-proof membrane (PE foil) for separating the heating cable from the surface of the insulation, e.g., a wire mesh with diameter of 2mm and a mesh area of max. 50x50mm (cannot be used in anhydrite screed, where it should be applied plastics mesh e.g. PP)



- A band clip or
  soft binding wire for fixing heating cables on the metal net

- ELEKTRA heating cables

- An ELEKTRA temperature controller

- A conduit for the temperature sensor

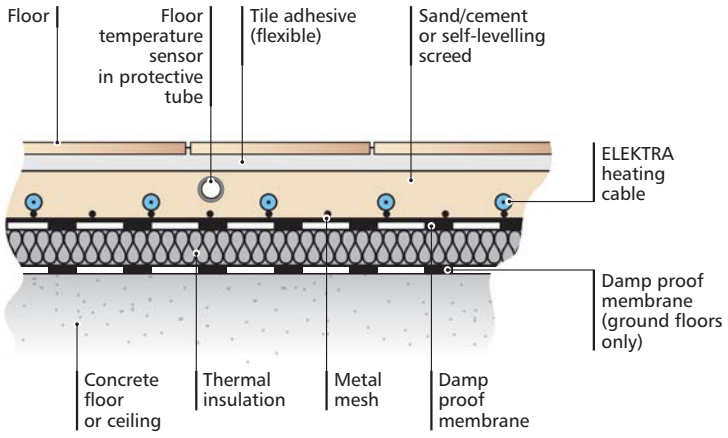
The following layers are placed one on top of the other at an even ceiling or cement base:

- PE foil (only for cement base)
- Thermal insulation
- Damp proof membrane
- Steel wire mesh

According to project specifications which were made before, heating cables are fixed to steel netting by means of band clips or soft binding wire.
If the insulation is foil backed or is covered with a thin layer of screed, an ELEKTRA TME installation tape can be used. After the heating cables have been arranged, a floor temperature sensor should be installed and the completed surface should be covered with sand/cement screed (min. 50mm) or with self-levelling cement.

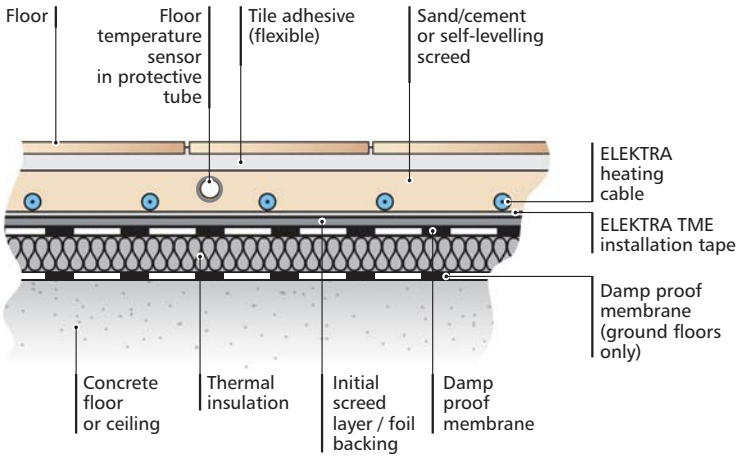
Please note that both the beginning and the end of the heating cable (black joint), as well as the heating cable itself, should be completely covered with screed.

Installation of ELEKTRA VC heating cable to metal mesh



Cross section of the floor with metal wire mesh

Installation of ELEKTRA VCD heating cable by using ELEKTRA TME installation tape



Cross section of the floor with ELEKTRA TME installation tape

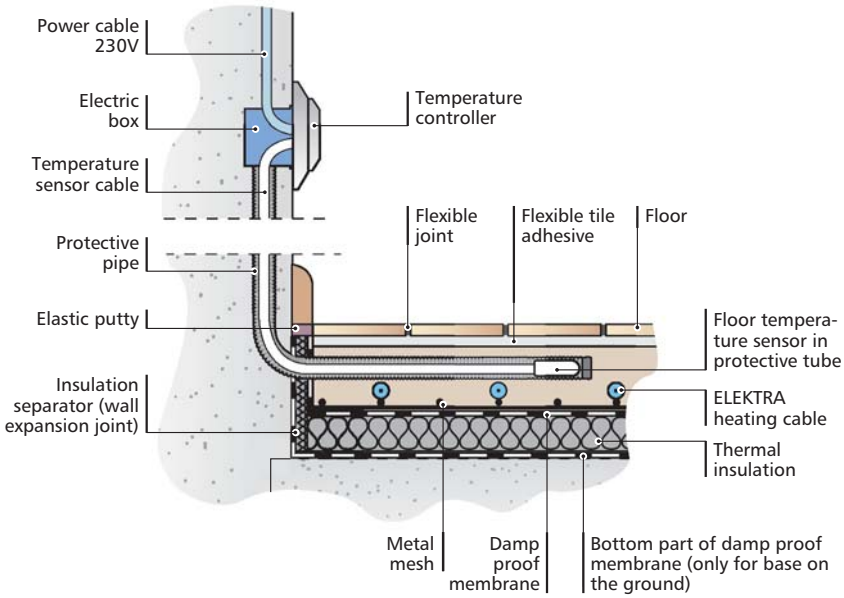
Heating Cable Connection

Connecting the heating cables to the electrical installation system should be via a temperature controller (see section 4.1).

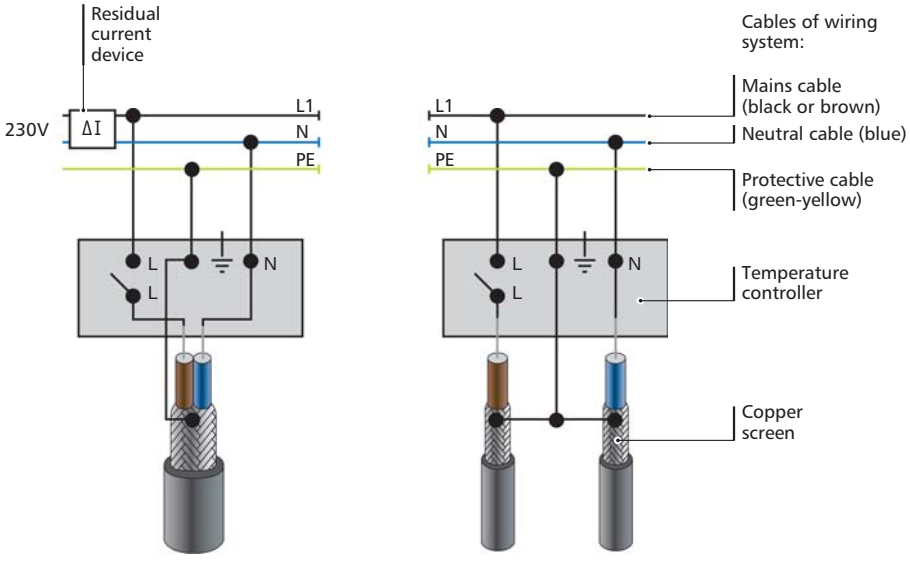
The temperature controller should be installed in an installation box. Within this box, the following should be led into it:

- Power supply cable (230V)
- "Cold" supply cable of the heating cable
- Temperature sensor cable

The floor temperature sensor should be in a plugged flexible conduit. The flexible conduit should not be bent at an extreme angle but rather in a gentle bow like shape. The proper placement for the installation box is dependant on aesthetic and practical reasons. The heating cables should be installed so that the 2.5m cold cable is able to be connected to the controller.



Assembly of temperature controller



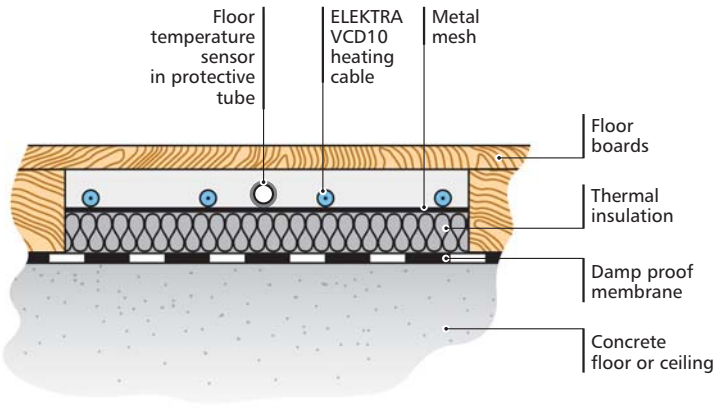
Connection diagram for ELEKTRA VC/VCD heating cables

2.3 Suspended Wooden Floors

Electric floor heating requires the wooden floor to have a thermal resistance no higher than 0.15m²K/W. To fulfill this condition, the thickness of the wooden floor should not exceed values given in the table below.

To calculate the necessary heat required, see section 2.1.5.
The installed power capacity should not exceed 90 W/m² whilst the power rating of the heating cable should not exceed 10 W/m.
Heating cables should not be installed directly on the thermal insulation and on wooden parts of the floor construction. It should be on top of the metal wire mesh, which is fixed to the sides of the joists. Where heating cables have the pass through joists, the joist should be notched and insulated with aluminium metal plates.

Installation of ELEKTRA heating cable by using metal mesh



Cross section of the floor

	Density	Thermal Conductivity	Max. Thickness of Floor	Heat Resistance
	[kg/m³]	λ [W/m·K]	d [mm]	R [m²K/W]
Pine-boards	550	0.16	24	0.150
Spruce-boards	550	0.16	24	0.150
Oak-boards	800	0.22	32	0.145

2.4 Storage Heating

A storage heating system is based on electrical power that is available during low tariff periods, often occurring during night hours.
The use of this power is less expensive, and therefore decreases the electric operating costs. In the period of time when this electricity is available, a concrete floor has the ability to accumulate and retain heat. Storage floor heating requires a solid floor construction (with a thickness of approximately 70-150 mm) and is most often applied in ground floors.

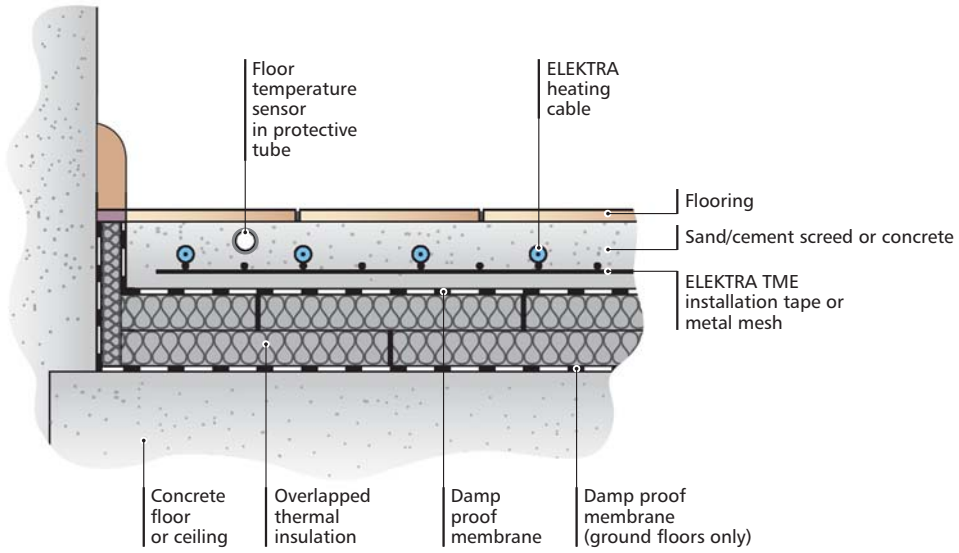
1.4.1 Calculating Heating Power

The formula to calculate the heat loss can be found on page 2.1.5. The duration of the low tariff lasts an average of 10 hours (ranging from 1:00 pm to 3:00 pm and then from 10:00 pm to 6:00 am) within the 24 hour day cycle. The heat accumulated in the floor during this time is sufficient enough to heat a room for the other 14 hours of the day. The total heat accumulation system can be calculated with the following formula:

$$\phi \times 24 \times 1.20 / \theta$$

Where
ϕ = heat loss [W],
θ = the duration of the II tariff [h], and
1.2 = a security factor.

If the result of the calculation surpasses 175W/m², a secondary source of heat is required.



Cross section of the floor

2.4.2 Calculating Screed Thickness

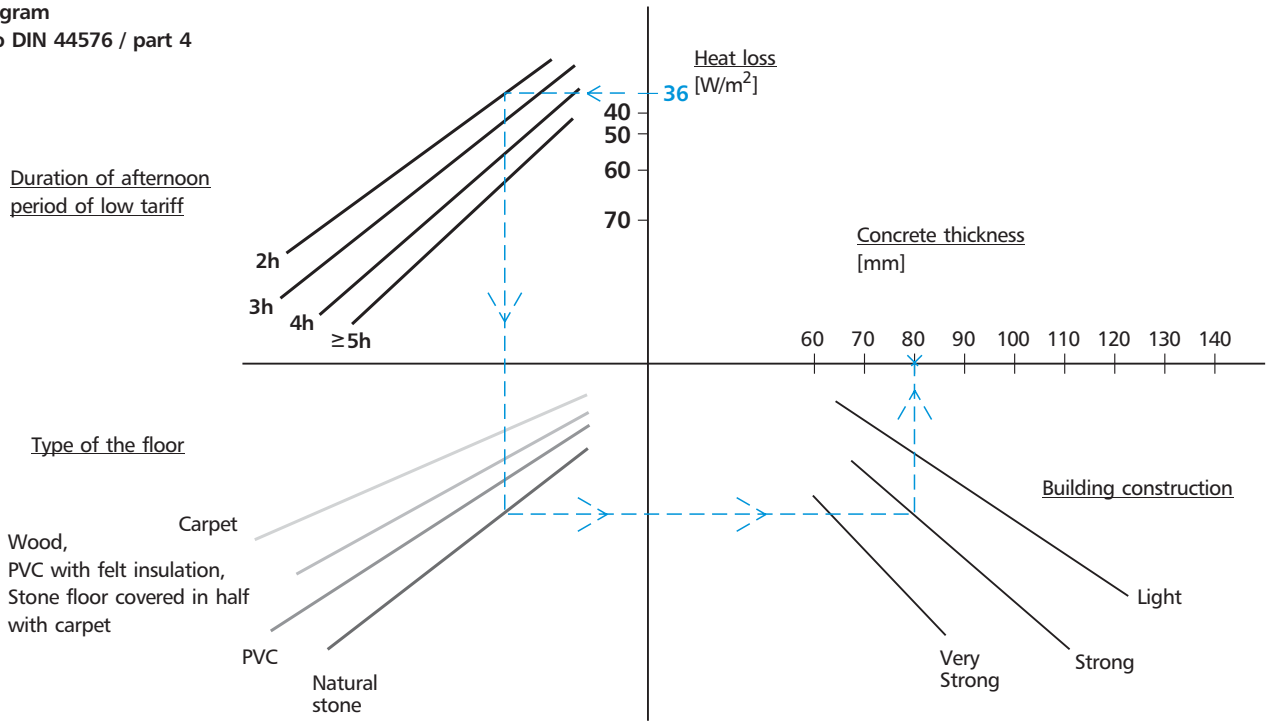
The thickness of the concrete slab is dependant on:

- Unit surface heat losses of the building [W/m²]
- The duration of the low tariff (in the afternoon)
- The type of floor finish
- The strength of the building construction

The specifications on which concrete plate thickness to use can be found in the nomogram below.

Building Construction	Unit Weight [kg/m³]	Construction Materials
Light	below 400	wood
Strong	400 - 1200	hollow brick, Ytong
Very strong	above 1200	concrete, solid brick

Nomogram
acc. to DIN 44576 / part 4



Example
(Building as described in section 2.2.2)

Data:

Thermal power demand	ϕ = 3630W
Total area of building	A = 100m^2
Duration of off peak tariff	10 hours, including two hours in the afternoon hours
Construction of building	strong

Total power of storage system amounts to:
3630W x 24 x 1.20 / 10 = 10454W (10.45kW)

Unit heat power demand amounts to:
10454W / 100m^2 = **104W/m^2**

Calculation of screed thickness:

Heat losses at 1m^2 of building surface	3630W / 100m^2 = 36W/m^2
Duration of off peak tariff	10 hours
Type of floor	floor tiles
Construction of building	strong

Using the given nomogram, the thickness of the screed should be 90mm.
This example is shown with the broken line.

Selection of heating cables:
The 28m^2 Living Room
Heat power demand: 104W/m^2 x 28m^2 = 2912W
We selected ELEKTRA VCD17, of which the total heating power is just under the required level. The heating cable ELEKTRA VCD 17/2950 has a total length of 172m and a power output of 2950W.
The spacing for the heating cables

$$\text{a-a} = \frac{S}{L+0.5P} = \frac{28\text{m}^2}{172\text{m}+11\text{m}} \approx 153\text{mm}$$

The 16m^2 Bedroom
Heat power demand: 104W/m^2 x 16m^2 = 1664W
We selected the heating cable ELEKTRA VCD 17/1590 with a length 93m.
The spacing for the heating cables

$$\text{a-a} = \frac{14.50\text{m}^2}{93\text{m}+7.8\text{m}} \approx 144\text{mm}$$

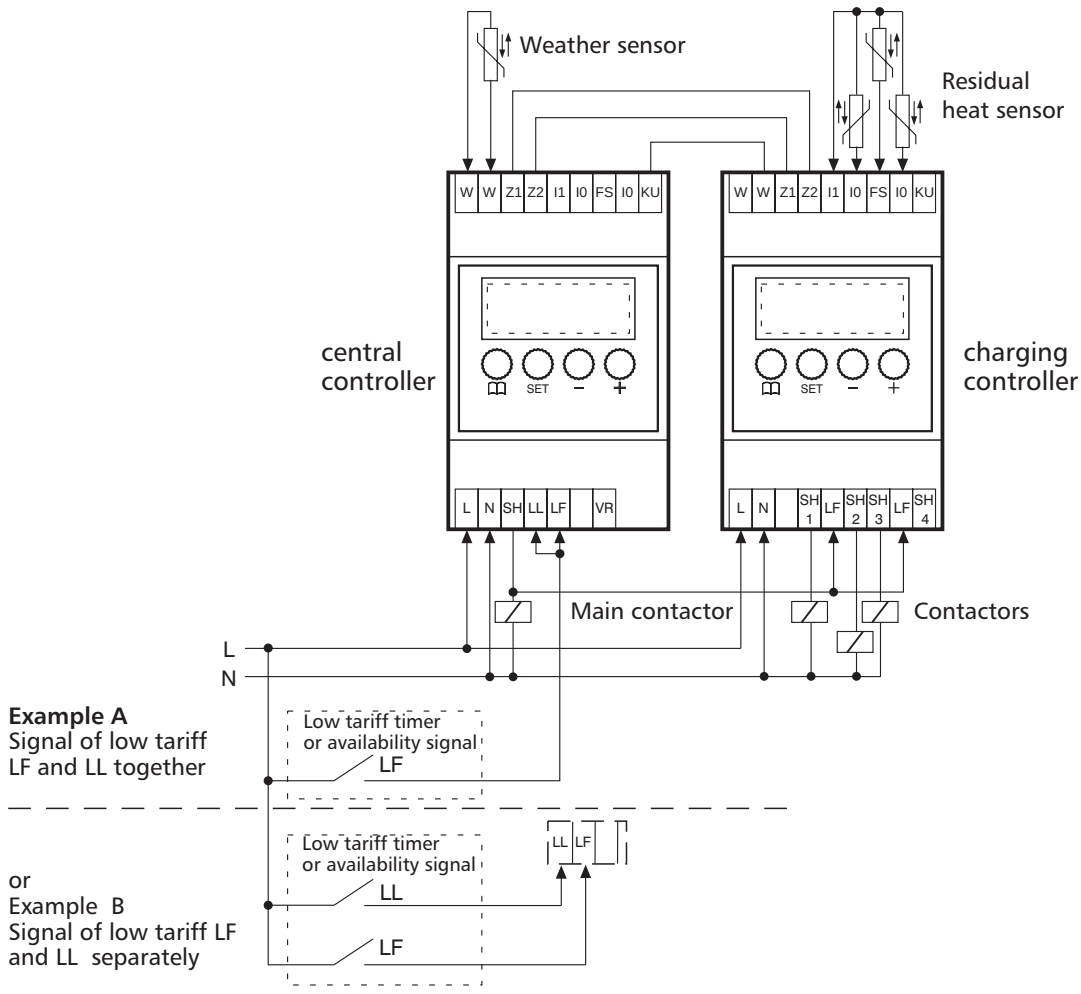
Control
To control storage heating systems, central controllers with charging controllers can be applied, according to the diagram below. A central controller will register average outdoor temperatures and tendencies in temperature change with a weather sensor. Additionally, it will recognize periods of low tariff, basing on signals sent by e.g. a clock or an electric energy supplier.

The charging controller is equipped with a residual heat sensor that records the floor temperature.

The central controller receives a signal confirming low tariff is available and using the measurements of external temperature, the forecast of temperature change and information on stored heat, from the day before. It will power the heating cable for the required time to provide sufficient stored heat, using the low tariff period.

The solution suggested below is just an example (illustration) of a technical solution for the complex control of storage electric floor heating systems. Detailed features of the final solution for such a control system should be discussed with the system's designer or installer.

Such control can be also realized with the following controllers: ELEKTRA ETN-1999, ELEKTRA OCD5, ELEKTRA OWD5 WiFi, ELEKTRA TDR 4022-PRO.



Typical wiring diagram for storage heating controls

2.5 Direct Acting Floor Heating in Adhesive or Self-levelling Slab

If ELEKTRA VC/VCD heating cable installation is not possible due to construction restrictions (e.g. floor levels must not be raised), as well as for renovation of old floors, ELEKTRA DM/UltraTec heating cables or ELEKTRA MG/MD heating mats can be used instead. These mats or heating cables are installed in a layer of adhesive or self-levelling screed / compound directly under the floor.

Heating mats and cables can be installed on concrete floors, self-levelling slab, old floor tiles, terrazzo or damp proof chipboards.

For surfaces that are large in size or irregularly shaped, it is recommended that ELEKTRA DM/UltraTec heating cables are used.

2.5.1 ELEKTRA Heating Mats

A heating mat consists of a thin heating cable that is stitched to a self-adhesive glass fibre mesh. The mat is 500 mm wide and ends in a 4 m "cold tail" supply cable.

ELEKTRA MG heating mats are approximately 3 mm thick and have 'cold tail' supply cables at both ends. ELEKTRA MD heating mats are approximately 3.9 mm thick. One side ends with a 'cold tail' supply cable and the other with a joint.

The single-sided ELEKTRA MD mats are easier to install, due to the single supply cable.

The installation of the double-sided MG mats is more complicated because both 'cold tail' supply cables must be connected to the temperature controller. Due to the miniscule thickness, they are commonly used in places where the floor can not be upraised too much.

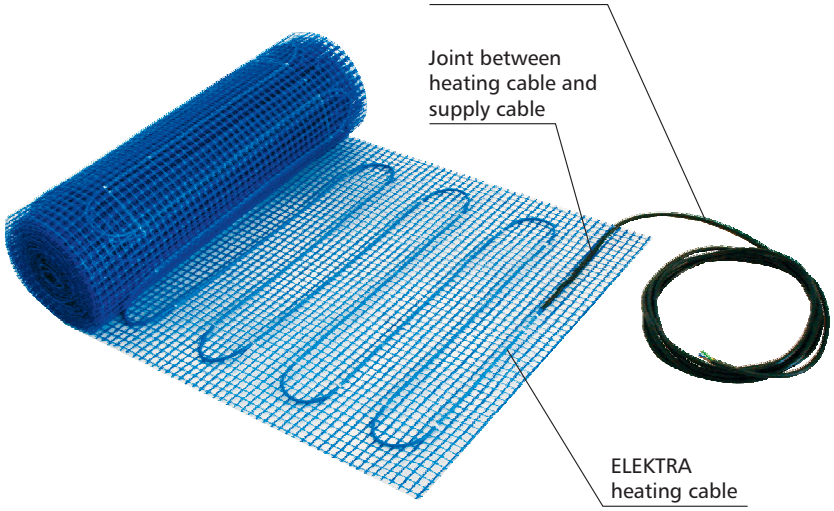
Heating mat power ratings:
MG - 100W/m^2 and 160W/m^2
MD - 100W/m^2 and 160W/m^2
MD - 200W/m^2 (applicable in the UK only, e.g. in conservatories)

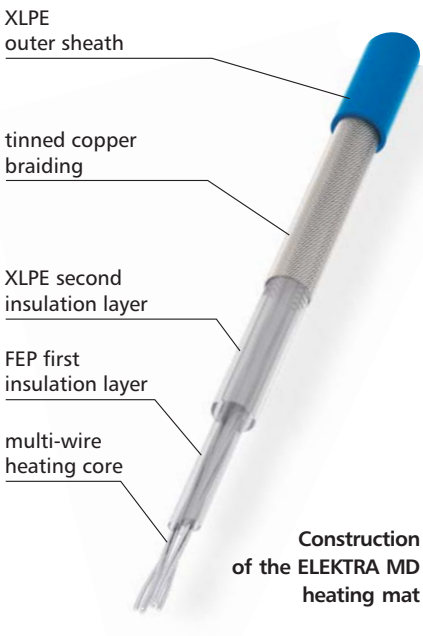
Mats with a power rating of 160W/m^2 (or more) can only be installed under floor tiles.
Heating mats with a power rating of 100W/m^2 can be installed under any type of floor.

Selecting the proper type of mat is dependant on the type of heating system and the size of the unfurnished surface/heating surface.

Selection of heating mat:

Function of the Heating System	Kitchen / Bathroom		Other rooms
	Heating Surface < 3/4 of Total Surface area	Heating Surface > 3/4 of Total Surface area	
	Heat Output [W/m^2]	Heat Output [W/m^2]	Heat Output [W/m^2]
Primary Heating	160	100	100
Warm Floor	100	100	100





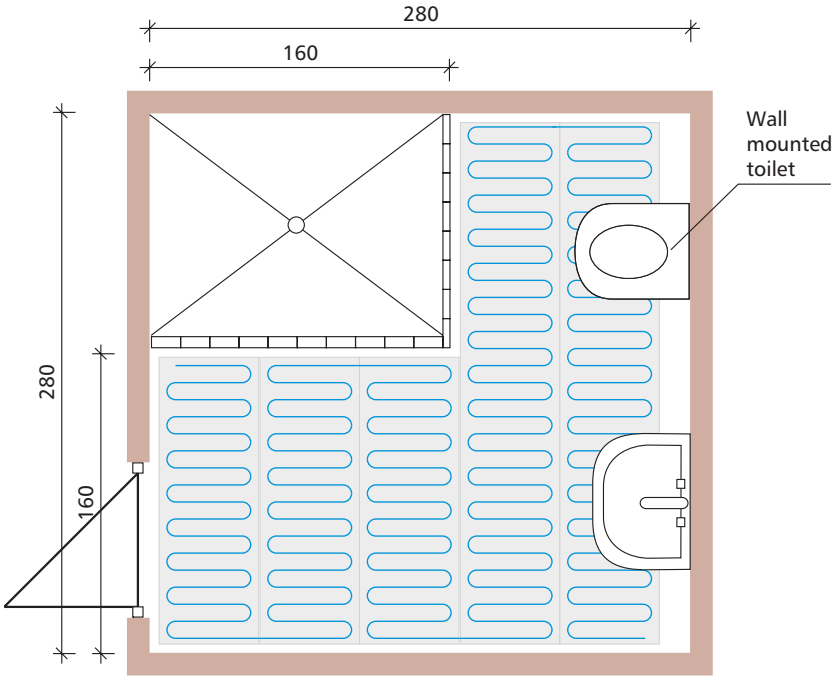
Construction of the ELEKTRA MD heating mat

2.5.1.1 Planning

Calculation of the heating mat's area

When selecting required dimensions of a heating mat, it is necessary to plan its layout on the floor surface free from any furnishings. The area of the heating mat should be equal to or slightly lower than the area of the unfurnished floor. In the latter case, the mat should be laid in such a way so as to ensure that any underheated areas (cold spots) adjoin the walls (see example).

Bathroom area:
2.80 x 2.80 = 7.84m^2
Unfurnished area: 5.92m^2
The length of the heating mat which can be positioned on the unfurnished floor:
3 x 1.60m + 2 x 2.80m = 10.40m
Area of heating mat:
10.40m x 0.50m = 5.20m^2
ELEKTRA MG or ELEKTRA MD heating mats can be selected, of max. dimensions 0.5m x 10.0m and the area of 5.0m^2.

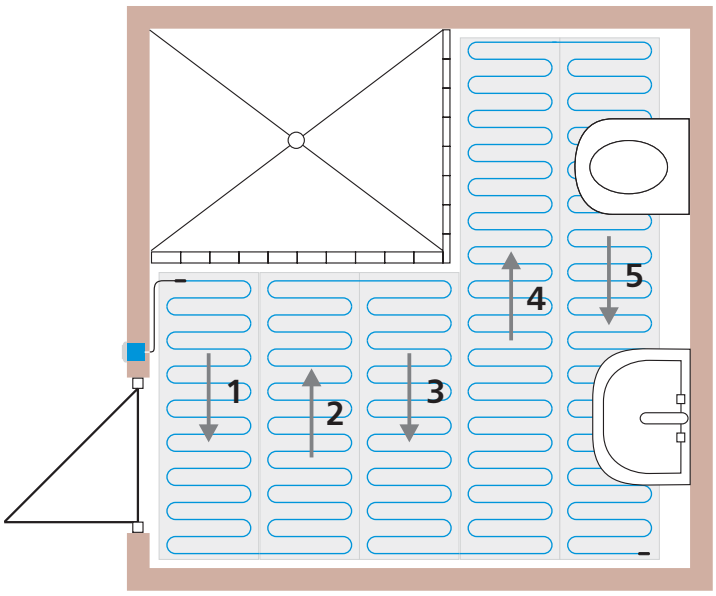


Adjustment of the heating mat's length

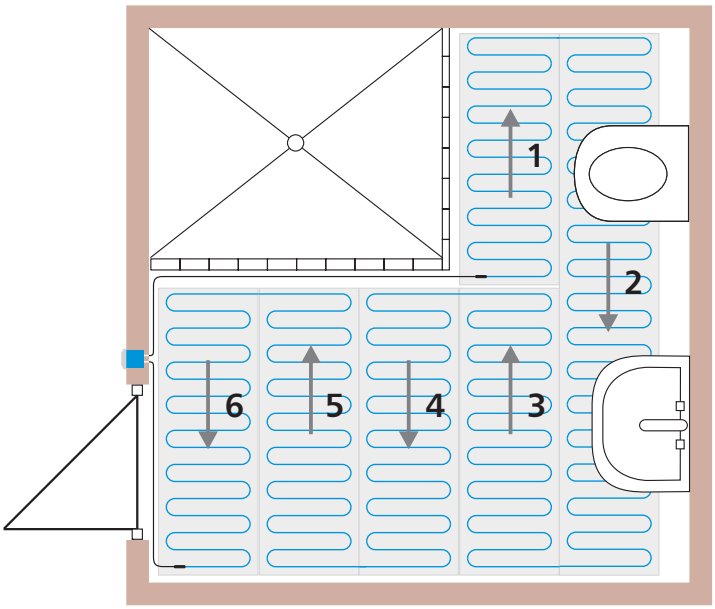
Choice between ELEKTRA MG and ELEKTRA MD heating mats will be determined by the possibility to raise the floor level, as ELEKTRA MD heating mat is approx. 1mm thicker than ELEKTRA MG.

Installation methods of the heating mat

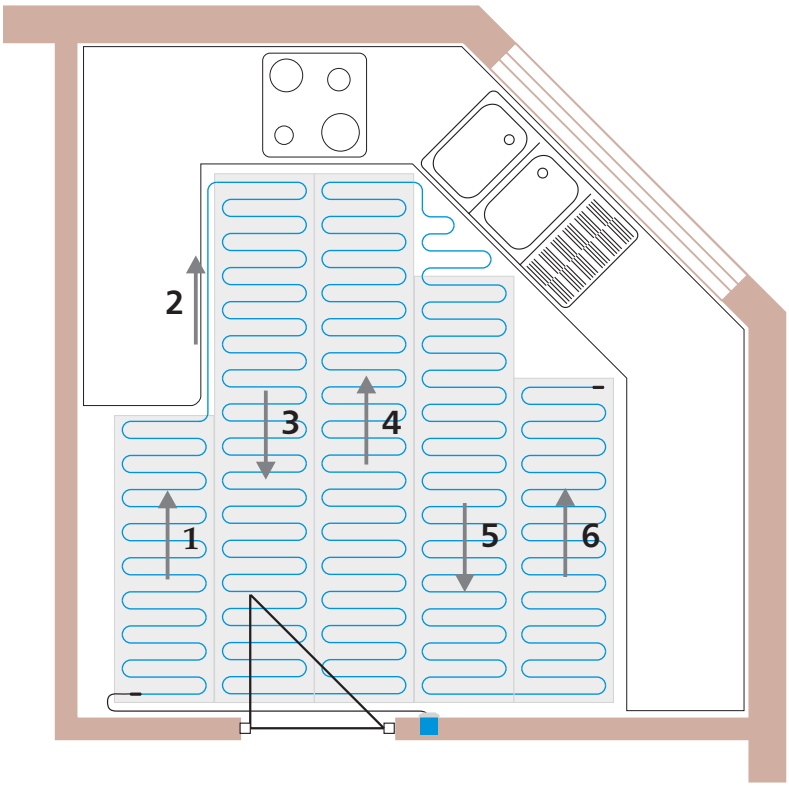
When selecting a heating mat, whether with single-side power supply (MD) or double-side power supply (MG), it is required to lead the mat's power supply cables (4m long) to the electric installation box where the temperature controller will be positioned.



Example layout of a single-side power supply ELEKTRA MD heating mat (power supply conductor marked in black)



Example layout of a double-side power supply ELEKTRA MG heating mat (power supply conductor marked in black)



Example layout of a single-side power supply ELEKTRA MD heating mat

Selection of the heating mat's heat output

If heating mats are to constitute the primary heating system in a room, the required heat load should be calculated according to section 2.1.5. Selection between the heat output of 100 or 160W/m² depends on the total heat load and the area of the unfurnished floor surface.

For the example discussed above, the heat output necessary to cover the heat losses (calculated result for example 47W/m) and maintain the required temperature will be:
7.94m² x 47W/m = 368W
(the heat load value has been assumed as in the example from section 2.1.5).

Calculated heating mat's area: 5 m². ELEKTRA MG 100/5.0 or ELEKTRA MD 100/5.0 heating mats would be selected, of the heat output 500W. The resulting heat output per 1m² of the bathroom's area will be 500W/7.84m² = 63.8W/m².

For bathrooms, higher temperature requirements are assumed than for other rooms, therefore selection of the higher heat output value is recommended.

Example: primary heating

In the kitchen of the area 9.36m², unfurnished area is 5.5m². Heat output necessary to cover the heat losses and maintain the required temperature will be:
9.36m² x 47 = 440W.

The heating mat's area to be fitted to the unfurnished area is 5m². ELEKTRA MD 100/5.0 or ELEKTRA MG 100/5.0 will be selected, of the heat output 500W.

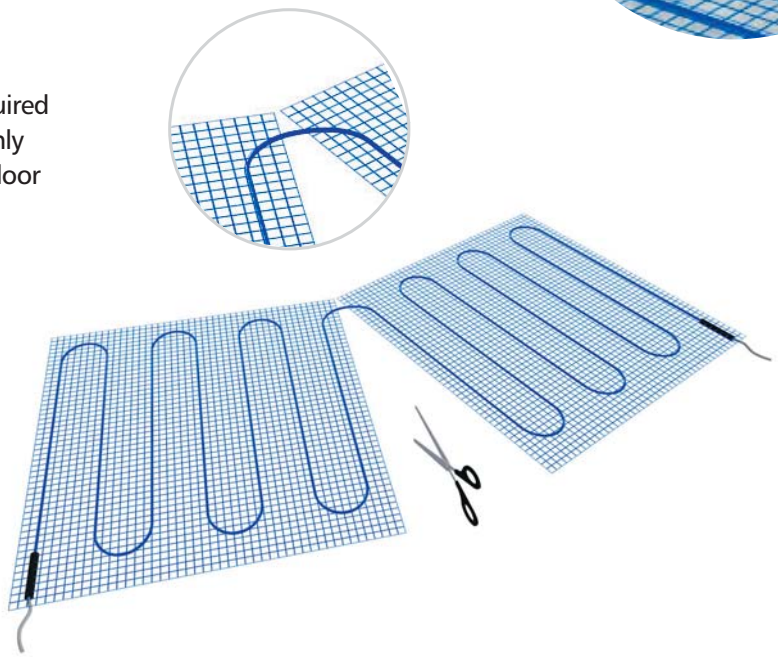
2.5.1.2 Installation

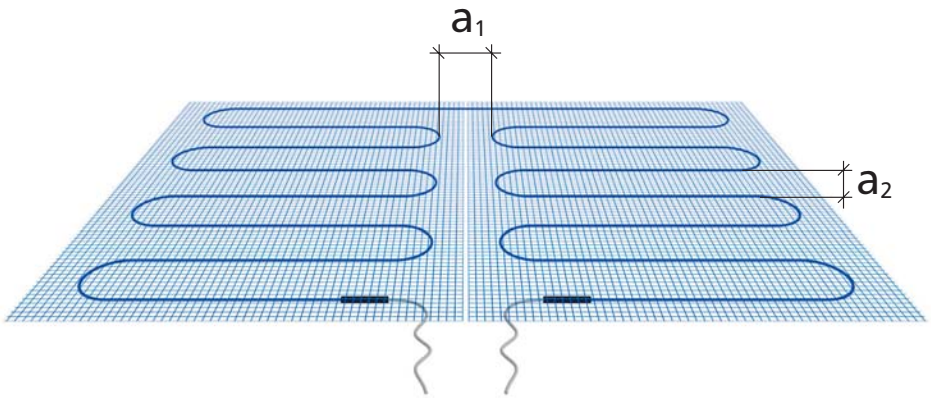
Before installing a heating mat, it is important to remember:

- Do not cut the heating cable for any reason
- To properly fit the mat to the shape of the floor, only cut the mat netting
- Do not shorten the heating cable
- Do not overstretch the heating cable
- Do not place the floor heating under permanently furnished areas
- Do not cross the heating mat over an expansion joint in the floor
- Electrical connections should only be done by a qualified electrician
- Use only flexible tile adhesives that are suitable for floor heating
- Heating mats should be installed at a minimum distance of 100mm away from other heat sources, i.e. smoke flues, central heating pipes, and/or water heating pipes

Installation of heating mats

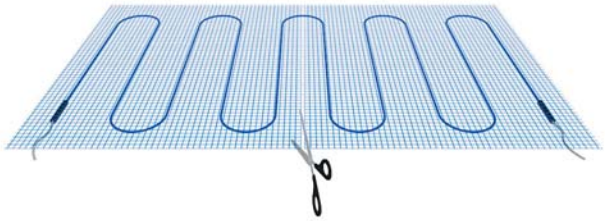
To prepare the mat to fit the required area, shape the mat by cutting only the mesh and position it on the floor to be heated.

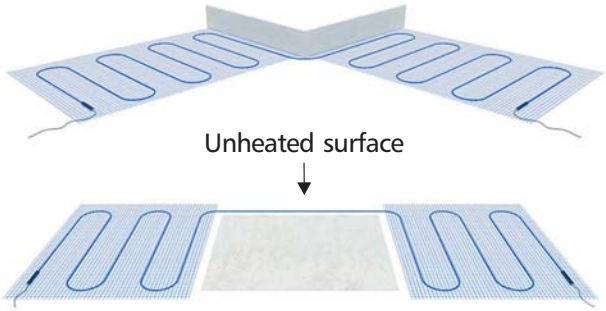




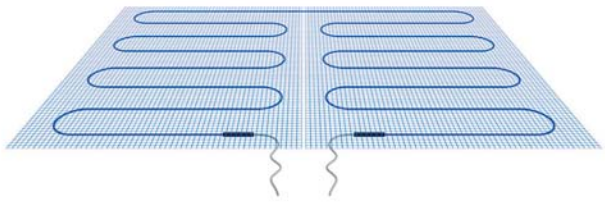
Distance $a_1 \approx a_2$

Typical layouts for heating mats

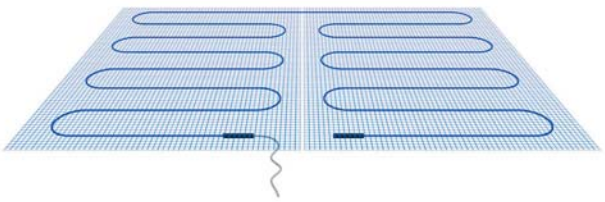


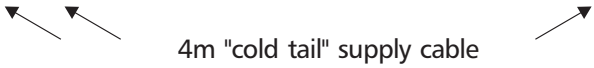


ELEKTRA MG heating mat (two cold tails)



ELEKTRA MD heating mat (one cold tail)

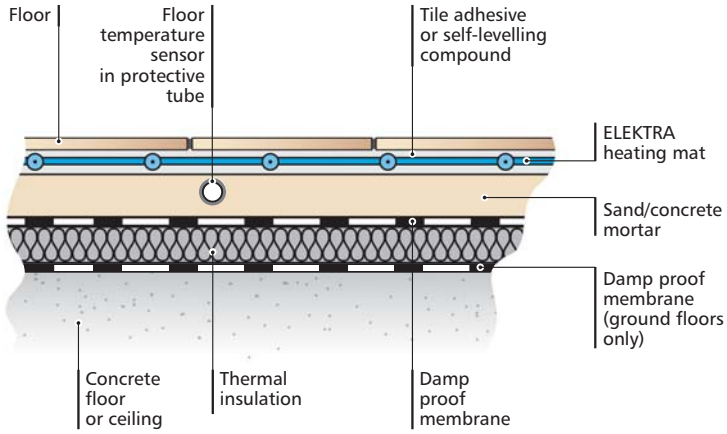




Installing the Temperature Sensor and its Cable

If possible, the temperature sensor should be placed in between the cables at the centre of the heated surface.

- The cable with the sensor is protected by a flexible pipe sealed at one end
- A groove to fit the temperature sensor pipe should be made before installing the temperature sensor
- The pipe containing the temperature sensor should be led to the temperature controller



Cross section of the floor

Installing the Heating Mat

Stone and ceramic flooring:

- The heating mat should be completely covered by flexible tile adhesive
- The tile adhesive can not be spread on the entire surface of the floor at once; the heating mat should be covered progressively
- When the mat is properly fixed on the floor, the "cold tail" supply cable should be taken in the flexible pipe to the temperature controller installation box

For parquet, laminate, engineered wood, carpet or PVC flooring, heating mats should be installed in a self-levelling screed / compound. It is then required to:

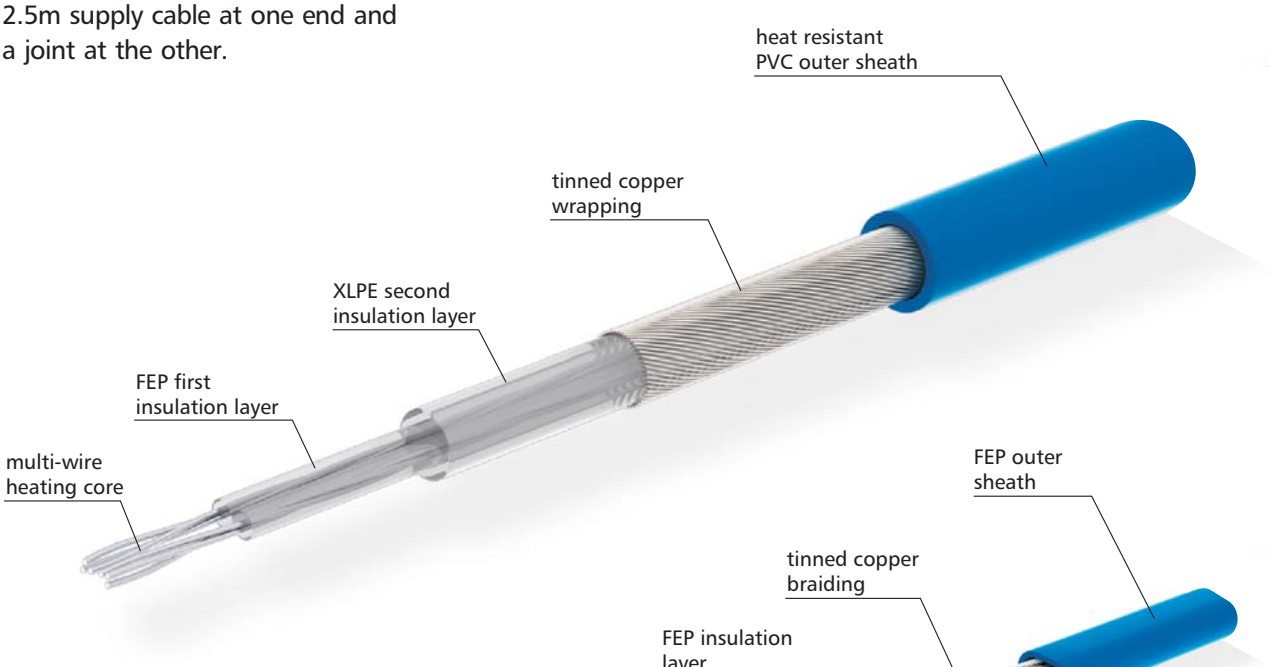
- lay the heating mat on the entire area to be heated
- fix to the floor
- lay the self-levelling slab

2.5.2 ELEKTRA DM and UltraTec Heating Cables

The ELEKTRA DM/UltraTec heating cable is a thin heating cable with a power rating of 10W/m. It has a 2.5m supply cable at one end and a joint at the other.

This type of cable should be installed in a thin, flexible tile adhesive or self-levelling compound.

Because of the small thickness, **ELEKTRA UltraTec** cables can be used in applications where elevating the floor level is not an option.



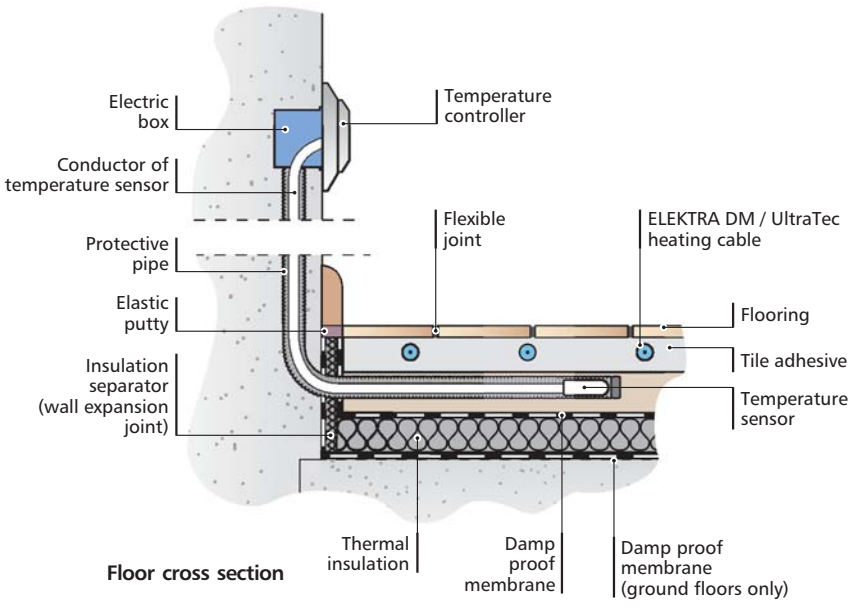
Construction of the ELEKTRA DM heating cable
– diameter of cable ~ 4.3 mm

Construction of the ELEKTRA UltraTec heating cable
– external dimension of cable ~ 2 x 3 mm

Primary heating

When selecting the heating cable, it is necessary to consider:

- the heat demand of the room, necessary to cover the heat losses and maintain the required temperature level (section 2.1.5)
- the fixed-furniture-free floor area, where the heating cable can be laid
- the heating cables should be laid at the maximum distance of 100 mm from one another, so that the underheated spots would not occur
- the heating cables should be laid at the minimum distance of 50 mm from one another, for ceramic tile finishing or stone floors, and 100mm for the wooden floors, PVC or fitted carpet floorings



Floor cross section

Warm floor

- **Ceramic tiles and stone flooring** heating cables should be laid with the spacing of 6.5 ÷ 10cm. For larger spacing, uneven temperature distribution (temperature differences over 2°C) on the floor surface will appear. Closer spacing of heating cables will speed up reaching full capacity of the warm floor's operation, for the conditions of noncontinuous operation of the heating.

- **Wooden flooring with PVC** heating cables should be laid with the spacing of approx. 10cm.

In order to calculate the required heating cable's spacing, apply the following formula:

$$a\text{-}a = \frac{S}{L+0.5P}$$

where:

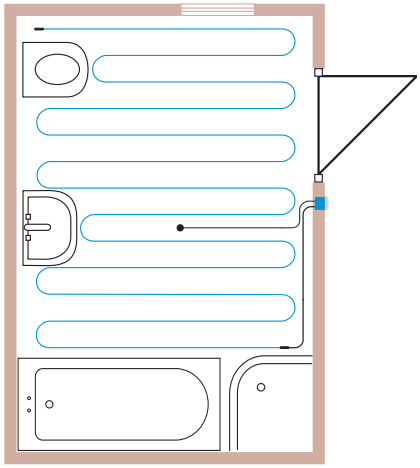
a-a – spacing between cables
S – floor surface area for the floor heated with the heating cable
L – heating cable's length
P – floor surface perimeter for the floor heated with the heating cable

Example: primary heating

Bathroom area: 8m^2
Floor surface area free from fixed furnishings: 5.5m^2
Heat output necessary to cover the heat losses and maintain the required temperature will be assumed as in section 2.1.5.
The heating cable ELEKTRA DM 10/400, 40m long, of the heat output 400W will be selected.
The spacing between the heating cables will be:

$$a\text{-}a = \frac{S}{L+0.5P} = \frac{5.5m^2}{40m+4.7m} =$$

$$= 0.123m = 12cm$$



The spacing of 12cm is required for the heating cables to cover heat losses. It is reasonable to lay the cables with denser spacing to prevent creation of underheated areas (cold spots) on the floor surface. For this, select the subsequent (longer) heating cable available in the range.

Initial fixing of the heating cable utilising self-adhesive tape

Installation

- the floor surface destined for the heating cables should be thoroughly cleaned and primed to allow effective fixing of the cable with a hot glue gun
- the heating cable with a floor temperature sensor should be installed as shown in section 2.5.1.2
- the heating cable should be laid out avoiding fixed furnishings and attached with self-adhesive tape – if the layout hasn't been planned properly, the self-adhesive tape can be removed and the layout of the cable changed

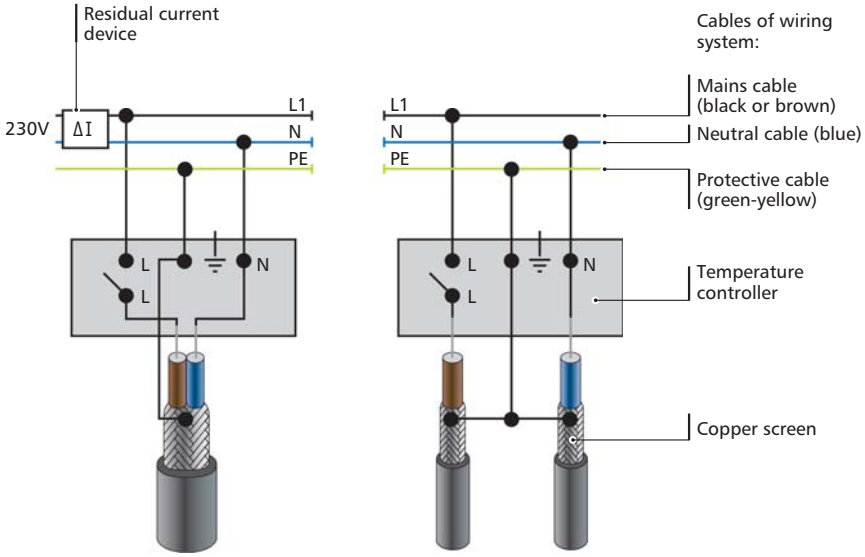
- the heating cable has to be fixed to the floor with hot glue
- the heating cable already fixed to the floor should be covered with:
  – the layer of tile adhesive – for stone and ceramic flooring
  – self-levelling slab – for other flooring

Fixing of the heating cable utilising of hot glue

ELEKTRA DM/UltraTec heating cables could be also fastened to thin wire netting or ELEKTRA TME installation tape.
This type of installation requires a larger quantity of tile adhesive or self-levelling compound and will increase the floor thickness.

1.5.3 Wiring Details

The power supply should be connected via a temperature controller. The power supply should be protected by an RCD (Residual Current Device) with a sensitivity of
Δ ≤ 30mA.



Heating mat
Single-side power supply
ELEKTRA MD

Heating mat
Double-side power supply
ELEKTRA MG

Connection diagram

Heating cable
ELEKTRA DM / UltraTec

2.6 Under-laminate Floor Heating – Dry Installation

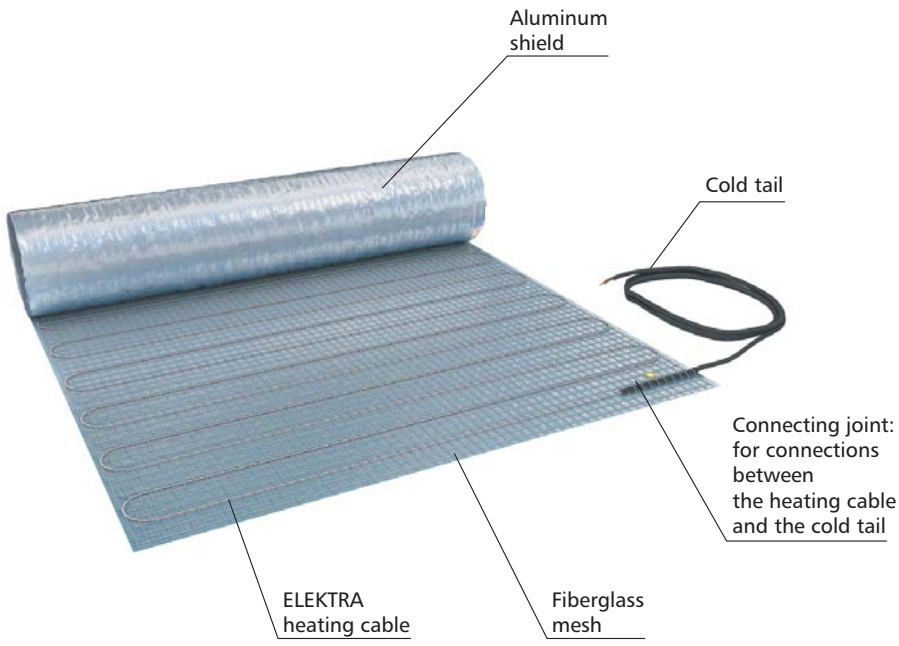
Laminate flooring or engineered wood floors may be heated with ELEKTRA WoodTec™ heating foils installed directly on the floor base.

ELEKTRA WoodTec™ heating foils of the heat output 60 and 70W/m² have been designed as the supplementary heating system to provide users with comfortable floor temperature. In buildings with excellent thermal parameters, such as low-energy and passive houses, these heating foils can be used as the primary heating system.

ELEKTRA WoodTec2™ 140W/m² heating foils serve for applications as a basic heating system of facilities characterized by a higher heat demand.

2.6.1 ELEKTRA WoodTec™ Heating Foils

Heating cables are attached to a fiberglass mesh and covered with aluminum foil on the reverse side. The aluminum foil provides a protective shielding (earth) for the heating cables.
Each heating foil is 500mm wide.



ELEKTRA WoodTec2™ heating foil

The ELEKTRA WoodTec1™ heating foils are 1.9mm thick and have 4.0m cold tails at both ends.

The ELEKTRA WoodTec2™ heating foils are 2.8mm thick and have a 4.0m cold tail at one end.

The single-sided ELEKTRA WoodTec2™ foils are easier to install, due to the single supply cable.

The installation of the double-sided ELEKTRA WoodTec1™ foils is more complicated because both of the 'cold tail' supply cables must be connected to the temperature controller.

Due to the miniscule thickness, they are commonly used in places where the floor can not be raised too much.

It is possible to install two or more foils in a single room. In this case the foils should be connected in parallel.

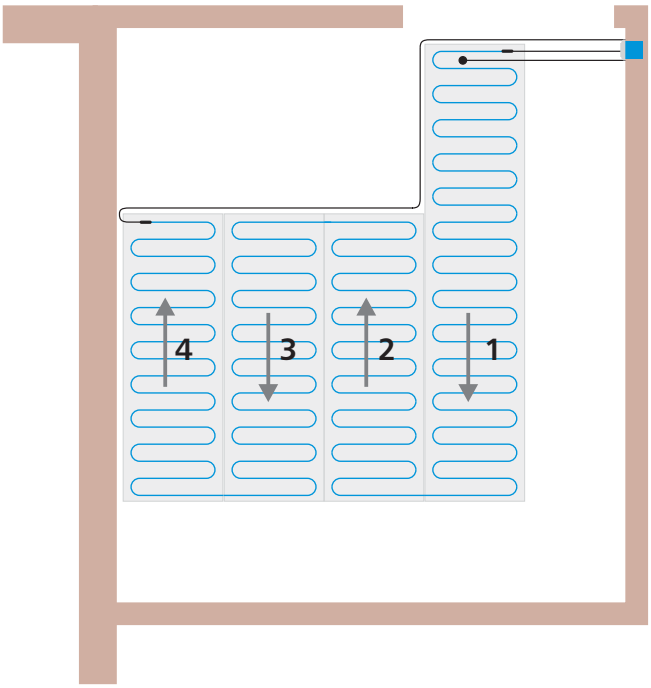
Heating foil power ratings:
ELEKTRA WoodTec1™ – 60W/m^2
ELEKTRA WoodTec2™ – 70W/m^2
ELEKTRA WoodTec2™ – 140W/m^2

Construction of the ELEKTRA WoodTec2™ heating cable

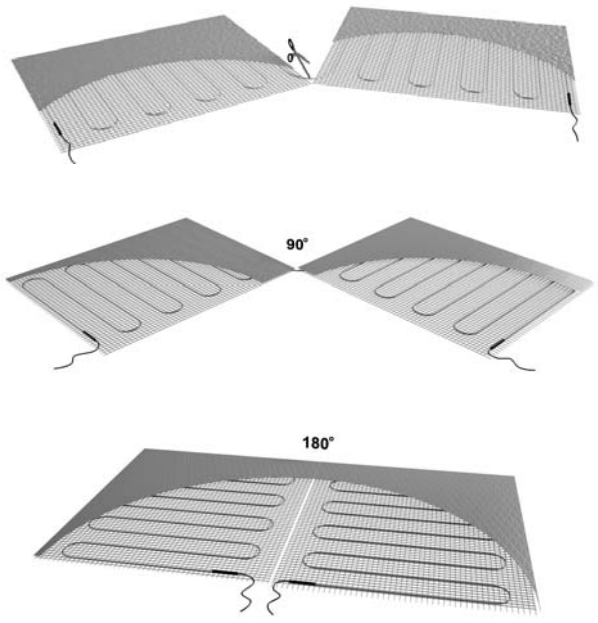
2.6.2 Planning

Before choosing the heating foil for a room (the heating foils come with a fixed width of 500 mm), their arrangement on the floor or on the selected floor areas should be planned.

The heating foils must not be laid in places where fixed pieces of furniture will later stand.
The heating foils can be cut to a desired shape and then laid out in various directions. While cutting the foil, the layer fiberglass mesh and aluminum layermay be cut, but never the heating cables.



Example of layout using ELEKTRA WoodTec1™ heating foils



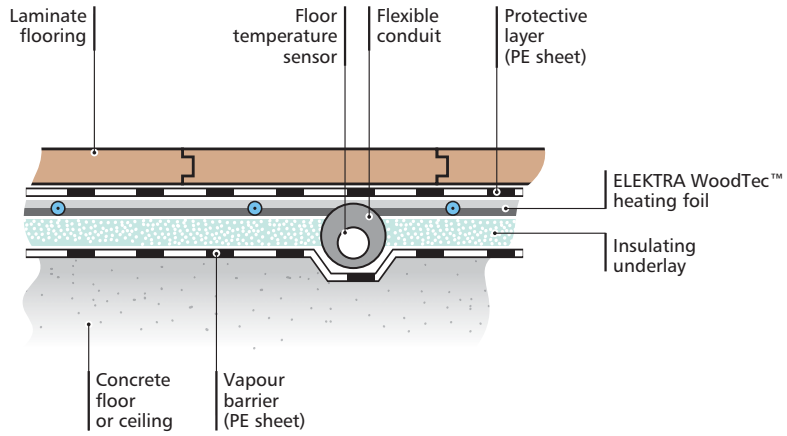
Typical layouts for heating foils (with two cold tails)

2.6.3 Underlay

The insulating underlay must be between 3 and 6mm thick.
The following issues should be taken into consideration:

- sound insulation
- mechanical parameters
- thermal insulation (the better the insulation, the shorter the time to warm up the floor)

Extruded polystyrene (XPS) insulating underlay meets these requirements optimally.



Cross section of the floor

2.6.4 Installation

The same rules should be as for ELEKTRA MG/MD heating mats (Section 2.5.1.2), except for the last two issues.
Preparation:

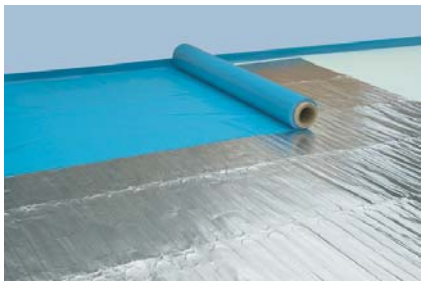
- Choice of the location for the temperature controller (Section 4.1)
- Installation of a installation box for the temperature controller (Section 4.2)
- Installation of flexible conduits (Section 4.2)

Laying the Heating Foil and Flooring:

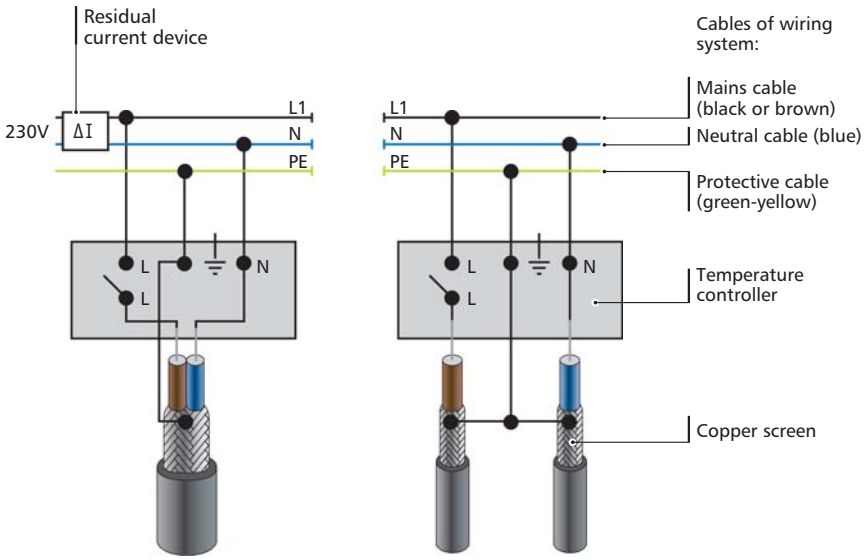
- The vapour barrier has to be laid over the prepared floor surface. The vapour barrier thickness should be at least 0.2mm. At least 20mm wide overlaps between vapour barrier sheets should be provided and the edges of the vapour barrier sheets turn up against the walls up to 50mm.
- The temperature sensor wire should be fed into the installed flexible conduit and lead to the temperature controller installation box.

Temperature sensor installation (depth of the groove should be 10-12mm)

- Insulating underlay between 3 and 6mm thick should be placed over the vapour barrier.
- Now it's time to lay out the ELEKTRA WoodTec™ heating foil.
- The heating foil has always to be laid out with it's aluminum layer facing up.
- With the heating foil in place grooves in the insulating underlay and in the floor, if necessary, should be cut to compensate for the extra thickness of the heating foil's cold tails, so a level surface is achieved.
- If the aluminum layer was cut when the heating foil was customized, adhesive aluminum tape should be used to join the heating foil sheets as shown in the picture. The aluminum layer serves as shielding for the heating cables, therefore the sheets must be electrically connected with self-adhesive aluminium tape.
- With the heating foil in place, a 0.2mm-thick layer of polyethylene sheet should be laid out on top, to protect the aluminium surface of the heating foil against possible abrasion.
- Installation of laminate or engineered wood flooring.



2.6.5 Connection To Mains
ELEKTRA WoodTec™ heating foils must be connected to mains via a temperature controller. The mains supplying power to the mats should be protected with an RCD (Residual Current Device) with a sensitivity of
Δ ≤ 30mA.



Connection diagram

3. Wall Heating

3.1 General Information

Temperature of building components, especially external walls, generating the outward heat loss, influences thermal comfort in rooms. The temperature of building components should not drop below indoor air temperature. Only wall heating can provide such conditions.

Wall heating is the low temperature surface heating system where heated external room walls are heaters. The heating surface temperature should amount to 24-28°C.

Wall heating can be applied as:
- room heating,
- supplementary heating for rooms with underfloor heating, when the floor surface is not enough to cover heat losses,
- drying out wall surfaces.

Wall heating can be realised with:
- ELEKTRA MG or MD heating mats,
- ELEKTRA DM heating cables.

ELEKTRA VCD12 heating cables (on special order only) or ELEKTRA VCD17 heating cables can be applied for the purposes of drying out wall surfaces.

External walls designed for wall heating should be well insulated, i.e. fulfill the following condition:

$$U \leq 0.3\ W/m^2 \cdot K$$

Fixing the ELEKTRA heating cable with hot glue

3.1.1 Designing wall heating systems

When designing a wall heating system, first assess:
- design heat load for a room,
- external wall surface area available for the heating purposes.

Calculating the heat output required to cover heat losses should be executed according to chapter 2.1.5, taking into account that now the floor surface should be substituted by the wall surface.

3.1.2 Installation

Heating cables or mats should be glued to the external wall and covered with a layer of plaster. In rooms of regular shapes, installation of heating mats should not cause a problem, in other situations ELEKTRA DM heating cables can be applied.

For the installation methods of heating mats and cables, as well as for the correct positioning method of a temperature sensor, please refer to chapter 2.5.

In this case, the floor sensor will act as the wall temperature sensor, and its installation method will be the same as for the underfloor heating (chapters 4.1, 4.2).

The heating system should be laid max. at 2m of height.
For plastering of heating walls the following are recommended:

- lime-sand mortars,
- conventional lime and cement-lime plastering materials.

Gypsum plasters are not recommended.
Installation of heating cables or mats on the walls does not influence the regular plaster thickness.

3.2 Drying Out Wall Surfaces

The cause of appearance of wall moisture is:

- frost penetration in foundations and walls of buildings,
- faulty anti-moisture insulation of foundations and walls,
- poor ventilation,
- high degree of relative humidity in the room (exceeding 65%),
- frequent flooding.

Moisture contributes to development of mould and fungus which damage walls and plasters, as well as negatively influence the health of inhabitants.

ELEKTRA VCD12 heating cables (on special order only) or ELEKTRA VCD17 heating cables should be laid in the wall's mortar joint or in dedicated grooves.
The groove spacing with installed heating cables should be carefully filled up with plastering mortar.

Switches with the on/off signalling must be applied for the control of the heating systems, due to intervention characteristics of operation.

4. Temperature Control

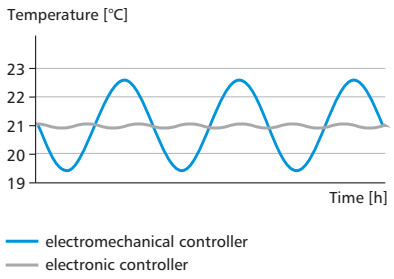
In room heating, a variety of temperature controllers can be applied:

- electromechanical
- electronic
- programmable electronic

For rooms that do not require precise temperature control, electromechanical controllers may be used whose inertia may be even ±5°C.

Electronic controllers feature highly accurate temperature measurements (0.1-0.3°C).

Working diagram of an electromechanical and electronic controller

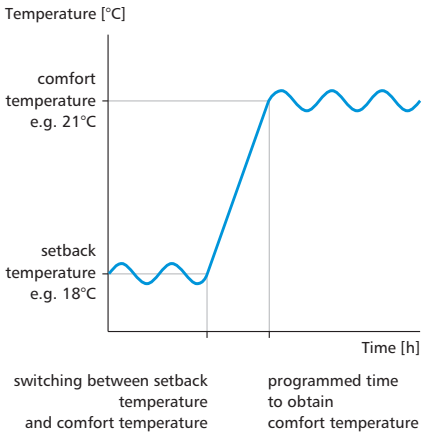


Programmable electronic controllers feature the possibility to program temperature settings for 24 hour- or weekly cycles. The following information is displayed on LCD screens:

- actual room temperature
- programmed temperature (comfort and setback)
- operation time of the heating system
- number and the graphic symbol of the running program

Some controllers are equipped with an adaptive function: the controller will automatically calculate the switch-on time of the heating system to obtain the required temperature, in the time programmed by users.

Working diagram of a programmable electronic controller equipped with the adaptative function



Classification of controllers due to type of temperature measurement method:

- with a floor temperature sensor
- with an air temperature sensor and floor limitation sensor (this controller type will measure air temperature and, simultaneously, the floor sensor will protect the floor and cables from overheating), additionally this type of controllers can be equipped with a function securing min. floor temperature

If the floor heating system is supplementary to the existing (primary) heating system, users will be interested mainly in achieving warm floors – application of temperature controllers is then recommended, equipped entirely with a floor temperature sensor.

If the floor heating system is the primary source of heating, and users will be interested in obtaining optimal room temperatures – it is recommended that a controller equipped with an air temperature and a floor limitation sensor is used. Due to the installation method, the controllers are classified as follows:

- flush
- surface
- mounted on DIN rails

4.1 Temperature Controller Placement

A controller with an air and floor limitation sensor should be installed on a wall inside the heated room, at 1.4 - 1.5m above the floor.
It should not be exposed to direct sunlight and draughts.
There is no limitation on placement for controllers equipped just with a floor sensor.

However, if the room being heated is often exposed to humid conditions (i.e. bathroom / sauna), only selected controllers with proper IP protection should be used.

Controllers with traditional floor sensor have no restrictions concerning their placement.

Some types of controllers may be installed in common frames in combination with light switches. It's not possible in all countries, so please check with your local regulations.

If it is required that the controller should not be visible or easily accessed (i.e. in hotel rooms), installing the controller on a DIN rail is possible. The floor sensor cable can be extended up to 100m.

4.2 Installation

Surface temperature controllers are installed on a wall with the use of an installation box. Flush temperature controllers are installed in deep flush installation boxes.

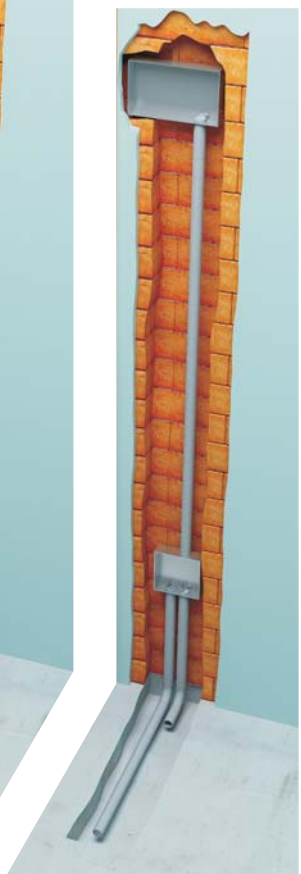
Temperature controllers for flush mounting are to be installed in a dedicated deep installation box.

The installation box should be supplied with 230V power supply with two flexible conduits (pipes) installed from the box to the floor. The flexible conduits should not be fixed at right angles, but instead, should be gently bent in the appropriate direction.

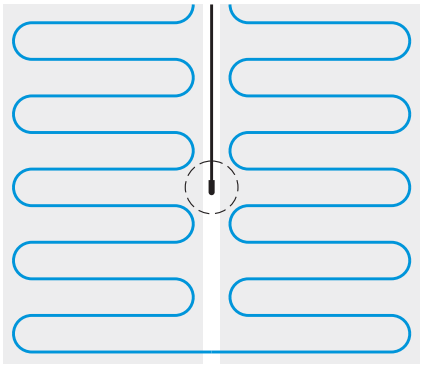
For aesthetic reasons, the conduits should be located in previously made chases. One conduit will contain cold tail supply cables for the mat, and the other a temperature sensor cable.

Flexible conduit installation

Applicable in the UK.



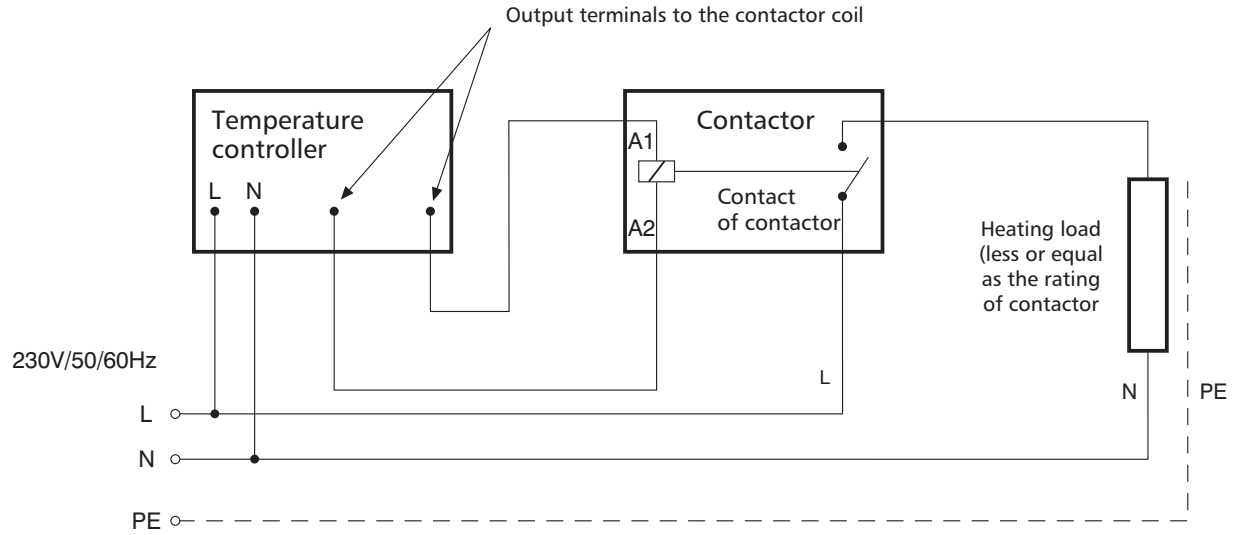
If possible, the temperature sensor should be located in the centre of the heated room, and be placed in an equal distance between two heating cables. The flexible conduit containing the temperature sensor cable should be sealed to protect it against moisture. It does not apply if the conduit is not placed in concrete or tile adhesive (Section 2.3 and 2.6).



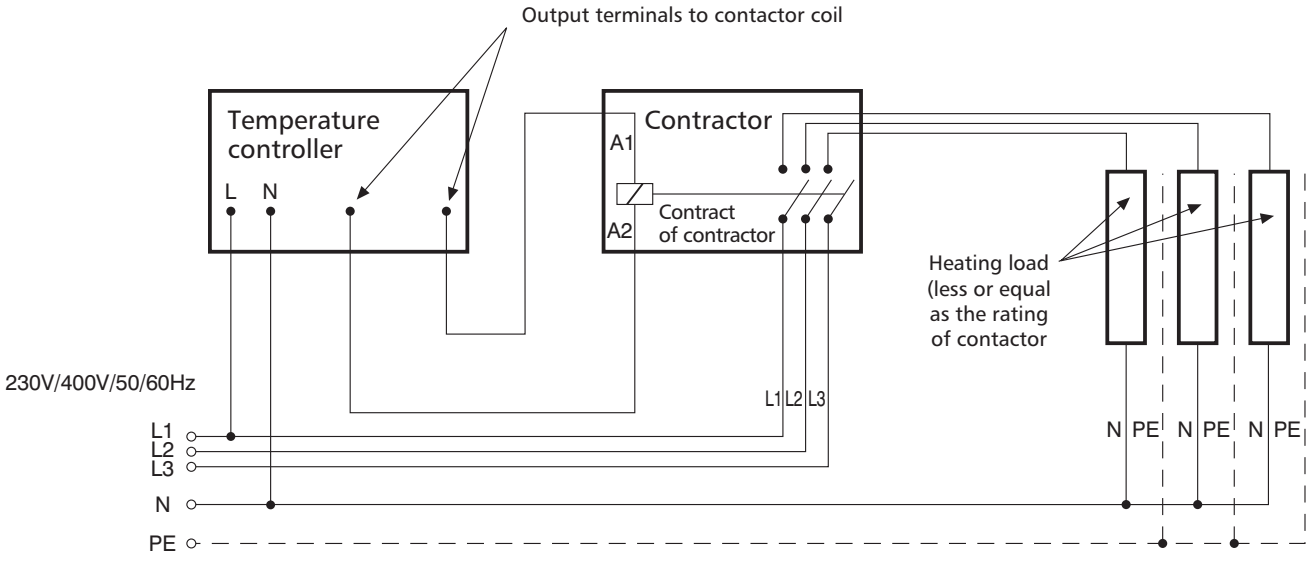
Example of temperature sensor location

Maximum heating load for temperature controller

If the heating load exceeds the rating of the temperature controller, a contactor should be used to switch the load (see diagram). The rating of the contactor should be greater or at least the same as the heating load.



Wiring diagram for controlling heating load using single pole contactor



Wiring diagram for controlling heating load using three pole contactor

4.3 Temperature Controllers

Programmable Electronic Temperature Controllers

ELEKTRA OWD5 WiFi
Flush mounting
The latest temperature controller model, with the WiFi functionality, touch screen and all other features of the OCD5 controller. Temperature control takes place via a dedicated iOS or Android smartphone app.

ELEKTRA OCD5
Flush mounting
Temperature controller with a touch-screen display, featuring the function of programming 6 events per day. It consists of a controller body with a built-in air temperature sensor and a thin floor temperature sensor.

It is equipped with a 2-inch colour touchscreen display. The software includes a calendar function enabling programming dates of start and end of a holiday or absence period during which the heating will be off, or maintaining the min. set temperature. Due to the application of the QR code, it is possible to efficiently view the controller's settings using a smartphone.

Adaptive function - the controller ensures comfort temperature at the required time as it's able to calculate the thermal inertia of the floor. Gives the possibility of configuration in 3 variants of the temperature measurement, via the room or floor sensor, as well as the room and floor sensor (temperature limitation).

ELEKTRA ELR 20
Flush mounting
Temperature controller with a large (2.9") LCD display, user's friendly operation, enables programming of six events daily. Especially designed for the purposes of the control of heating systems, in particular under-floor heating. Equipped with a built-in air sensor, as well as floor sensor for floor temperature measurements and floor temperature limiting.

Temperature controller ELEKTRA OCD5 WiFi

Temperature controller ELEKTRA OCD5

Temperature controller ELEKTRA ELR 20

ELEKTRA Digi2p
Surface mounting
Programmable controller with 2 temperature levels within a day. Equipped with a floor temperature sensor. Designed for the control of supplementary heating systems.

Holiday temperature set-back - automatically turns the temperature back to the comfort level after a programmed number of days.

Temperature controller ELEKTRA Digi2p

Manual Temperature Controllers

ELEKTRA OTN
Flush mounting
Manual controller equipped with a floor temperature sensor. Designed for the control of supplementary heating systems. An external timer may activate the temperature set-back.

Temperature controller ELEKTRA OTN

Possibility to install controllers in one frame with light switches (not UK)

ELEKTRA ETV

DIN-rail mounting

Manual controller. An external timer may activate the temperature set-back (5°C). Equipped with a floor temperature sensor. Designed for the control of supplementary heating systems.

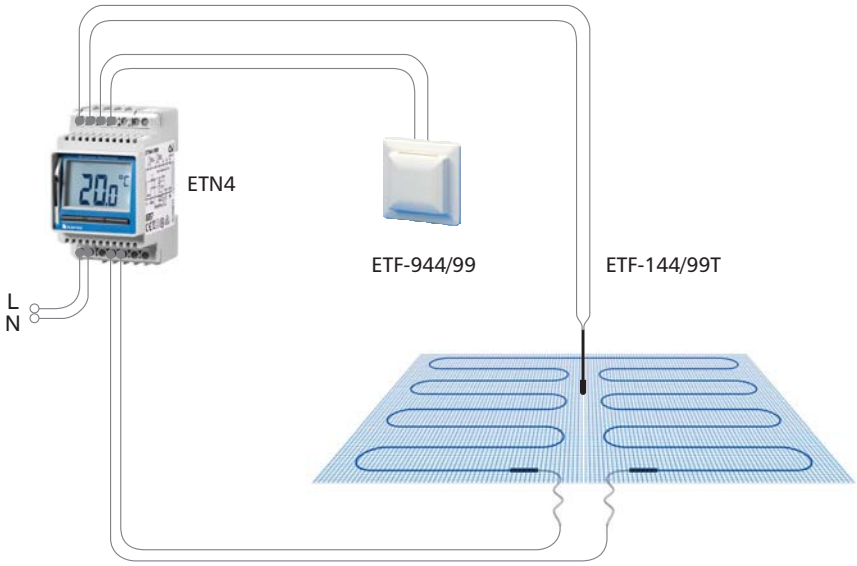
Temperature controller ELEKTRA ETV

ELEKTRA ETN4

DIN-rail mounting

Temperature controller supporting two temperature sensors, including a limiting one. Large backlit display presents the operating parameters of the controller. Especially designed for the control purposes of electric heating systems, both primary and supplementary. Adjustable hysteresis allows to define the floor temperature measurement's precision – the function which will prove useful in storage heating. Connecting an external timer will access the options of (night) set-back, temperature increase and anti-frost protection.

Temperature controller ELEKTRA ETN4



DIN-bus connection diagram for the ETN4 controlling the primary heating system

To successfully operate as the primary heating controller, the ELEKTRA ETN4 should be equipped with the ETF-944/99 air sensor and ETF-144/99T floor sensor.

This configuration will enable control of air temperature with simultaneous anti-overheating floor protection.

5. Product Selection Guide

Type of heating	Type of room	Type of floor	In-screed heating: Heating Cables: VCD 10	VCD 17	VC 15	VC 20	Heating directly under floor finish: In adhesive or self-levelling screed / compound: DM UltraTec	Heating Mats: MG 100	MG 160	MD 100	MD 160	Dry installation: Heating Foils: WoodTec™	Temperature Controllers
warm floor	rooms in residential buildings	ceramic tiles, stone	–	–	–	–	+	+	+	+	+	–	OWD5-1999 OCD5-1999 ELR 20 DIGI2p OTN-1991 ETV-1991 ETN4-1999
		PVC	+	+	+	–	+	+	–	–	–	–	
		wood flooring glued to the floor	+	–	–	–	+	+	–	+	–	–	
		laminate or engineered wood flooring	+	+	+	–	–	–	–	–	–	+	
primary	rooms in residential buildings	ceramic tiles, stone	+	+	–	–	+	+	+	+	+	–	OWD5-1999 OCD5-1999 ELR 20
		PVC	+	+	+	–	+	+	–	+	–	–	
		carpet and wood flooring glued to the floor	+	–	–	–	+	+	–	+	–	–	
		laminate or engineered wood flooring	+	+	+	–	+	+	–	+	–	+	
		suspended wooden floors	+	–	–	–	–	–	–	–	–	–	
	churches, commercial and industrial premises, basements, garages	ceramic tiles, stone, resin flooring, concrete	–	+	+	+	–	–	–	–	–	–	OWD5-1999 OCD5-1999 ELR 20 ETV-1991 ETN4-1999
storage	rooms in residential buildings	ceramic tiles, stone, resin flooring	–	+	–	–	–	–	–	–	–	–	individual selection suitable for a particular design
	churches, commercial and industrial premises, basements, garages		–	+	+	+	–	–	–	–	–	–	

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Type of heating	Type of room	Type of floor	Heating Cables					Heating Mats				Heating Foils	Temperature Controllers
			VCD		VC		DM UltraTec	MG		MD		WoodTec™	
			10	17	15	20		100	160	100	160		
wall heating	all rooms	plaster ceramic tiles stone	–	–	–	–	+	+	+	+	+	–	OWD5-1999 OCD5-1999 ELR 20
drying out walls			+	+	+	–	–	–	–	–	–	–	OWD5-1999 OCD5-1999 ELR 20 Digi2p OTN-1991 ETV-1991 ETN4-1999

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6. Snow and Ice Protection

ELEKTRA systems protect against snow and ice on roofs, gutters, conductors, roads, stairs, terraces, viaducts, bridges and much more. The unique design and proficient performance allows the heated surfaces to be free of snow and ice through proper control.

To eliminate the negative results of unsightly weather, it is recommended that controllers with microprocessors are used. The system can be efficiently programmed for the controllers to measure the temperature / moisture and to predict the possibility of weather conditions that require the system to start.

The capital costs for a snow & ice protection system are low. The running costs are often the subject of debate, especially when considering large areas which require a large amount of power. The system must be regulated by a suitable controller, to ensure efficient operation only when it's snowing or raining in freezing temperatures. There are almost no snow falls in temperatures below -10°C, so the system will stay in stand-by mode for those temperatures.

In most European countries, there are just a few days a year where the weather conditions permit the system to turn on. In this time, heating will operate for about 30-100 hours in total to easily remove snow build up and prevent ice formation.

6.1 Outdoor Surfaces

When heating external areas, it is required to assess the required heat output value per m^2. Recommended heat output depends on the regional climate conditions, i.e. minimum ambient temperature, snowfall intensity and wind strength.

Application of required heat output

Ambient temperature	Power output [W/m^2]
> -5°C	200
-5°C ÷ -20°C	300
-20°C ÷ -30°C	400
< -30°C	500

Higher output is required if the heated area is:

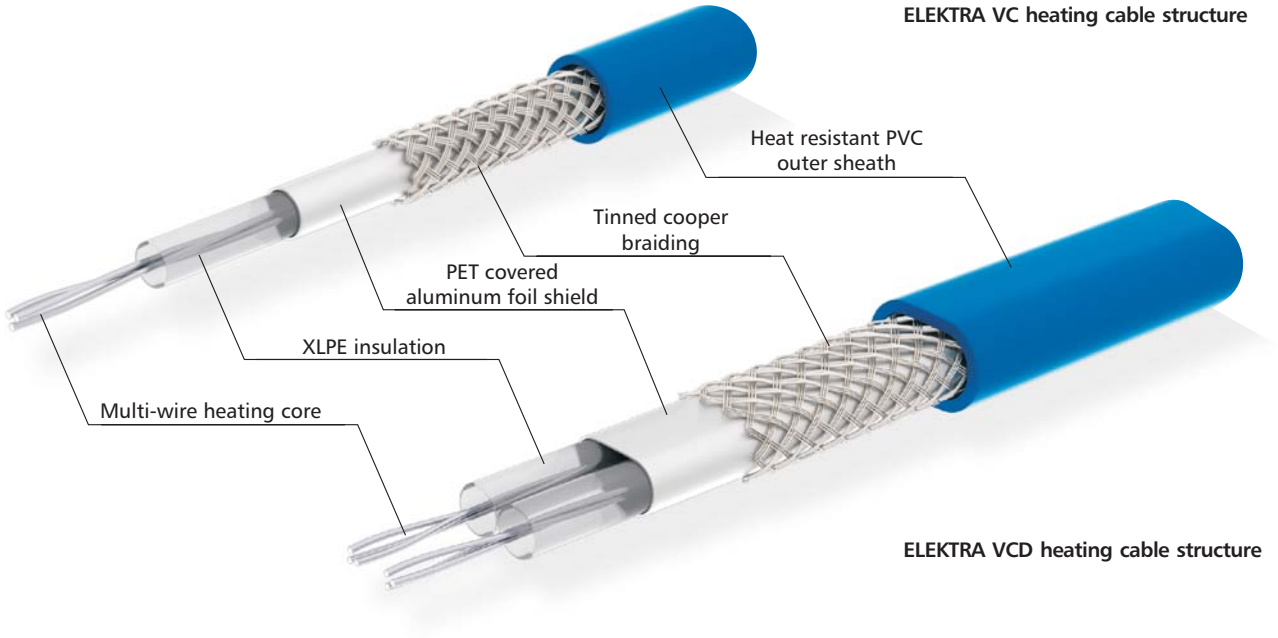
- exposed to low temperatures,
- exposed to wind chill from below:
  – bridges, stairs, loading platforms,
- located in regions of intense snowfall.

Applying insulation layer to the surfaces exposed to wind chill from below can improve the heating system's effectiveness.

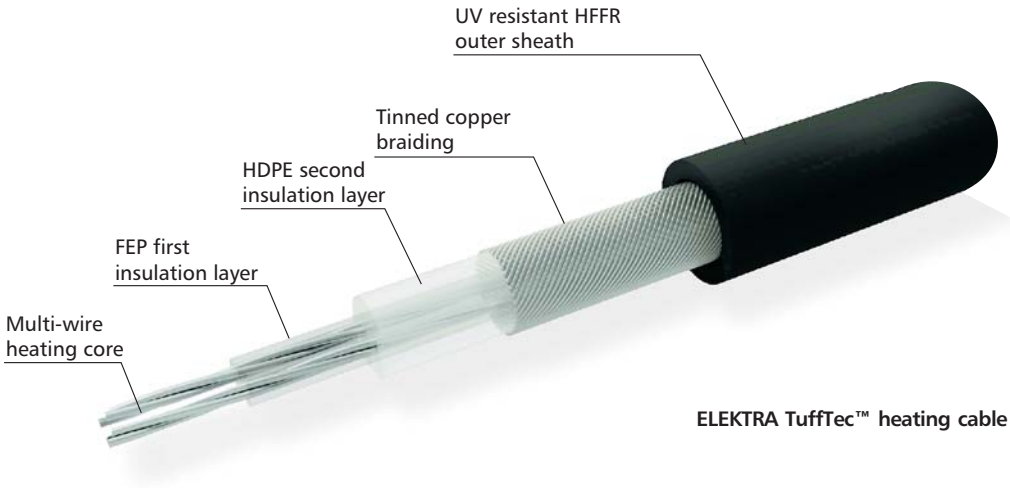
For heating external areas, the following options can be utilised:

- ELEKTRA VC20 single-side supplied heating cables (power output 20W/m),
- ELEKTRA VCD25 single-side supplied heating cables (power output 25W/m),
- ELEKTRA SnowTec® heating mats, made from ELEKTRA VCD heating cable (mat's power output 300W/m^2).
- ELEKTRA TuffTec™ single-side supplied heating cables (power output 30W/m) for 230 and 400V.
- ELEKTRA SnowTec®Tuff heating mats, for 230 and 400V, made from ELEKTRA TuffTec™ heating cable - mat's surface power 400W/m^2

ELEKTRA VC heating cable structure



ELEKTRA VCD heating cable structure



ELEKTRA TuffTec™ heating cable structure

Selection of the proper heating cable or heating mat depends on:

- the required power output per m² of the heated area,
- time horizon for completing the works on the heating system,
- shape of the heated area,
- number of power supply cables (double-side supplied cables require having both power supply conductors fed to the installation box, single-side supplied cables – only one),
- the cable's endurance and thermal requirements.

Heating mats are an optimal solution for projects, where heating systems must be installed within a strict deadline (heating systems assembled from heating cables require approx. 6-8 longer installation time than in case of heating mats). However, heating systems assembled from heating mats require that the shapes of areas to be heated are not too complex, e.g. rectangular areas.

SnowTec® heating mats are available in standard widths of 60cm and 40cm, SnowTec® 400V heating mats are available in one width of 60cm only.

ELEKTRA TuffTec™ heating cables and SnowTec®$_{Tuff}$ heating mats have been especially designed for installations in conditions characterized by the increased risk of mechanical damage e.g. in case when concrete consolidation machinery is utilized for surface works. Due to their high thermal resistance as well as resistance against bituminous substances, ELEKTRA TuffTec™ heating cables and SnowTec®$_{Tuff}$ heating mats can be installed directly in asphalt. SnowTec®$_{Tuff}$ 230V and 400V heating mats are 60cm wide.

In order to calculate the required heating cable's spacing, apply the following formula:

$$a\text{-}a = \frac{S}{L}$$

where:

a-a – spacing between cables
S – floor surface area for the floor heated with the heating cable [m²]
L – heating cable's length [m]

The length of the heating cable per 1m² of the heated surface and the spacing for laying the heating cables depend on the type of the selected cable and required heat output

Heat output per m² of the heated area	VC 20		VCD 25		TuffTec™30	
	Cable length	Spacing a–a	Cable length	Spacing a–a	Cable length	Spacing a–a
[W/m²]	[m]	[cm]	[m]	[cm]	[m]	[cm]
250	12.5	8.0	10.0	10.0	8.3	12.0
300	15.0	6.7	12.0	8.3	10.0	10.0
350	17.5	5.7	14.0	7.1	11.7	8.6
400	20.0	5.0	16.0	6.3	13.3	7.5
450			18.0	5.6	15.0	6.7
500			20.0	5.0	16.7	6.0
600					20.0	5.0

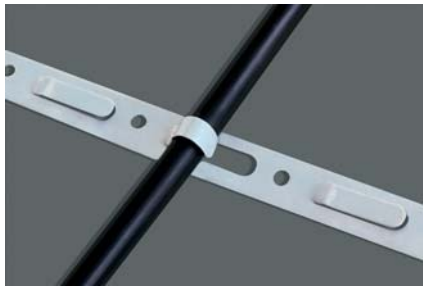
6.1.1. Installation

Heating cables or mats can be laid:

- in the layer of sand or dry concrete constituting the base for the asphalt, flagstone or paving cobbles surfaces,
- directly in concrete,
- directly in asphalt (exclusively TuffTec™).

To maintain fixed positioning of the cables and steady spacing conforming to the calculated values, the cables need to be attached with the ELEKTRA TMS installation tape (in sand bases or asphalt) or ELEKTRA TME aluminium installation tape (in concrete).
Optionally, cables can also be attached with an installation mesh of 5 x 5cm grid, made of Ø 2mm wire.

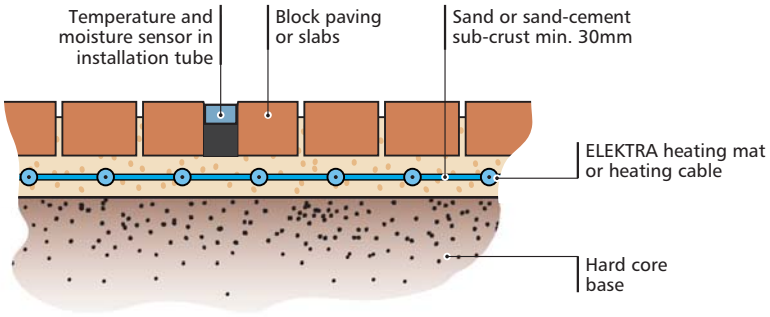
Heating mats also require securing to the surface, so that the mats' heating cables remain in a fixed position.



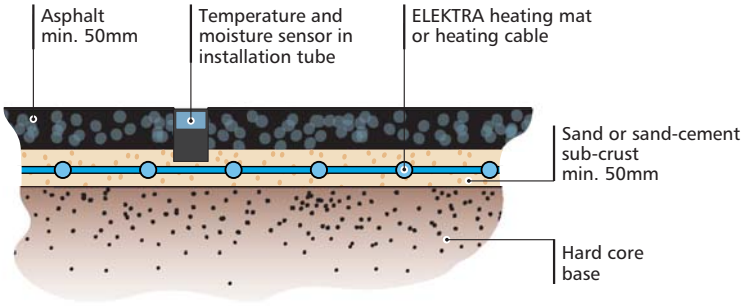
ELEKTRA TMS installation tape

Paving cobbles, concrete flagstones or asphalt surfaces
The hard core base that is covered by a thin layer of sand or dry concrete serves as a base for ELEKTRA VC/VCD heating cables or ELEKTRA SnowTec® mats.

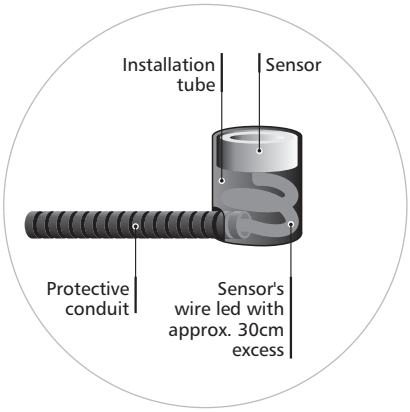
The supply cables should be led directly to the switchboard, and then covered with packed sand. Lastly, these layers should be covered by the desired surface.



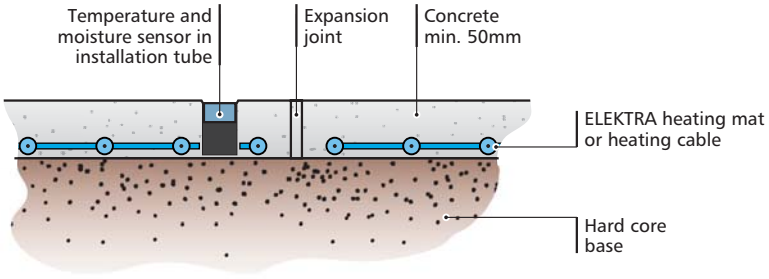
Cross section of path or driveway of slabs or block paving



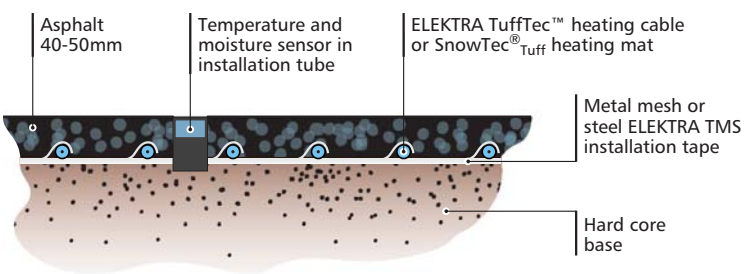
Cross section of asphalt path / driveway



Temperature and moisture sensor in an installation tube



Cross section of side walk or ramp made of concrete



Cross section of a driveway with asphalt surface (cable installation directly in apshalt)

Concrete Surfaces and Reinforced Concrete Surfaces
In concrete surfaces, heating cables should be fixed with:

- ELEKTRA TME aluminium installation tape or
- any installation tape with mesh dimensions 10 x 10cm, made of ø4mm diameter wire

In reinforced concrete surfaces heating cables should be fixed to reinforcement of concrete slabs. This installation method will protect cables against mechanical damage during laying concrete and concrete vibration.

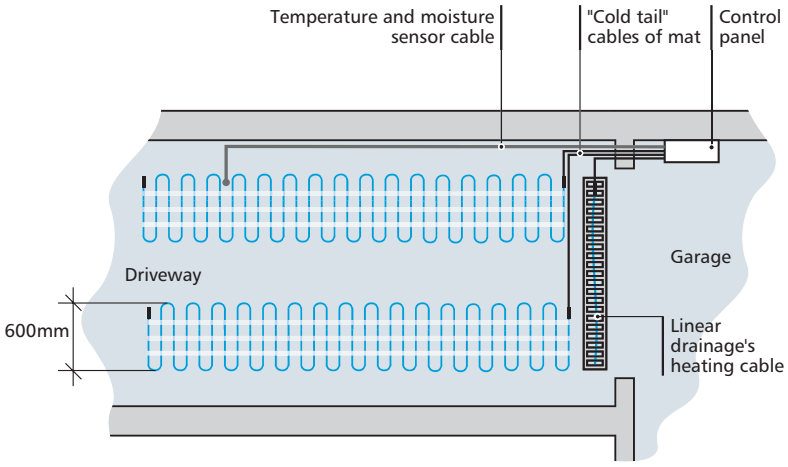
Switching the system on may be executed only after the concrete has completely cured, i.e. after 30 days. The length of heating mats or cables must be selected in the way so as not to cross expansion joints.

Only power supply conductors may cross expansion joints.
They must be then positioned in min. 50cm long metal protective conduits.

Asphalt surfaces
After laying the ELEKTRA TuffTec™ heating cables or SnowTec® heating mats, proceed with the manual laying of the asphalt layer.

6.1.2 Loading Bays and Driveways
Depending on the location of the driveway (either in an open or built up area) and the climate, it is necessary to select required heat output per m^2 of the heated area. Heating mats or cables should be installed under the entire surface or merely where the tyres will drive.

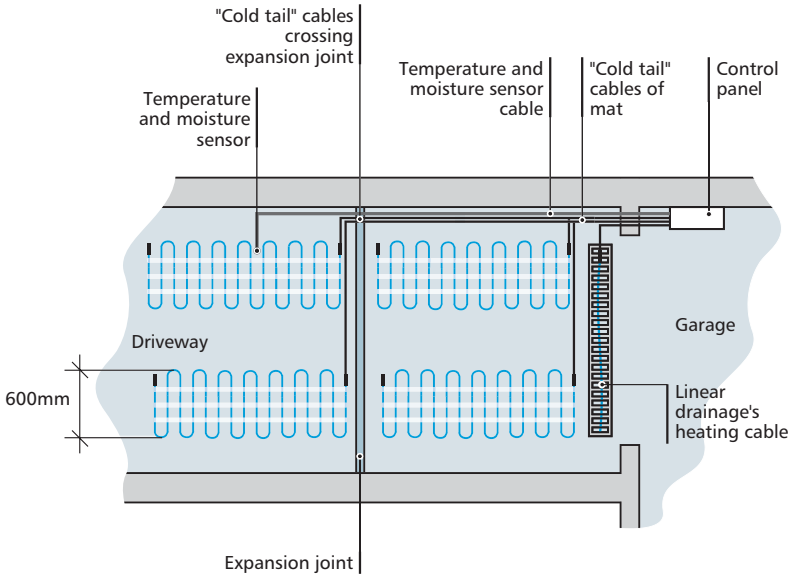
Example: Driveway to garage, 10m long
Surface: Block paving
Using ELEKTRA SnowTec® heating mats.
Two runs of heating with a width of 600mm each, to clear tyre tracks.
Use ELEKTRA SnowTec® 300/10, power rating 1860W, the total power would be
2 x 1860W = 3720W = 3.72kW.



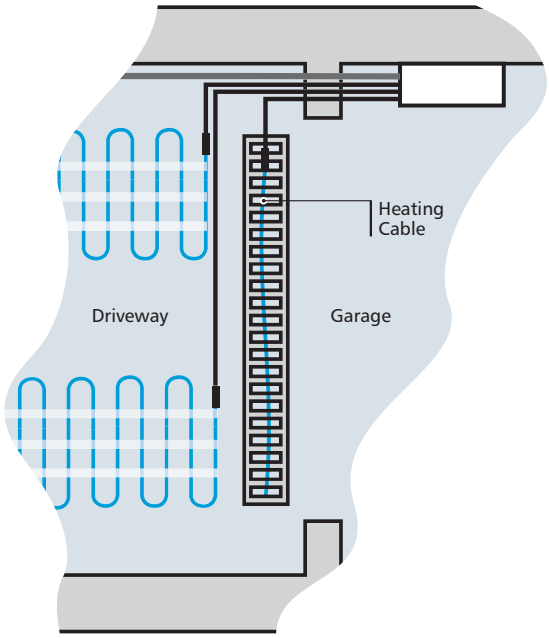
Typical layout of ELEKTRA SnowTec® on driveway to garage

Example: Driveway to garage with concrete surface, 10m long. ELEKTRA SnowTec® heating mats are used. The 10m driveways has an expansion joint, which must not be crossed by the heating mat(s). This should be taken into consideration when choosing the length and number of heating mats. Four 5m long ELEKTRA SnowTec® 300/5 heating mats were selected. Each mat has a power of 930W.

<u>The temperature and moisture sensor is to be placed within the heated surface.</u>
<u>It should not be positioned directly under the car wheel track</u> to avoid bringing in the snow.
Small amount of snow poses no threat to the system's integrity, however it could cause the system switch on unnecessarily.



Typical layout of ELEKTRA SnowTec® on concrete driveway to garage with expansion joint

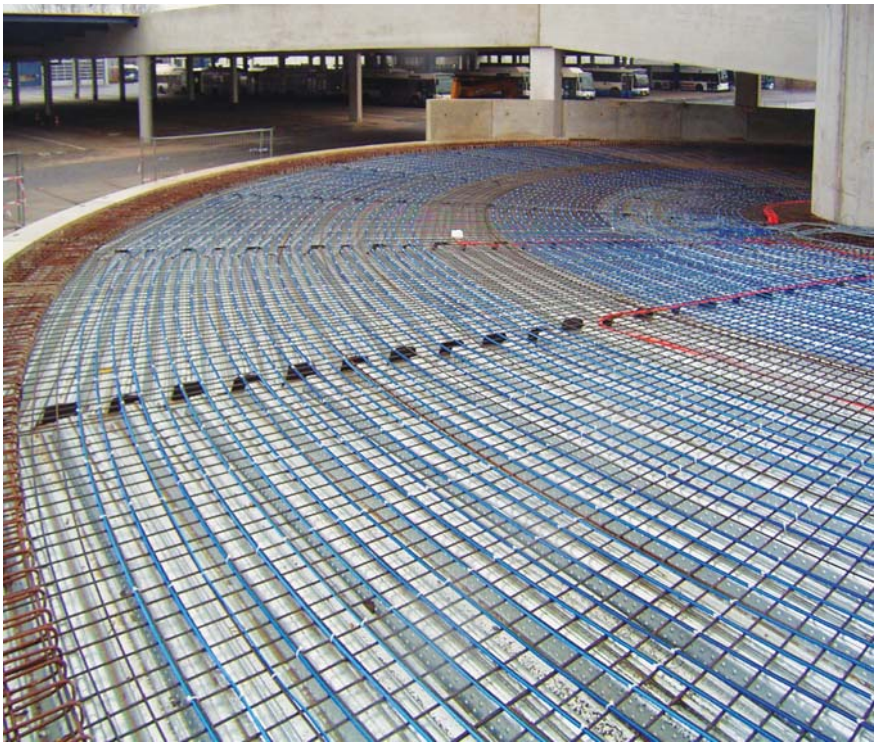


Linear drainage heating

It is also necessary to warm up the drainage channel, in order to ensure the outflow of snow melt water residue. The ELEKTRA SelfTec®PRO 33 self-regulating heating cable is recommended for this purpose (chapter 7.2.2).
The cable should be placed on the bottom of the drain, with the length of 0.5 - 1.0m downfed into the drainage system. The heating circuit then needs to be connected to the power supply unit in the vehicle's main switchboard, to ensure operation start simultaneous with other heating circuits.

For the connection of the self-regulating cable and the power supply conductor, ELEKTRA EC-PRO joint set will be required.

Fixing heating cable to installation mesh



Constructions not positioned on ground, vulnerable to influence of low temperatures and wind from the bottom – ramps, foorbridges, overpasses – require fixing heating cables to upper reinforcement of concrete slabs

6.1.3 Car Parks

Parking dimensions:
9m x 21m = 189m²
Surface material: Block paving

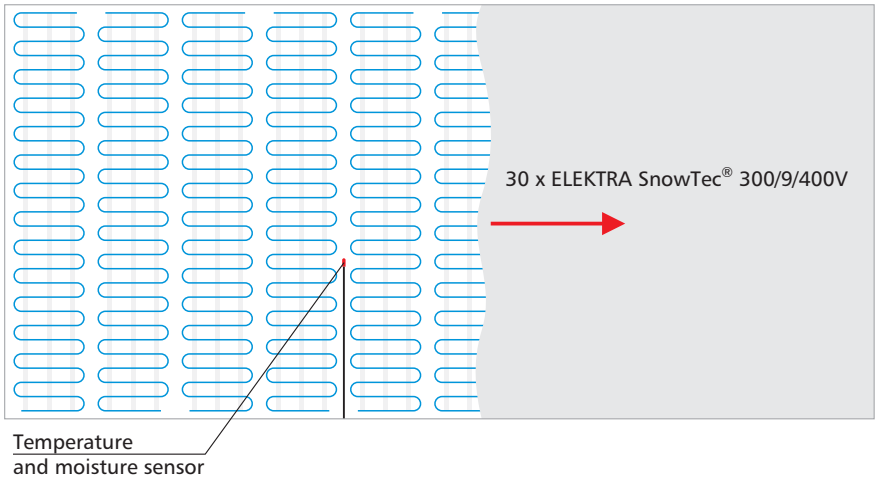
Example 1a:
Heating mat type: ELEKTRA SnowTec®

Given the dimensions of the parking lot, the appropriate heating mats would be SnowTec® 300/9, each having an individual length of 9m and 1680W of power.

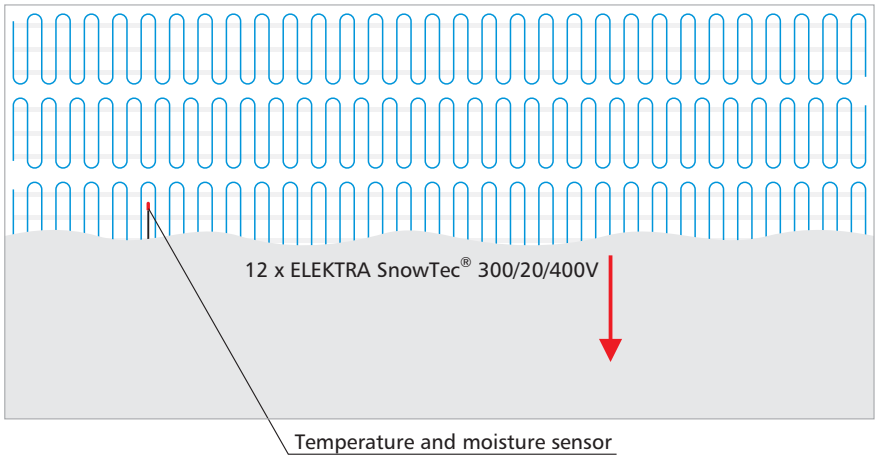
By installing mats that have identical lengths to that of the parking width, all of the supply cables will be installed on one edge. This concentration of cables along a single-side of the car park will simplify connecting the mats to an electrical supply.

Heating mat width: 600mm
Minimal distance between mats: 100mm
Space per mat required:
600mm + 100mm = 0.7m
Total mats: 21m : 0.7m = 30 mats
Total ELEKTRA SnowTec® 300/9/400V mat power:
1680W x 30 = 50400W.
Surface power of 1m²:
50400W : 189m² = 267W/m²

To increase the effectiveness of operation of the car park or loading ramp's protection, it is necessary to apply an additional temperature and moisture sensor.



Typical layout of ELEKTRA SnowTec® under parking spaces with a block paving surface



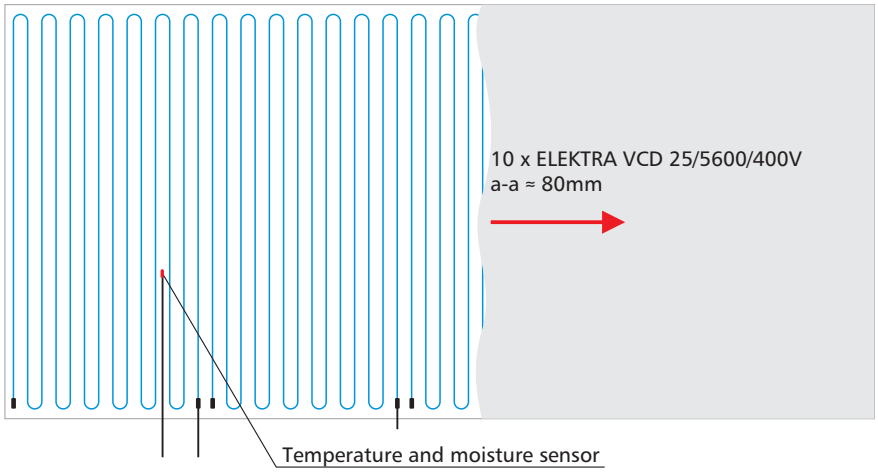
Mats can be laid out parallel to the longer side of parking space

Example 1b:
Installing ELEKTRA VCD25/400V Heating Cables

When selecting heating cables, it is important to consider how they are going to be installed. By installing all cold supply cables to one side of the car park, it is easy to connect the mats to the power supply.

Required power per m^2: 300W/m^2
Total parking heating power required:
189m^2 x 300W/m^2 = 56700W.
Selected cable type:
ELEKTRA VCD 25/5600/400V (227m).
Cables required:
56700W / 5600W = 10 pcs
Total cable length:
10 x 225m = 2250m.

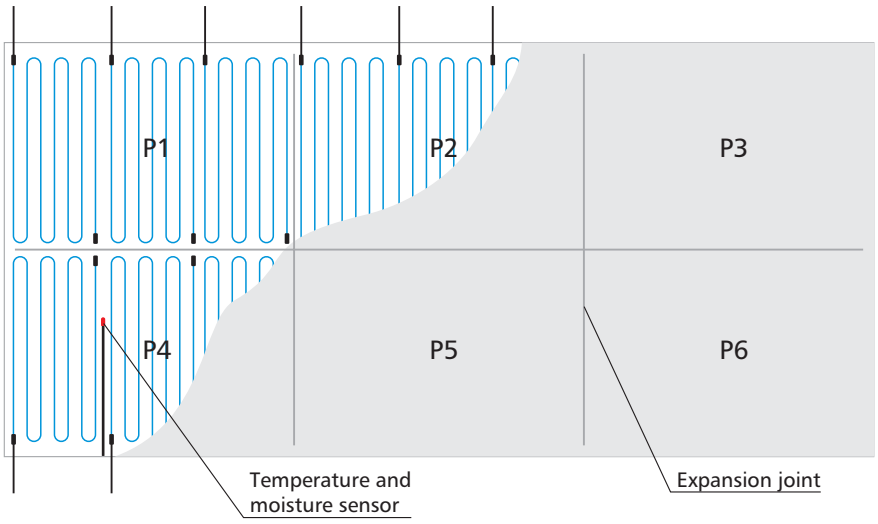
Distance between cables:
a-a = 189m^2 / 2250m = 0.084m = = 84mm
Power per 1m^2:
10 x 5600W / 189m^2 = 296W/m^2



Typical layout of heating cables on a car park made of block paving

Example 2:
Reinforced Concrete Car Park
Dimensions: 10m x 21m = 210m^2.

- The area of the car park is divided by expansion joints (as shown)
- Heating cables or mats must be installed so that the expansion joints are not bridged. This should be taken into consideration when choosing the length and number of heating cables.
- In the example, there are 6 heated areas, each with an area of 7m x 5m = 35m^2.



Example of heating mats or cables on heated spaces P1-P6 in a reinforced concrete car park

Installation with ELEKTRA SnowTec® Heating Mats

The ideal heating mat for the areas would be the ELEKTRA SnowTec® 300/5 with a power capacity of 930W.
Heating mat width: 600mm
Minimum distance between mats: 100mm
Space per mat required: 700mm = 0.7m
Number of mats per area: 7m / 0.7m = 10
Single field power capacity: 10 x 930W = 9300W
Total mats needed: 10 x 6 = 60
Total power capacity: 60 x 930W = 55800W
Capacity of $1m^2$: 55800W / $210m^2$ = 265.7 W/m^2

Installation with ELEKTRA VCD25 Heating Cables

Required power per m^2: 250-300W/m^2
Total heating power required: between 8750W and 10500W.

Given the dimensions, one VCD 25/3030 cable (with a capacity of 3300W and a length of 130m) and two VCD 25/3030 cables (with a capacity of 3030W and a length of 120m) would be used.
Heating capacity per area: 3300W + 2 x 3030W = 9360W
Total heating capacity: 6 x 9250W = 56160W
Capacity per $1m^2$: 55500W / $210m^2$ = 267.4 W/m^2
Distance between cables: a-a = $35m^2$ / 130m + 2 x 120m = 0.095m = 95mm.

If there is no reinforcement, the heated areas (divided by expansion joints) should not exceed $9m^2$.

6.1.4 Stairs

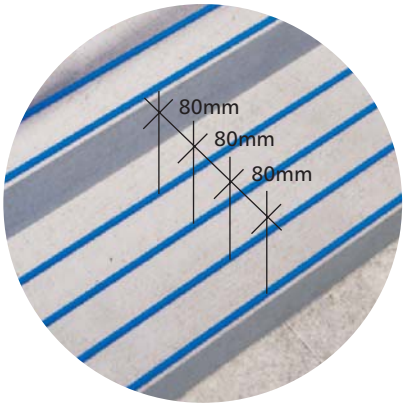
Effective anti-snow and ice protection will be achieved when selecting properly the required heat output, according to the table (chapter 6.1).
In case of suspended stairs (not positioned directly on the ground), the selected heat output should be increased with approx. 20%.

The following cables can be used for stair heating:

- An ELEKTRA VCD25 one cold tail with a power rating of 25W/m
- An ELEKTRA VC20 two cold tails with a power rating of 20W/m

The type of cable used is dependant on the desired method of installation. If the heating cables are going to be located at the bottom of the steps it is easier to use ELEKTRA VCD25 with one cold tail.

Installing the cables will cause an increase in step thickness. If such an alteration is not possible, ELEKTRA VC20 or ELEKTRA VCD25 should be set inside grooves made in the steps.



Example: outer stairs made of reinforced concrete

Number of steps:	4
Length of step:	1.2m
Width of step:	300mm
Height of step:	150mm
Landing:	1.2 x 1.2m
Heating power:	300W/m^2

a) heating using ELEKTRA VCD25 (single-side power supply)

To achieve power of 300W/m^2 using 25W/m cable, the spacing a-a between cables should be:

$$\text{a-a} = \frac{25\text{W/m} \times 100\text{cm/m}}{300\text{W/m}^2} = 8\text{cm}$$

On one step with dimensions 0.3 x 1.2m, the following length of heating cable should be used:

$$\frac{300\text{W/m}^2}{25\text{W/m}} \times 0.3\text{m} \times 1.2\text{m} = 4.3\text{m}$$

Length of heating cable laid out on 4 steps of stairs: 4 x 4.3m = 17.3m
This length should be increased by height of steps: 4 x 150mm = 600mm
Length of heating cables laid out on the landing:

$$\frac{300\text{W/m}^2}{25\text{W/m}} \times 1.2\text{m} \times 1.2\text{m} = 17.3\text{m}$$

Total length of cable required: 35.2m.

We select ELEKTRA VCD 25/890 heating cable with a length of 36m.

Example of ELEKTRA VCD25 heating cable layout

b) heating using ELEKTRA VC20 (double-side power supply)
To achieve power of 300W/m² by using a cable with power rating of 20W/m distance a-a between cables should amount to:

$$\text{a-a} = \frac{20\text{W/m} \times 1\text{m/m}}{300\text{W/m}^2} = 60\text{mm}$$

Length of cable installed at one step:

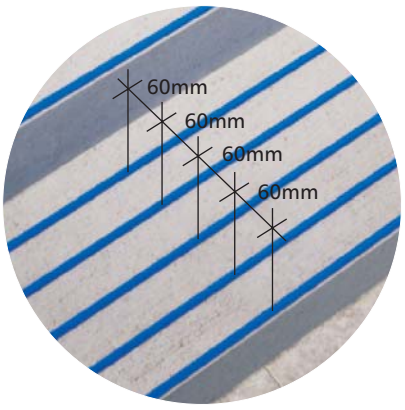
$$\frac{300\text{W/m}^2}{20\text{W/m}} \times 0.3\text{m} \times 1.2\text{m} = 5.4\text{m}$$

Length of cable installed on 4 steps:
4 x 5.4m = 21.6m
The length should be increased by height of steps:
4 x 150mm = 600mm = 0.6m
Length of cable installed on the landing of the stairs:

$$\frac{300\text{W/m}^2}{20\text{W/m}} \times 1.2\text{m} \times 1.2\text{m} = 21.6\text{m}$$

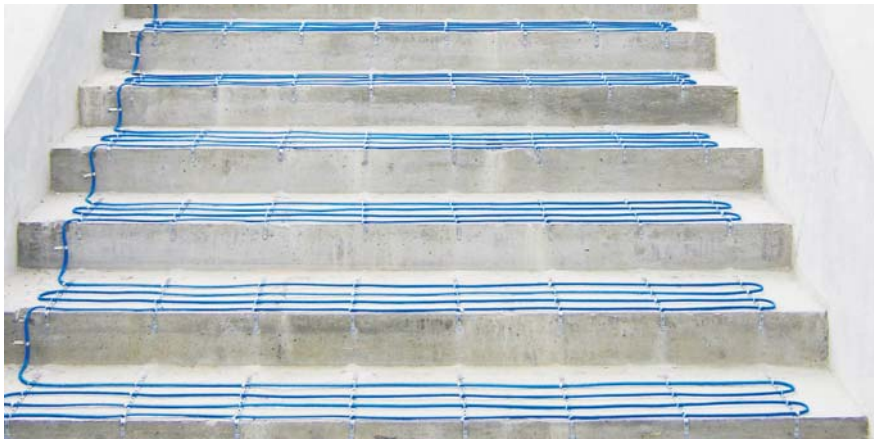
Total required length of heating cable is 43.8m. We select ELEKTRA VC 20/830 with length of 42m. After the required heating cable's length has been estimated, plan the cable's layout on the steps and landings.

Example of ELEKTRA VC20 heating cable layout



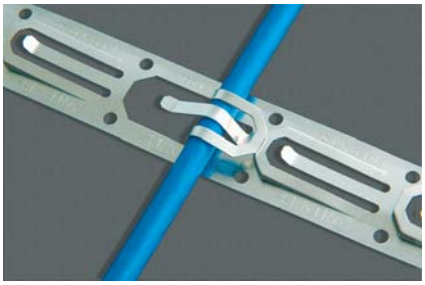
Installation
ELEKTRA heating cables should be positioned with the min. spacing of 50 mm.

Due to the fact that the vertical surfaces of the steps are not heated, the heating cable run on the surface of each step, which is closest to the edge. It's recommended to cut out grooves for the heating cables to be laid into.
The cables should then be covered by mortar. This installation method makes it much easier to install tiles on the stairs without raising the height of the steps.



Example of ELEKTRA heating cable layout

When installing up a flight of stairs, the heating cables should be installed directly on the surface of the steps through means of a wire net or ELEKTRA TME installation tape. The fixed cables should then be covered in a layer of 30mm (minimum) cement.



ELEKTRA TME installation tape

6.2 Roofs and Gutters

Snow and ice protection systems protect against:

- Snow and ice build-up on roofs
- Damage caused by ice build-up in gutters and downpipes
- Unsightly water damage on building walls
- Icicle formation

Damage to roofs and gutters can be far more costly than a heating system installation.

For the most effective heating system, the heating power should correspond to the guidelines shown in the table.

Application of the selected heat output

Ambient temperature	Heat output			
	> -5°C	-5°C ÷ -20°C	-20°C ÷ -30°C	< -30°C
Gutters & downpipes Roof troughs Roof edges	20 W/m 20 W/m 200 W/m^2 ~150 W/m^2	20 – 40 W/m 20 - 40 W/m 200-250 W/m^2 ~250 W/m^2	40 - 60 W 20 – 40 W/m 250 - 300 W/m^2 ~300 W/m^2	60 W 40 W/m 350 W/m^2 ~350 W/m^2
Roof area extending beyond the building outline	~250 W/m^2	~300 W/m^2	~350 W/m^2	~500 W/m^2

The values given above refer to a gutter of the Ø100-125mm diameter.

Gutters of larger diameters require application of the 20W/m higher heat output.

Flat roofs, or when roof snow barriers are installed, which would cause snow deposition, require increase of the given values with approx. 15%.

Selecting the ideal power range is dependant on the climate the gutter system is installed in.

UV-resistant heating cables should be used to protect roofs and gutters:

- ELEKTRA VCDR
- ELEKTRA TuffTec™
- Self-regulating ELEKTRA SelfTec®

The ELEKTRA VCDR heating cables are characterized with the fixed power value of 20W/m, the TuffTec™ heating cables – 30W/m. Both types are offered as ready-to-install units, terminated with power cables (so called "cold tails"). While planning the installation's design, it is necessary to match the required cable lengths with the available ones.

Thanks to their exceptionally high resistance against damaging influence of any bituminous substances, ELEKTRA TuffTec™ heating cables are ideally suited for the purposes of heating roofs covered with tar paper or bituminous shingles.

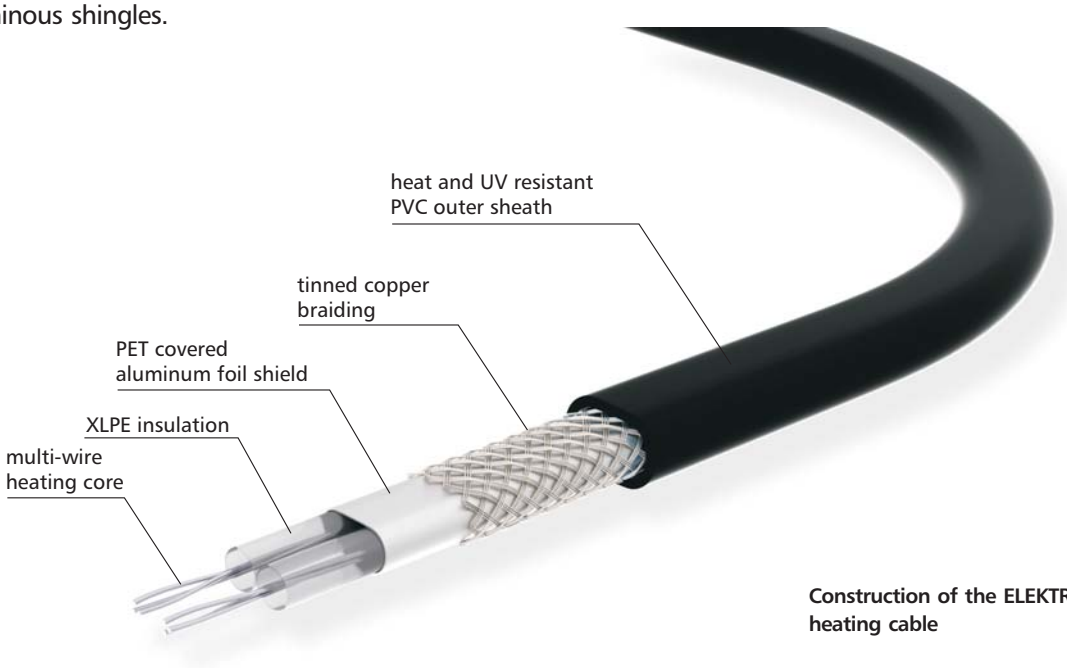
The ELEKTRA SelfTec® self-regulating heating cables (of the characteristics described in detail in chapter 7.2.2) are available:

- as ready-to-install units terminated with power cables (so called "cold tails"), with the hermetically-sealed plugs- the ELEKTRA SelfTec®ready2heat 16W/m cables designed for the do-it-yourself installation in the short segments of gutters, downpipes or other trouble spots requiring intervention,
- on the spool - the ELEKTRA SelfTec®PRO 20 designed for expanded professional installations.

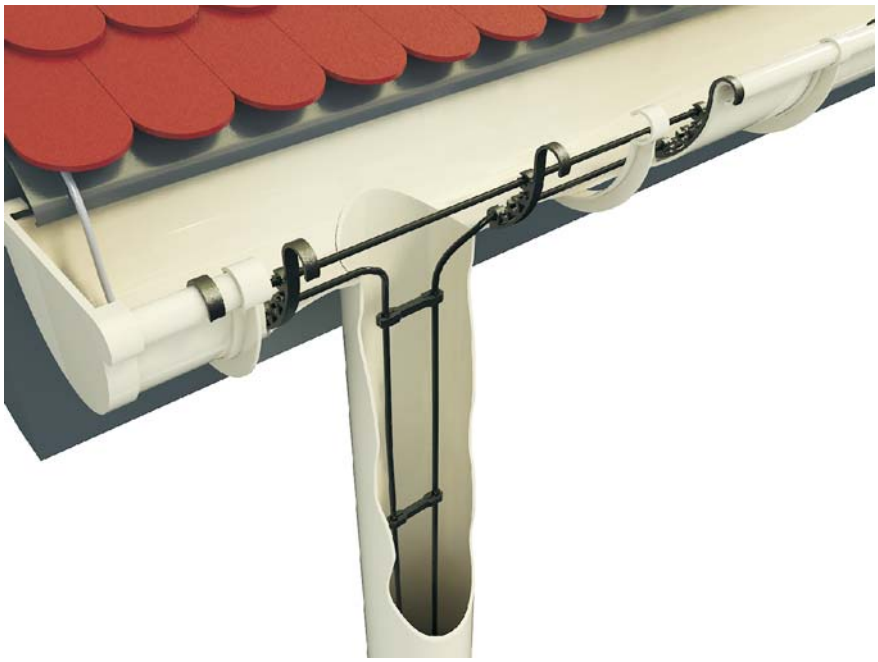
Usually the cables are installed twice along the gutter, which allows the required heat power to be reached.

If in a mild climate the diameter of a gutter or downpipe is ≤ 120mm, double runs are not necessary.

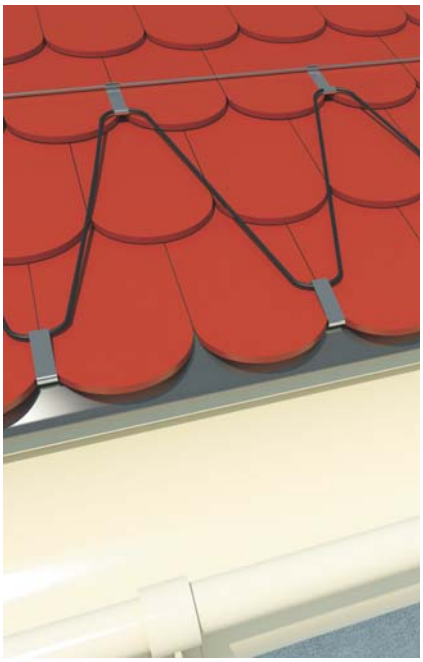
In regions that receive large amounts of snowfall, heating only gutters and downpipes does not ensure a complete removal of snow and ice. In such climates, it is necessary to heat the edge of the roof (approximately 500mm) that borders the gutter.



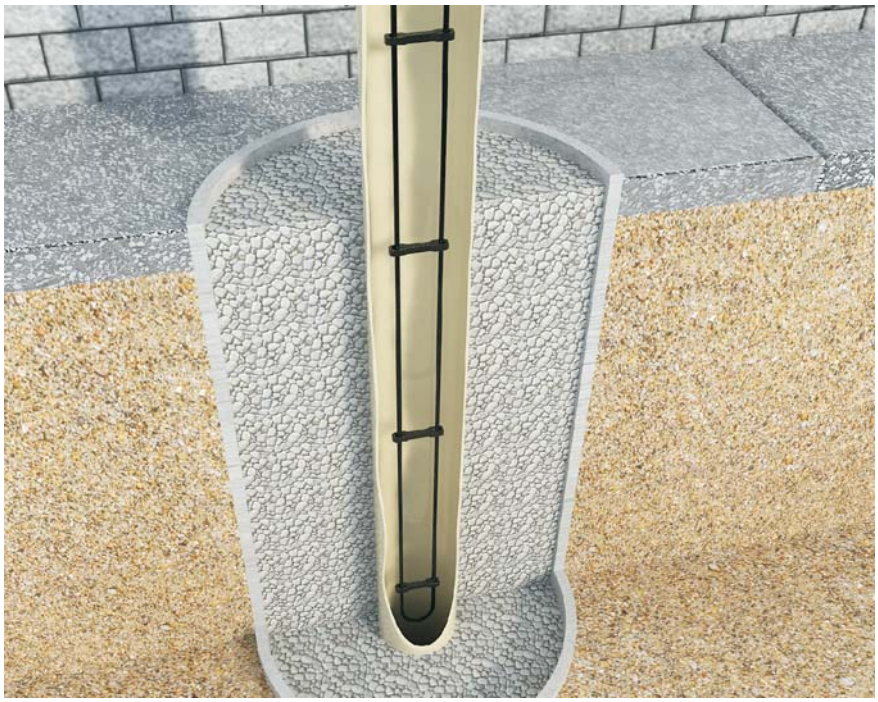
Construction of the ELEKTRA VCDR heating cable



Typical ELEKTRA VCDR heating cable layout, with the application of the GH-2 holders for gutters and DSC-2 holders for rainwater downpipes



Example of roof edge heating

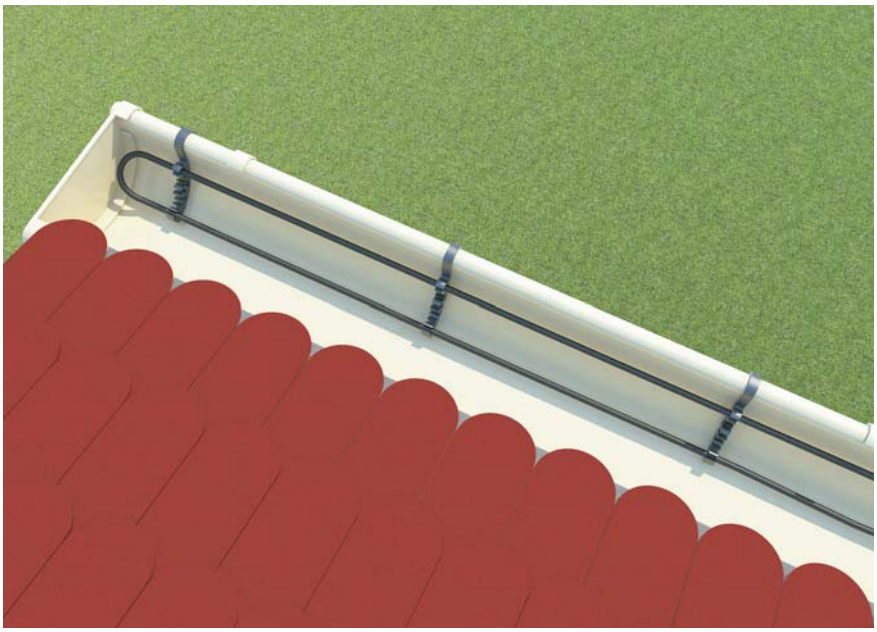


Heating cable installation below the ground surface

If rainwater runs directly from the piping to a drainage system, the base of the pipe where freezing is likely to occur, should be heated.

Cable Fastening

Utilising assembly holders allows the correct distance to be kept between heating cables.

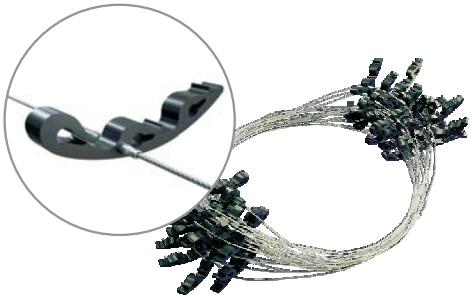


Cables fastening in gutter, with the application of the GH-2 holders

Gutters

The heating cables can be fastened to gutters and downpipes by the means of either clips or spacing wire with clips.
Spacing between the holders should not exceed 30cm.

Gutter holder GH-2



Gutter spacing wire with clips GSW-2
(this way of the cable installation facilitates gutter cleaning)

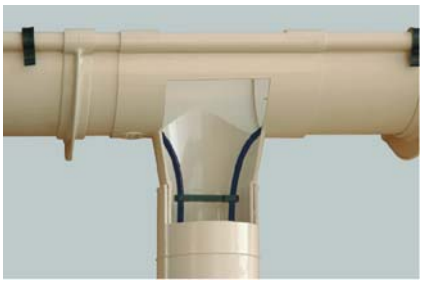
Rain Water Pipes

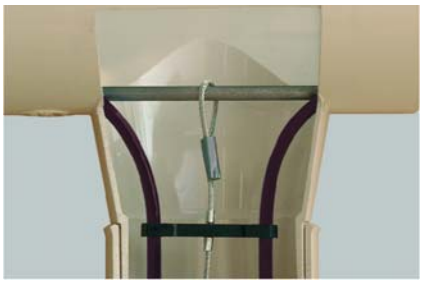
In rain water pipes, heating cables are fastened by means of holders. Spacing between the holders should not exceed 40cm.

Downpipe spacing clip DSC-2

In case the length of the heating cable in water pipe exceeds 6m, a wire with holders should be used.

Downpipe spacing wire with clips DSW-2





Roof troughs

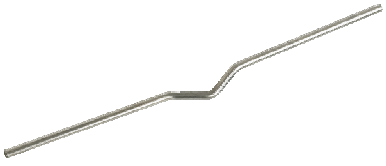
Installation plastic band for roof troughs of small gradient
RT-IB-1-P

Self-adhesive installation strip for permanent fixing with metal sheet
RT-L500-S-AL

Additional accessories

Flexible cable support will protect the heating cable against wear through in the joining spot of the gutter and downpipe.

Flexible cable support
FCS-1-SS

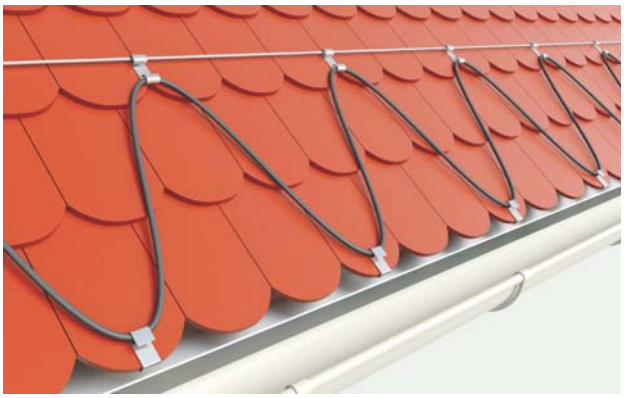


Downpipe spacing wire support bar
DSW-SB-1

Heating cables need to be fixed to the roof surface with copper tin holders or titanium zinc alloy-plated sheet holders.

– **If the roof covering is metal sheet**
the holders can be:
• glued to the roof surface,
• fastened through means of rivets (with the fastening insulated with silicone),
• suspended on insulated structural wires.

– **If the roof covering is tiles,**
the holders can be:
• fastened to the battens,
• fastened to the battens and structural wire.



Holders made of titanium zinc RE-IH-1-ZNTI or copper RE-IH-1-CU

– **on roofs covered with tar paper, roof tiles or bituminous shingles**
the holders are attached to the roof's stretches with pieces of heat-sealing tar paper glued across the holders

6.3 Control

The most effective and economical solution is to use controllers equipped with both temperature and moisture sensors. The controller will only activate if the temperature and the moisture sensors detects signs of snowfall or ice buildup.

The ELEKTRA ControlTec Smart SMC controller controls two independent heating zones, additionally enabling their coupling, to control one zone using just one or two sensors.

The built-in WiFi module and the Ethernet port for connecting the network in case of poor WiFi propagation, enable operation of the heating system via an internet browser from any device, as well as signalling the status of the current operation mode and any errors detected, and also software auto update.

Additionally, the controller records vital statistical data derived from the heating system's operation and keeps the diary of events. The service site enables control over multiple devices by an installer in the sharing process or integrated remote control over devices in multiple locations.

The ELEKTRA ControlTec Smart SMC controller supports a unique function of linear output control of in-built sensors' heaters depending on ambient temperature, thus preventing occurrence of possible negative "igloo" effects over the sensors when sudden precipitation occurs, and temperature increase around the sensors with no precipitation present.

ELEKTRA ControlTec Smart SMC controller

The ELEKTRA ETO2 can control up to 2 zones or a single zone utilising 2 sensors. The controller can be used as an alternative solution for users who do not expect functions such as remote supervision or linear output control of in-built sensors' heaters.

With proper connection to one controller of two sensors for gutter control or two sensors for traffic areas and routes, independent control over two heating zones becomes possible. An additional option is combination of above mentioned sensors which enables control over two various areas, e.g. gutters and a driveway.

Smaller, single zone applications may be controlled by ELEKTRA ETR2 (max load 16A).

All controllers are compatible with the ETOG-56T, ETOR-55 and ETF-744 sensors.

The controller should be installed in an enclosure and connected to the cold tail supply cable of the heating cable or mat and the temperature sensor cable. The controller should be provided with a power supply complying with wiring regulations.

ELEKTRA ETO2 controller

ELEKTRA ETR2 controller

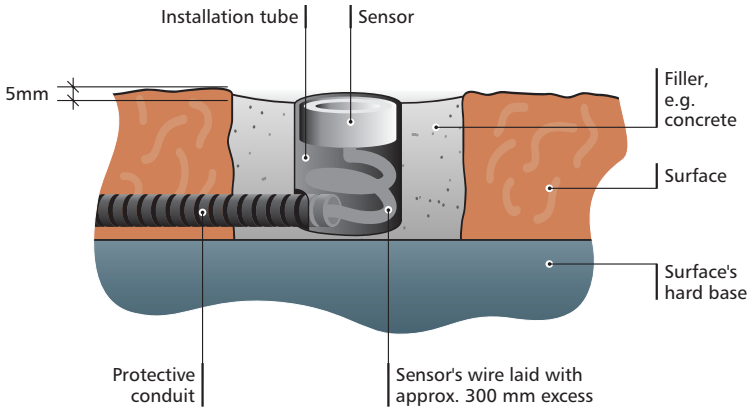
6.3.1 Traffic Routes and Areas

Dependent on the size of the application and/or number of zones, an controller with one (ETR2) temperature and moisture sensor, alternatively or an controller with one or two such sensors should be used (ControlTec Smart SMC or ETO2).

Regardless of the type and the location of the controller, the temperature and moisture sensor should be installed inside the heated surface, where it is exposed to the longest retention of moisture and the lowest temperature. The sensor should be installed 5mm below the surface to prevent water from seeping away.

Mounting of the temperature and moisture sensor should be done after covering the surface in concrete or block paving. The sensor should be mounted in the installation tube after the finishing surface is laid, therefore – before the finishing surface is ready in the place of the planned positioning of the sensor, a protective conduit should be led to the installation tube which will later serve to conduct the sensor's cable safely.

It is recommended that the sensor cable is led to the controller without extending the cable. However, if an extension is needed, the connection should be made in a joint box or by using an approved heat-shrink joint.



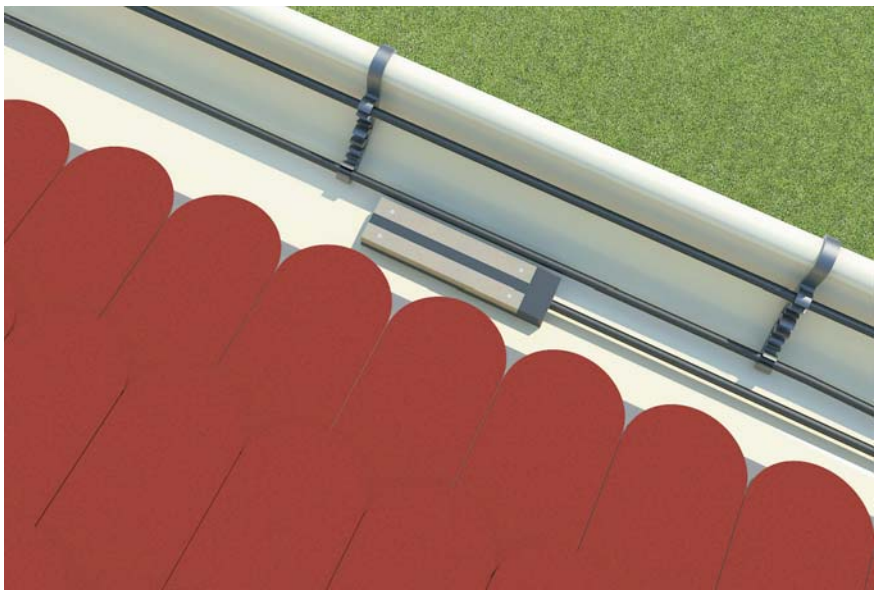
Installation concept of temperature and moisture sensor in the pavement

Temperature and moisture sensor ETOG-56T and Installation tube ETOK-T

6.3.2 Roofs and Gutters

Dependent on the size of the system and/or number of zones, ETR2 with one or ETO2 controller with one or two moisture sensors and an external temperature sensor could be used. The temperature sensor should be placed in an area that is not exposed to sunlight and the moisture sensor at the bottom of the gutter.

ETF-744
air temperature sensor
and ETOR-55 moisture sensor



Moisture sensor location

6.3.3 Controllers Configuration

Traffic routes and areas

Small applications, 1 zone

ELEKTRA ETR2G

Large applications, 1 zone

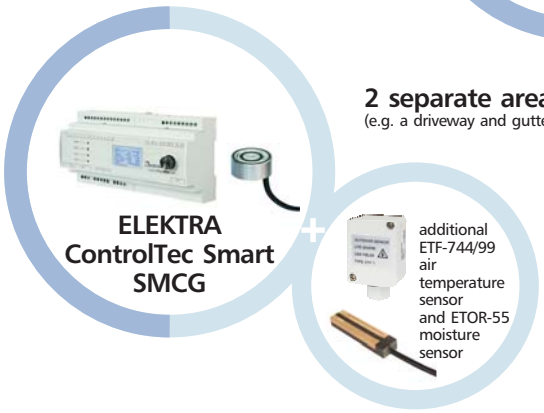
ELEKTRA ControlTec Smart SMCG

Large applications, 2 zones

ELEKTRA ControlTec Smart SMCG + additional ETOG-56T temperature and moisture sensor

Large applications, 2 zones

2 separate areas
(e.g. a driveway and gutters)



ELEKTRA ControlTec Smart SMCG + additional ETF-744/99 air temperature sensor and ETOR-55 moisture sensor

Roofs and gutters

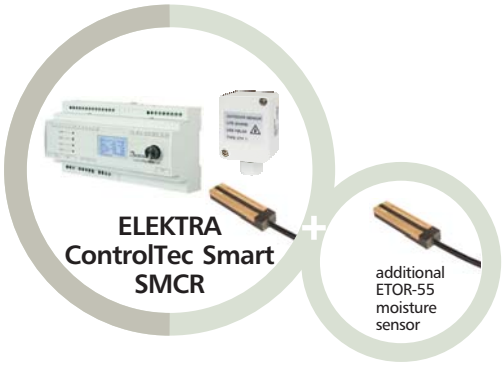
Small applications, 1 zone

ELEKTRA ETR2R

Large applications, 1 zone

ELEKTRA ControlTec Smart SMCR

Large applications, 2 zones



ELEKTRA ControlTec Smart SMCR + additional ETOR-55 moisture sensor

Large applications, 2 zones

2 separate areas
(e.g. a driveway and gutters)

ELEKTRA ControlTec Smart SMCR + additional ETOG-56T temperature and moisture sensor

6.4 Product Selection Guide

Application	moc grzejna	Heating Cables								Heating Mats		Control
		Constant wattage				Self-regulating						
		VC 20	VCD 25	VCDR 20	TuffTec™	SelfTec®16	SelfTec®16 ready2heat	SelfTec®PRO 20	SelfTec®PRO 33	SnowTec®	SnowTec®Tuff	
Driveways, pavements, car parks, stairs laid directly on the ground	200-300 [W/m²]	+	+	—	+	—	—	—	—	+	—	SMCG ETOG2 ETR2G
	300-400 [W/m²]	—	+	—	+	—	—	—	—	—	+	
	>400 [W/m²]	—	—	—	+	—	—	—	—	—	—	
Loading ramps, bridges, overpasses, stairs exposed to wind operation from below	250-300 [W/m²]	+	+	—	+	—	—	—	—	+	—	
	300-400 [W/m²]	—	+	—	+	—	—	—	—	—	+	
	>400 [W/m²]	—	—	—	+	—	—	—	—	—	—	
Linear drainage	25-33 [W/m]	—	+	—	+	—	—	—	+	—	—	
Gutters	20-60 [W/m]	—	—	+	+	+	+	+	—	—	—	SMCR ETOR2 ETR2R
Downpipes	20-40 [W/m]	—	—	+	+	+	+	+	—	—	—	
Roof troughs	200-300 [W/m²]	—	—	+	+	+	+	+	+	—	—	
Roof edges	150-250 [W/m²]	—	—	+	+	+	+	+	+	—	—	
Roof edges covered with bituminous materials	150-250 [W/m²]	—	—	—	+	—	—	—	—	—	—	
Roof area extending beyond the building outline	250-400 [W/m²]	—	—	+	+	+	+	+	+	—	—	

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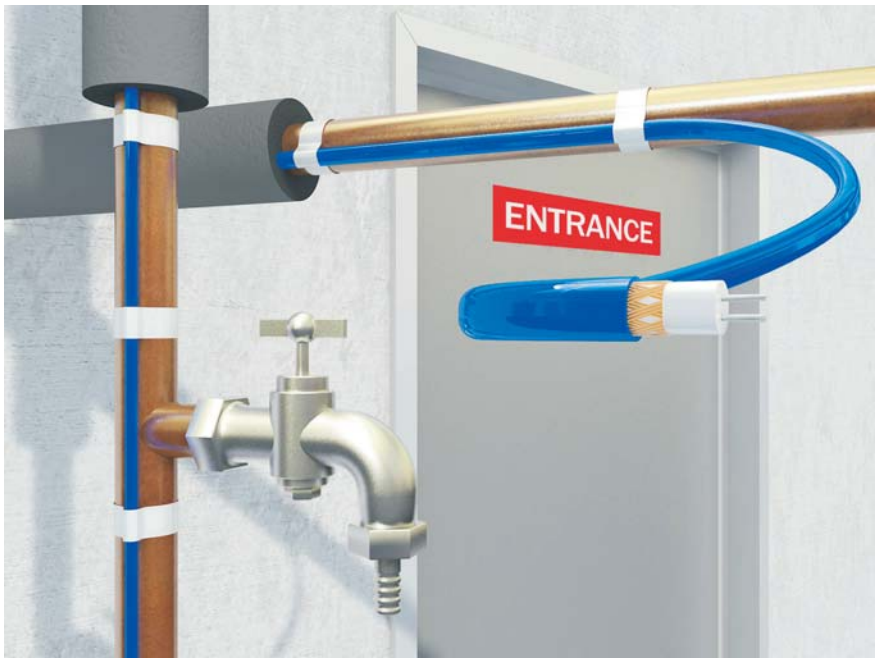
7. Pipe and Pipeline Heating

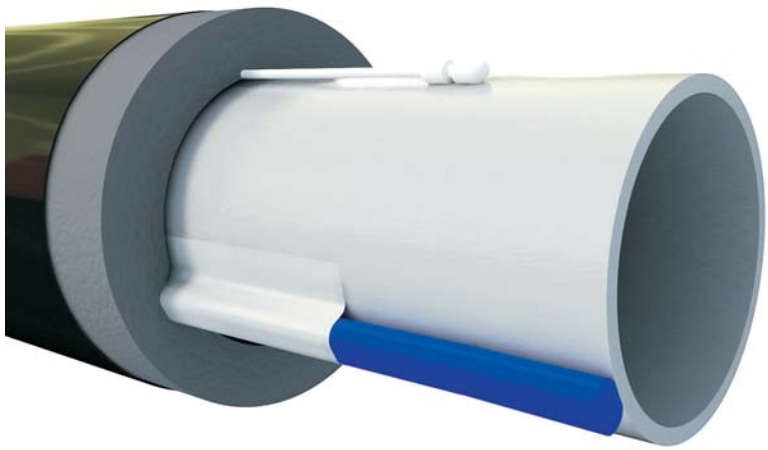
7.1 General Information

These heating systems are used for:

1. Preventing frozen
   - Water fixtures
   - Sewage systems
   - Sprinkler systems
   - Hydrants
   - Air conditioning and ventilating pipe systems

2. Maintaining required temperatures in
   - Hot water pipelines
   - Industrial pipelines containing highly dense liquids





All metal (steel, copper, iron) and plastic pipes and tubes can be heated. Cables can be installed outdoors and indoor buildings, as well as in the ground.

7.2 Heating Cable Selection

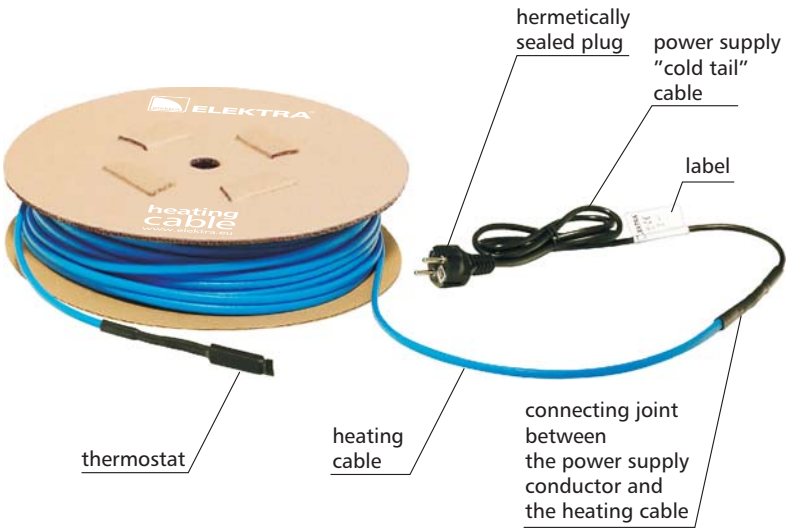
Pipes and pipelines can be heated with heating cables of appropriate lengths, terminated with "cold tail" power cables, ready for installation, or self-regulating heating cables on spools, which can be adjusted on site to the pipeline length. Self-regulating heating cables require the cable termination and connection with cold tails.
Heating cables can be of constant wattage or self-regulating.

7.2.1 Constant Wattage Cables

- The ELEKTRA VCD10 single-side powered heating cables.
- The ELEKTRA VC10 double-side powered heating cables.
- The ELEKTRA FreezeTec® with built-in thermostats heating cables.

The ELEKTRA VC/VCD10 heating cables are fixed-powered at 10W/m and are available as ready-to-install units terminated with "cold tail" power supply cables.
While planning the installation's design, it is necessary to match the required cable lengths with the available ones. While planning the ELEKTRA VC10 it is also crucial to account for the necessity of connecting both cold tails to the installation box. The ELEKTRA VC/VCD10 cable installations require the application of temperature controllers.

The ELEKTRA FreezeTec® heating cables are ready-to-install units including the heating cable powered at 12W/m with a thermostat built-in at one end. The other end is terminated with a 1.5m long three-core power supply cable, with a hermetically sealed plug.
The thermostat will switch on the cable in the ambient temperature of +3°C and switch it off at +10°C.



ELEKTRA FreezeTec® heating cable

The ELEKTRA FreezeTec® heating cables do not require any additional control means.

They are designed to service simple devices, such as servo motors, pipes of a diameter of maximum 50mm. The installation can be carried out on a do-it-yourself basis, without the necessity of applying the services of a professional installer.

7.2.2 Self-regulating Cables

Self-regulating cables consist of two copper cores in parallel, connected with a core of crosslinked polymer with the addition of graphite.
The core is a self-regulating heating element with the resistance value depending on the ambient temperature. The lower the ambient temperature, the higher number of conducting paths, which means the lower electrical resistance value, causing the increased electrical current flow and correspondingly the increased heat generation.

The higher the temperature, the more loose the structure becomes (the carbon particles repel one another), which - in turn - signifies the breaking of conductive paths, the increase in resistance, and ultimately the decreased current flow with associated decreased heat generation. Thanks to the above feature, the cables increase their heating power with the decrease of the temperature in the heated system, and correspondingly decrease the power when the temperature goes up.

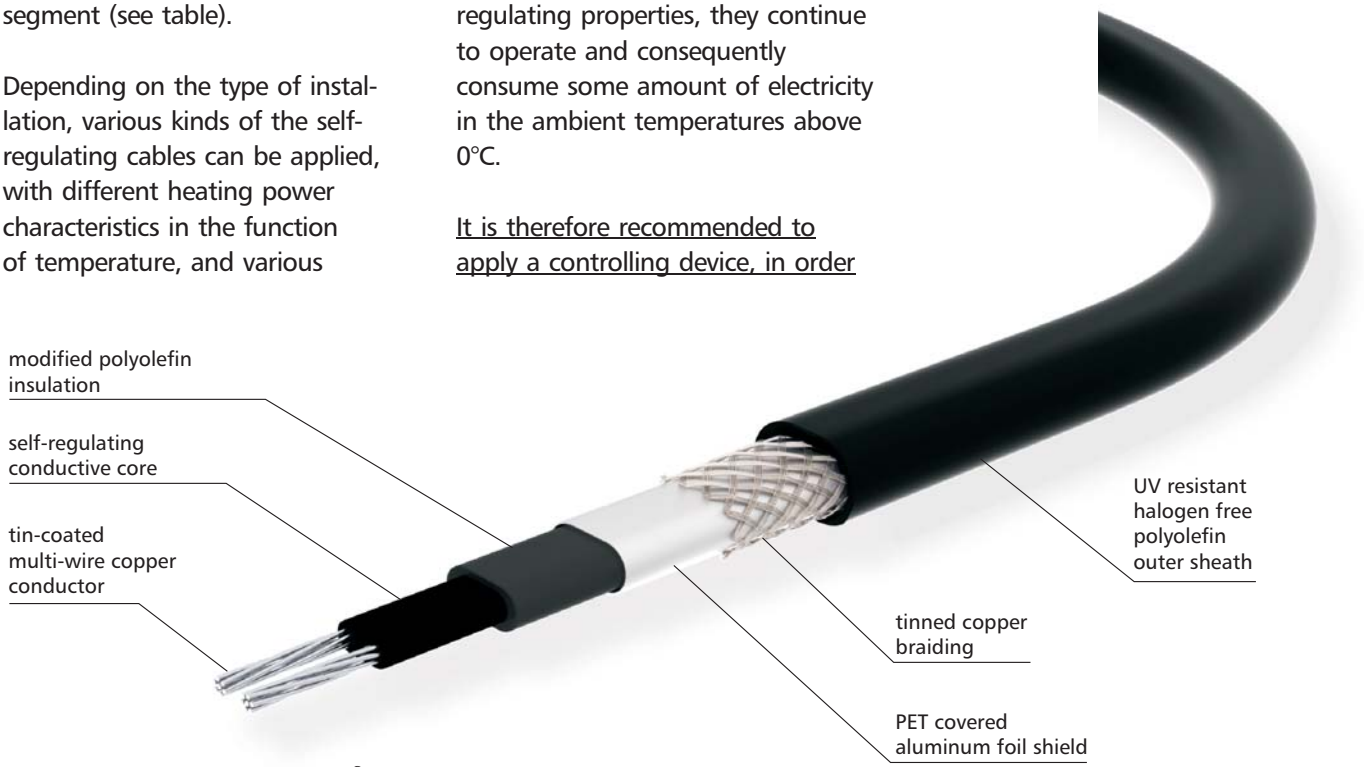
As power fluctuations occur only in the spots of the ambient temperature change and do not influence the power value in the remaining part of the cables, the self-regulating cables are in no danger of overheating, and that is why they can touch or cross freely.

Thanks to their properties, the cables can be cut and mounted into segments of required lengths. The only restriction is the maximum permissible length of a single segment (see table).

Depending on the type of installation, various kinds of the self-regulating cables can be applied, with different heating power characteristics in the function of temperature, and various properties of the insulating and sheath materials.

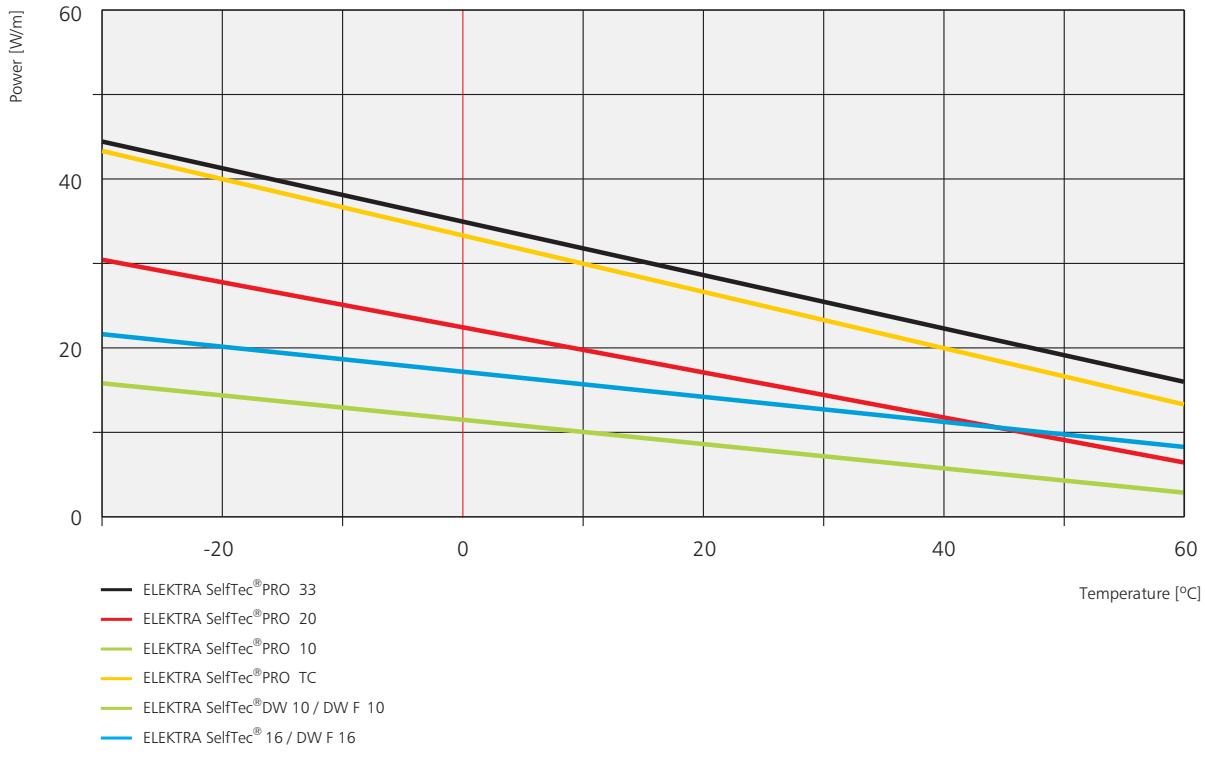
It is necessary to bear in mind that, even though the cables possess self-regulating properties, they continue to operate and consequently consume some amount of electricity in the ambient temperatures above 0°C.

It is therefore recommended to apply a controlling device, in order to eliminate the unnecessary power consumption in the temperature conditions when operating heating is not required.



Construction of the ELEKTRA SelfTec® heating cable

Heating power of the ELEKTRA SelfTec® self-regulating cables in the function of temperature



Type/power output (10°C)	SelfTec®DW / DW ready2heat 10 W/m	SelfTec® DW F 10 W/m	SelfTec® DW F 16 W/m	SelfTec®16 / 16 ready2heat 16 W/m	SelfTec® PRO 10 W/m	SelfTec® PRO 20 W/m	SelfTec® PRO 33 W/m	SelfTec® PRO TC 30 W/m
Power supply	230 V ~ 50/60 Hz							
External dimension of cable	~ 7x10mm	~ 6x9mm		~ 7x10mm	~ 7x11mm		~ 7x13mm	~ 6x13,5mm
Min. installation temperature	-25°C				-30°C		-50°C	
Max. working temperature	65°C							100°C
Max. exposure temperature	65°C				85°C			135°C
Type of heating cable	Self-regulating, conductor screen, single-side power supply							
Conductor	tin-coated copper 0.6mm^2				tin-coated copper 1.1mm^2			nickel-coated copper 1.3mm^2
Insulation	Modified polyolefin							XLEVA
Outer sheath	double-layer, halogen free polyolefin + external LDPE, certified for drinking water applications	single-layer, fluoropolymer, certified for drinking water applications		UV resistant, halogen free polyolefin				HFFR
Min. bending radius	3.5 D							6 D

Max. length of the heating circuits as related to turn-on temperature

	SelfTec® DW/DW F 10 W/m		SelfTec® 16 / DW F 16 W/m		SelfTec® PRO 10 10 W/m			SelfTec® PRO 20 20 W/m				SelfTec® PRO 33 33 W/m				SelfTec® PRO TC 30 W/m			
	circuit-breaker, C-type																			
	10A	16A	10A	16A	10A	16A	20A	10A	16A	20A	32A	16A	20A	32A	40A	16A	20A	32A	40A
min. installation temperature	-25°C				-30°C											-50°C			
turn-on temperature	max. cable length per circuit [m]																		
-20°C	75	110	55	75	85	125	180	45	65	90	120	50	65	85	100	69	91	103	103
-15°C	80	115	60	80	100	145	190	50	75	105	125	55	70	90	105	73	94	103	103
0°C	95	120	70	90	115	170	205	60	90	120	135	60	75	95	110	80	100	106	106
+10°C	100	125	80	100	130	205	–	80	110	135	–	70	70	110	120	96	109	109	109
0°C in ice water	55	65	40	55	–	–	–	40	55	70	85	40	55	70	90	–	–	–	–

For protection of self-regulating heating cables, it is recommended to use miniature circuit breakers with type C characteristics. Because of the inrush current, which can significantly exceed the nominal current value, max. lengths of the heating circuits should comply with the lengths given in the table. The values have been assessed for the min. turn-on temperature.

The advantages
of the self-regulating cables:

- They can be cut on site of the construction into segments of appropriate lengths (the maximum permissible length values are given in table). This feature facilitates the selection of the required self-regulating cable's length for the application to be heated while planning the system, as well as during the installation process.
- They can cross.
- The ambient temperature's drop will cause the automatic increase of the cable's heating power.
- They allow the construction of max. 3-5m long branches with no necessity of creating additional circuits.

After the self-regulating cables are cut to the required length, they need to be terminated and connected to the power supply "cold tail" cable, with the application of the EC-PRO joint set.

Self-regulating heating cables are also available as the ready-to-install units of specific lengths, with the factory-provided power supply "cold tail" cables terminated with the plugs, e.g. ELEKTRA SelfTec®16 ready2heat.

They are designed especially for do-it-yourself installation, Multi-purpose, self-regulating ELEKTRA SelfTec®DW / DW F heating cables, are suitable for applications both outside and inside pipes. The SelfTec®DW/DW F heating cables are additionally available as the ready2heat version, for do-it-yourself installation. Installation on pipelines of the ELEKTRA SelfTec®16 ready2heat and SelfTec®PRO heating cables is described in detail in chapter 7.5.2.

For installation inside pipelines of the ELEKTRA SelfTec®DW/DW F and SelfTec®DW ready2heat heating cables, see chapter 7.5.3.

It is crucial to carefully and tightly terminate the cable and then to connect the self-regulating cable with the cold tail. The joints should be executed with the application of the EC-PRO joint set.

ELEKTRA SelfTec®PRO self-regulating heating cables have been especially designed for protection of extended sanitary installations, e.g. pipelines with branching, flanges, valves and (depending on the output) gutters, downpipes and linear drainage. ELEKTRA SelfTec®PRO TC heating cables are intended for applications in systems where - temporarily or permanently - increased temperatures of even 110°C may occur, e.g. in process heat pipelines, central heating pipelines, or to maintain fixed temperature in fat drainage pipelines. For installation by qualified installers only.

7.3 Planning

Applying the heating cables on pipes for the purpose of maintaining the steady agent temperature, requires individual planning every time it is to be done. The proper selection of the heating cable means the calculation of the heat loss in the particular pipeline and in specific conditions.
It is necessary to find out in advance:

- the pipeline's diameter and material.
- the thickness and type of the thermal insulation in use.
- the contents type and flow values.
- the temperatures required to maintain the contents temperature, together with possible minimum ambient temperatures which could occur in the valid geographical location.

Reaching the required heating power value is ensured by the carefully considered and proper selection of the heating cables' types, together with the temperature controlling system.

These applications would need the constant wattage or self-regulating heating cables.

When selecting a heating cable, the following principles are suggested for consideration:

- for simple systems of the max. 50mm diameter use:
  - the ELEKTRA FreezeTec® or SelfTec® ready-to-install units terminated with hermetically sealed plugs.
  - constant wattage ELEKTRA VC/VCD cables.
- for extended pipelines use the ELEKTRA VC/VCD constant wattage heating cables or self-regulating ELEKTRA SelfTec®PRO heating cables.
- for extended pipelines with branching, valves and flanges use self-regulating ELEKTRA SelfTec®PRO heating cables.
- for anti-frost protection of process heat or central heating pipelines, where during normal operation the temperature might exceed 95°C, SelfTec®PRO TC heating cables are recommended, for which the maximum operating temperature is 110°C (maximum exposure temperature in the off-mode is 130°C).

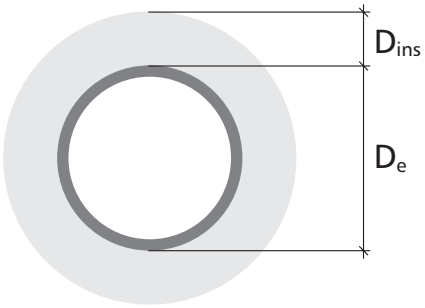
7.3.1 Heat Loss Calculation

A heat loss of 1m of pipeline can be calculated through the following formula:

$$Q = \frac{2\,\pi\,\lambda\,E\,(\theta_i - \theta_e)}{\ln\left(1+\frac{2D_{ins}}{D_e}\right)}\ [W/m]$$

where:

- Q – heat loss [W/m]
- θ_i – required temperature maintained by the heating cable [°C]
- θ_e – min. ambient temperature [°C]
- D_e – external pipeline diameter [mm]
- D_{ins} – insulation thickness [mm]
- E – safety margin
- λ – thermal conductivity of insulation $[\frac{W}{m\cdot K}]$



Thermal Conductivity

Material	Thermal Conductivity at (+10°C) λ [W/m·K]
Glass wool	0.036
Mineral wool	0.038
Polyurethane foam	0.023
Rubber foam	0.035
Polyethylene foam	0.037

Example: Heat loss calculation for the supply water pipeline, laid outdoors, diameter: 2 inches, length: 6 m, polyurethane foam heat insulation.

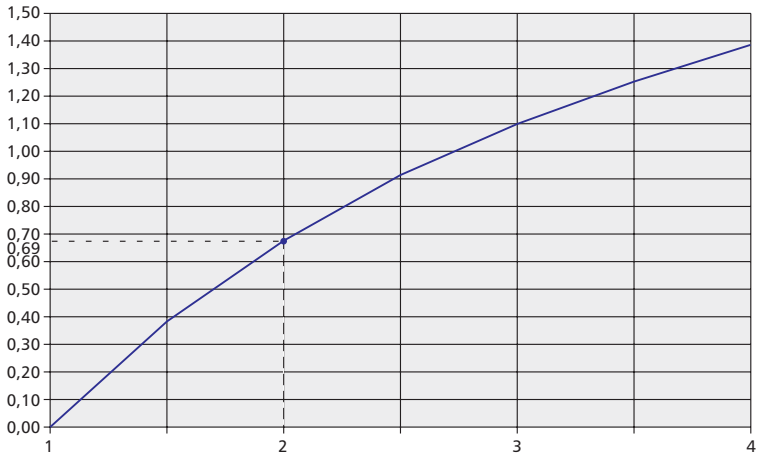
Data:

- D_e – 50 mm external pipeline diameter
- D_{ins} – 25mm - insulation thickness

The following assumptions were made:

- θ_i – +5°C - required temperature inside the pipeline, protecting water against freezing;
- θ_e – -25°C - min. outdoor temperature in the current climate zone;
- E – 1.1 - safety margin.

For easier calculations, the logarithmic diagram has been placed below, for the required $\ln$ value readout.



The diagram gives us the following readout: $\ln 2.0 = 0.69$.
After including the value, the above formula gives the result: 10.5 W/m.
Required heat load for the pipe:
6 m x 10.5 W/m = 63 W

$$Q = \frac{2\,\pi\ 0.035\ x\ 1.1\ x\ (5 - (-25))}{\ln\left(1+\frac{2\ x\ 25}{50}\right)}\ [W/m]$$

$$Q = \frac{2\,\pi\ 0.035\ x\ 1.1\ x\ 30}{\ln 2.0} = 10.5[W/m]$$

An appropriate heating cable can be chosen once the heat losses have been calculated. The power of the heating cable must be at least equal to the heat loss in the pipe.
To protect the pipe described in the example, the following cables can be chosen from:

1. The ELEKTRA SelfTec®ready2heat 16/7 selfregulating heating cable (7m long 112W), laid individually along the pipeline.
2. The ELEKTRA FreezeTec® 12/7 heating cable (7m long 72W), laid spirally along the pipeline.
3. The ELEKTRA VCD 10/70 heating =cable (7m long 70W), laid spirally along the pipeline.
4. The ELEKTRA SelfTec®PRO 10 self-regulating heating cable (6.3m long, 10 x 6.3 = 63W), laid along the pipeline.

The first three variants feature some power surplus, but are simple solutions, using the ready-to-install units.

- Variant 1 - ELEKTRA SelfTec®:
  The cable terminated with a plug. Simple mounting, for do-it-yourself installation, requires manual control of the cable, i.e. in the ambient temperatures above 0°C it is necessary to switch the system off manually.
- Variant 2 - ELEKTRA FreezeTec®:
  The cable terminated with a plug at one end and with a thermostat at the other end. Simple mounting, for do-it-yourself installation, no additional temperature controller required.
- Variant 3 - ELEKTRA VCD:
  The cable terminated with a joint set.
  Simple mounting, for do-it-yourself installation, only the mains connection requires the intervention of a certified electrician. The application of a temperature controller required, for precise temperature setting. The beneficial result will be low operation costs.
- Variant 4 - ELEKTRA SelfTec®PRO 10:
  Allow for the precise selection of the cable length, and consequently matching the power required and obtained. Professional mounting, requiring the cable's termination and connection to the cold tail power cable. Temperature controller required.
  Usually utilised in larger systems, in need of the self-regulating properties.

<u>In case of the Variant 1 selection, with the large power surplus, it is possible to consider the decrease of the insulation thickness (in this case from 25 to 16 mm).</u>

$$Q = \frac{2\pi \ 0.035 \text{ x } 1.1 \text{ x } (5 - (-25))}{l_n \left(1 + \frac{2 \text{ x } 16}{50}\right)} =$$

$$= 14.7 \text{[W/m]}$$

After the insulation thickness has been decreased, the required pipe heat load:
6 m x 14.7 W/m = 88.2 W.

For heat loss calculation, the ready table can be used (polyurethane foam insulation, temperature difference $\theta_i - \theta_e$ =30°C).

Dependence of heat losses on pipe diameter and thickness of thermal insulation

Thickness of Insulation λ = 0,035W/m·K ["] [mm]	ΔT [°C]	Diameter of Pipe ¼ 8	½ 15	¾ 20	1 25	1¼ 32	1½ 40	2 50
10	30	5.8	8.6	10.5	12.3	14.9	17.9	21.6
13		5.0	7.2	8.7	10.2	12.2	14.5	17.3
16		4.5	6.4	7.6	8.8	10.5	12.3	14.7
19		4.1	5.7	6.8	7.9	9.3	10.9	12.8
20		4.1	5.6	6.6	7.6	8.9	10.5	12.3
25		3.7	4.9	5.8	6.6	7.7	8.9	10.5
30		3.4	4.5	5.2	5.9	6.9	7.9	9.2
32		3.3	4.4	5.1	5.7	6.6	7.6	8.8
40		3.0	3.9	4.5	5.1	5.8	6.6	7.6

The formula given above can be applied as a general estimator of heat loss in an insulated pipeline. Still, with detailed heat loss calculation, it is crucial to account for numerous additional parameters such as: wind velocity, exposure of pipeline, changes occurring in the surroundings, etc. It is by far the easiest way to use the ready tables where heat loss values are given as the function of the pipe's diameter, thermal insulation's thickness and temperature difference.

Heat loss values are given in W/m for mineral wool insulated pipelines, placed outdoors and wind-exposed.

In practice, while proceeding with the installation, it is necessary to additionally account for the heat loss occurring e.g. on valves, flanges, pipeline fastenings, etc. and apply the appropriate length of the cable which will cover the heat loss in such spots.

Heat loss as the function of the pipe'd diameter and thermal insulation's thickness

Mineral wool insulation's thickness: λ = 0.035W/m·K		ΔT	Pipeline diameter											
	["]	[°C]	½	¾	1	1¼	1½	2	3	4	5	6	8	10	12
	[mm]		15	20	25	32	40	50	65	80	100	150	200	250	300
	10	20	7.3	9.0	10.6	12.8	15.3	18.4	23.1	27.8	34.0	49.6	65.1	80.7	96.2
		30	11.0	13.4	15.8	19.2	23.0	27.7	34.7	41.7	51.1	74.4	97.7	121.0	144.3
		40	14.7	17.9	21.1	25.6	30.6	36.9	46.3	55.6	68.1	99.2	130.3	161.3	192.4
		50	18.3	22.4	26.4	32.0	38.3	46.1	57.9	69.5	85.1	124.0	162.8	201.7	240.5
		60	22.0	26.9	31.7	38.4	45.9	55.3	69.4	83.5	102.1	148.8	195.4	242.0	288.6
	20	20	4.8	5.7	6.5	7.7	9.0	10.6	12.9	15.3	18.4	26.3	34.0	41.8	49.6
		30	7.2	8.5	9.7	11.5	13.4	15.8	19.4	23.0	27.7	39.4	51.1	62.7	74.4
		40	9.6	11.3	13.0	15.3	17.9	21.1	25.9	30.6	36.9	52.5	68.1	83.7	99.2
		50	11.9	14.1	16.2	19.1	22.4	26.4	32.4	38.3	46.1	65.7	85.1	104.6	124.0
		60	14.3	17.0	19.5	23.0	26.9	31.7	38.8	45.9	55.3	78.8	102.1	125.5	148.8
	30	20	3.9	4.5	5.1	5.9	6.8	7.9	9.5	11.1	13.2	18.4	23.7	28.9	34.0
		30	5.8	6.7	7.6	8.8	10.2	11.8	14.2	16.6	19.8	27.7	35.5	43.3	51.1
		40	7.7	9.0	10.1	11.8	13.5	15.7	19.0	22.2	26.4	36.9	47.3	57.7	68.1
		50	9.6	11.2	12.7	14.7	16.9	19.7	23.7	27.7	33.0	46.1	59.2	72.1	85.1
	40	20	3.4	3.9	4.3	5.0	5.7	6.5	7.7	9.0	10.6	14.5	18.4	22.4	26.3
		30	5.0	5.8	6.5	7.4	8.5	9.7	11.6	13.4	15.8	21.8	27.7	33.5	39.4
		40	6.7	7.7	8.7	9.9	11.3	13.0	15.5	17.9	21.1	29.0	36.9	44.7	52.5
		50	8.4	9.6	10.8	12.4	14.1	16.2	19.3	22.4	26.4	36.3	46.1	55.9	65.7
		60	10.1	11.6	13.0	14.9	17.0	19.5	23.2	26.9	31.7	43.6	55.3	67.1	78.8
	50	20	3.0	3.5	3.9	4.4	5.0	5.7	6.7	7.7	9.0	12.2	15.3	18.4	21.6
		30	4.6	5.2	5.8	6.6	7.4	8.5	10.0	11.5	13.4	18.2	23.0	27.7	32.4
		40	6.1	6.9	7.7	8.8	9.9	11.3	13.3	15.3	17.9	24.3	30.6	36.9	43.2
		50	7.6	8.7	9.6	11.0	12.4	14.1	16.7	19.1	22.4	30.4	38.3	46.1	53.9
		60	9.1	10.4	11.6	13.1	14.9	17.0	20.0	23.0	26.9	36.5	45.9	55.3	64.7

7.4 Project Data Form

Basic information necessary for the proper design of a heating system for an extended pipeline is given in the presented form.
If the T_o or θ_{imax} values are unavailable, the relevant form fields can be left blank.

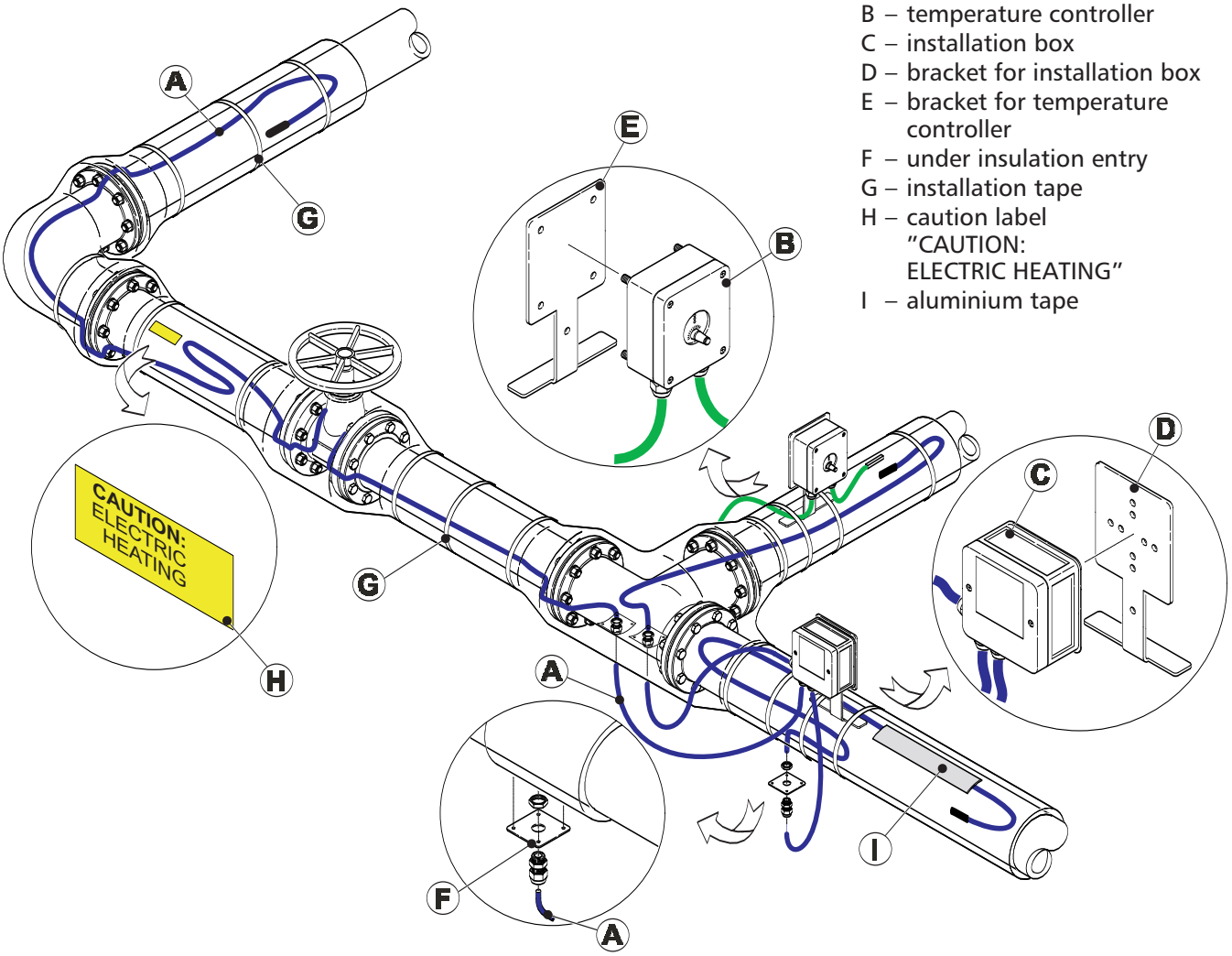
Intro information:		Legend:
First name:		Θi - required temperature maintained by the heating cable, e.g. +5°C protecting against freezeing.
Surname:		Θe - minimum ambient temperature outside the pipeline, e.g. Θe -25°C.
Name of the project:		Θimax - temperature harmful for the agent.
Location:		Td - pipeline temperature causing heating cable damage, e.g. while hot steam rising or cleaning.
Date of enquiry:		To- regular steady pipeline operation temperature.
Response deadline:		Dė - pipeline external diameter.
		Dins - insulation thickness.
		E - safety coefficient.

Application:	
Anti-frost	
Maintaining temperature	

Technical data of the pipeline:		Temperatures:	
Material: (steel, plastic)			
Diameter - De:			
Lenght:		Maintained temperature - Θi:	
Number of valves/supports:		Min. external - Θe:	
Contents:		Max. permissible of the contents -Θimax :	
Location:		Max. designed (of the pipeline's damage) - Td:	
Explosion zone Ex:		Regular operational - To:	

Technical data of the thermal insulation:		Technical data of the supplying network:	
		Supply voltage:	
Type/ material:		Max. load:	
Thickness - Dins:		One/multiple phase circuit power supply:	

Other information:



A – ELEKTRA SelfTec® self-regulating heating cable
B – temperature controller
C – installation box
D – bracket for installation box
E – bracket for temperature controller
F – under insulation entry
G – installation tape
H – caution label "CAUTION: ELECTRIC HEATING"
I – aluminium tape

7.5 Installation

7.5.1 Constant **W**attage **C**ables

Heating cables can be installed individually along one side, several times along one side or be spiraled around the pipe. The manner in which the cable is installed is dependant on the pipe diameter and the number of any additional pipes that branch out.

Cables should be fixed to the pipe every 300mm with the use of self-adhesive, high temperature resistant tape (i.e. glass yarn). Do not use wire or cable bands, as they may cause damage to the cable. After the cable has been set into place, the entire length of the cable should be covered by self-adhesive aluminum tape (minimum thickness: 0.6mm, minimum width: 50mm), it helps ensure that the heat is transferred in to the pipeline. The aluminum tape provides a barrier between the heating cable and the thermal insulation and protects the cable from overheating. Pipes made from synthetic materials must be covered with aluminium tape before the heating cables are installed. It improves the perforamce and protects the pipe from over-heating.

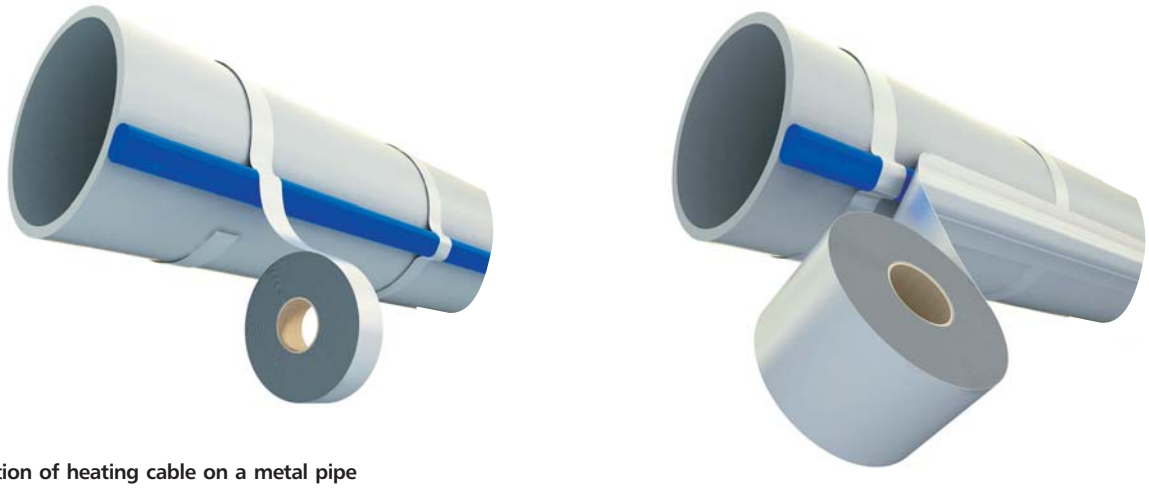
In case of self-regulating heating cables, aluminium tape fixed on the cable installed on the pipeline is a recommendation only, not a requirement.

During the installation, it is necessary to remember that the cables should not touch or cross, be near any sharp edges, or be excessively bent (the maximum bending radius is 3.5 x d, where d = diameter of the heating cable).

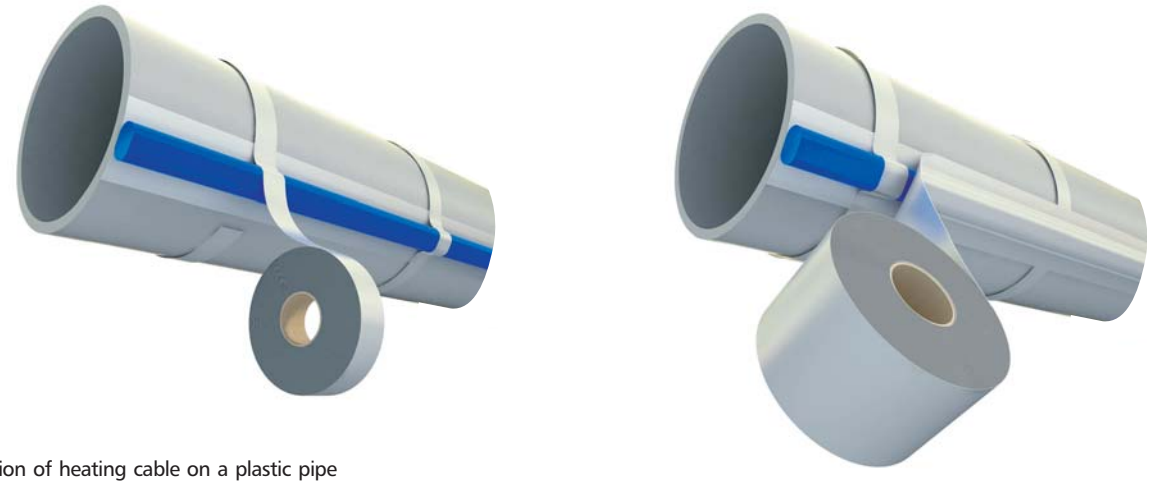
The temperature sensor should be located between adjacent cables, and if possible, in the upper part of the pipe. The terminal of the temperature sensor should be fixed to the pipe and tightly bound by tape.

The cold tails of the heating cables must be connected to a power supply with appropriate circuit protection.

The joint between the heating cable and cold tail must be attached to the pipe.

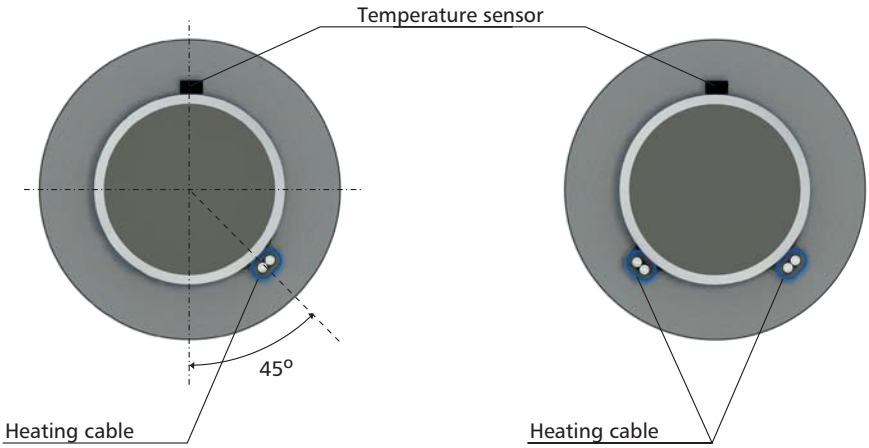


Installation of heating cable on a metal pipe

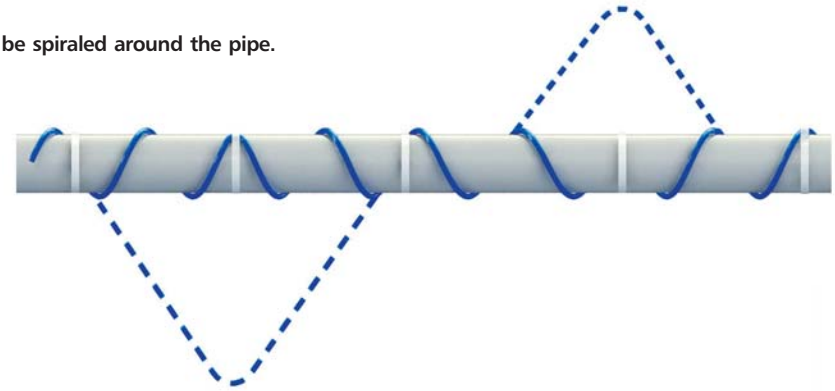


Installation of heating cable on a plastic pipe

Heating cables can be installed individually along one side, several times along one side



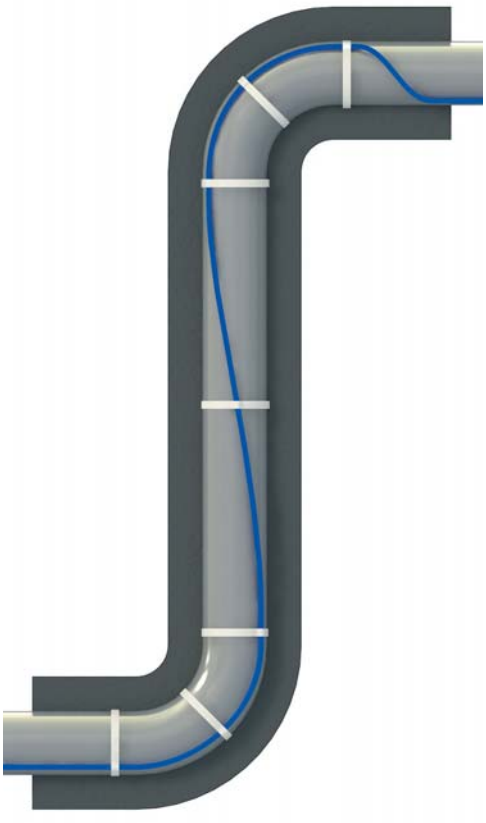
or be spiraled around the pipe.



Cable spacing can be assessed from the following formula:

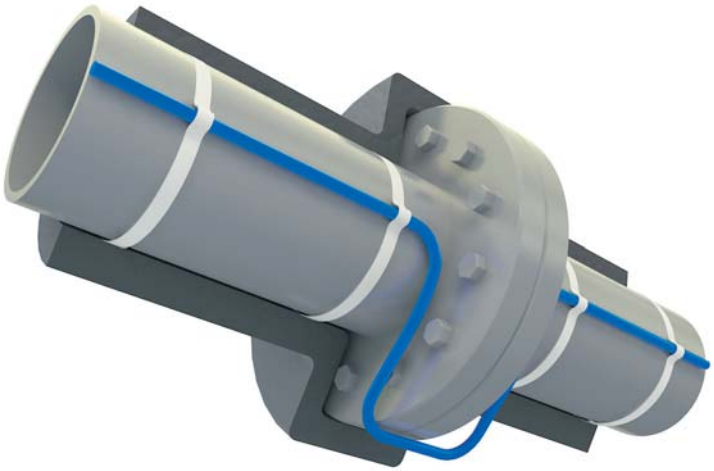
$$p = \frac{\pi\ (D_e + d)\ L_P}{\sqrt{L_{HC}^{\ 2} - L_P^{\ 2}}}$$

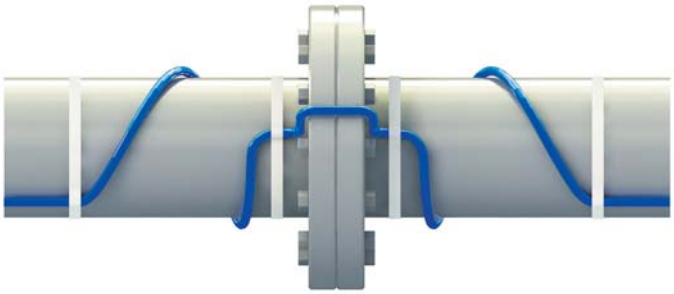
where:
D_e – external diameter of the pipe
d – dimension of the heating cable
L_{HC} – length of the heating cable
L_P – length of the pipe



Example of cable installation at bends and elbows

Example of cable installation
at valves and flanges

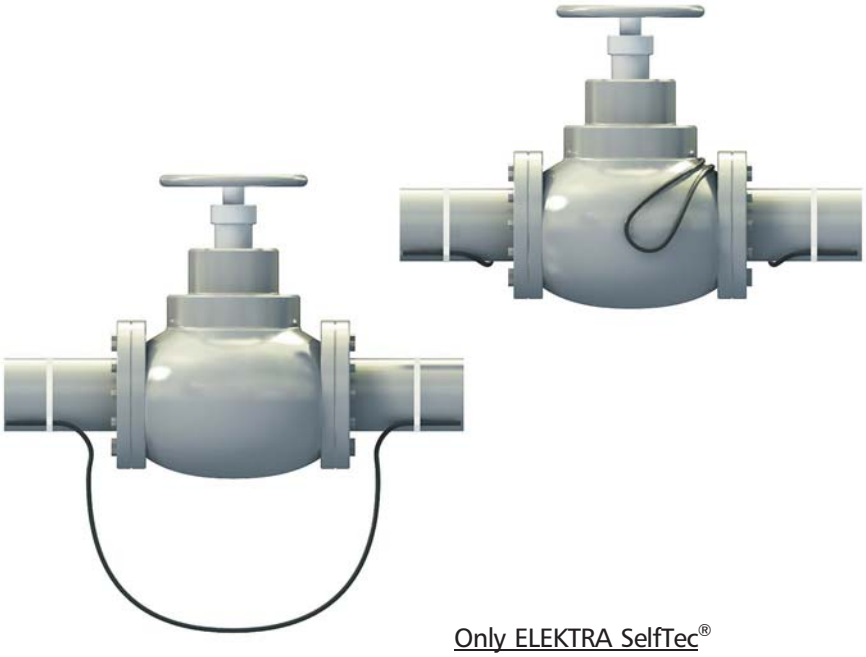




ELEKTRA FreezeTec® heating cable with built-in thermostat

7.5.2 Self-regulating Cables

The pipeline mounting of the self-regulating cables proceeds in the same way as for the constant wattage ones, one difference being the fact that - unlike the latter ones - they can cross or touch freely, which greatly facilitates installation on valves and flanges. Moreover, the self-regulating cables can be cut into segments of any required length, precisely matching the length of the pipeline. When laying the self-regulating cables, it is necessary to leave the surplus length of the cable for the cold tail connection -approximately 0.5m.



Example of ELEKTRA SelfTec® self-regulating cable on a valve

Only ELEKTRA SelfTec® self-regulating cables can cross or touch.

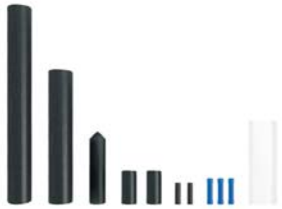
Power supply for the self-regulating cables can be provided in one of the following ways:

- Via the cold tail power cable - the connecting joint should be positioned on the heated pipeline, under the insulation. The EC-PRO joint set should be used to terminate the self-regulating heating cable and connect it with the power supply.

- Via supplying the heating cable directly to the junction box KF 0404-PRO, using the joint set ECM 25-PRO.

Connection of a self-regulating heating cable can be undertaken in either of the two following ways:

- by connecting cables using the power supply cable and two connecting joints positioned on the heated pipeline, under the insulation. S-TWIN-PRO twin splice connection set should be applied for this type of connection;
- by feeding both heating cables into the KF 0404-PRO junction box using two ECM 25-PRO joint sets. This type of connection of heating cables allows for fast inspection of the connecting spot, as the junction box should be mounted on the BKF-PRO mounting bracket, over the insulation.



EC-PRO joint set

S-TWIN-PRO twin splice connection

ECM25-PRO joint set

Junction box made of halogene-free thermoplast with IP66 protection index

BT-PRO mounting bracket for the UTR 60-PRO controller

BKF-PRO mounting bracket for the KF 0404-PRO installation box

CL-PRO caution label

EK-PRO Insulation entry kit for self-regulating heating cables

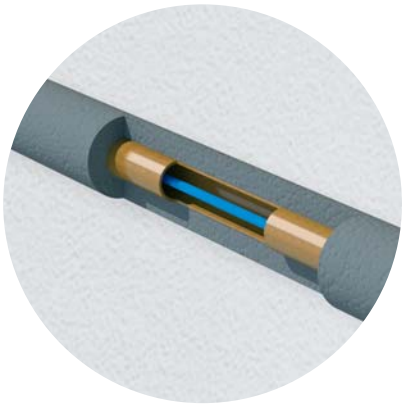
7.5.3 Self-regulating Cables Inside of Pipes

Frost protection of water pipelines can be achieved by placing heating cables inside pipelines. This method of installation enables frost protection of the pipelines already in use, without the need of removing the insulation, or wall drilling. This heating cable installation method is also possible for the underground pipelines.

Such heating method can be realized with the ELEKTRA SelfTec®DW self-regulating heating cables, which have double-layer sheath made of halogene-free polyolefins and the external LDPE (Low Density Polyethylene) sheath approved for drinking water applications and certified for placement inside drinking water pipelines, as well as ELEKTRA SelfTec®DW F heating cables with a single-layer fluoropolymer sheath.

The SelfTec®DW ready2heat heating cables are also available as the ready-to-install units of specific lengths, with the factory-provided power supply "cold tail" cables terminated with the plugs, for do-it-yourself installation, without the necessity of applying the services of a professional installer.

Fixing of the ELEKTRA SelfTec®DW heating cable inside a pipeline

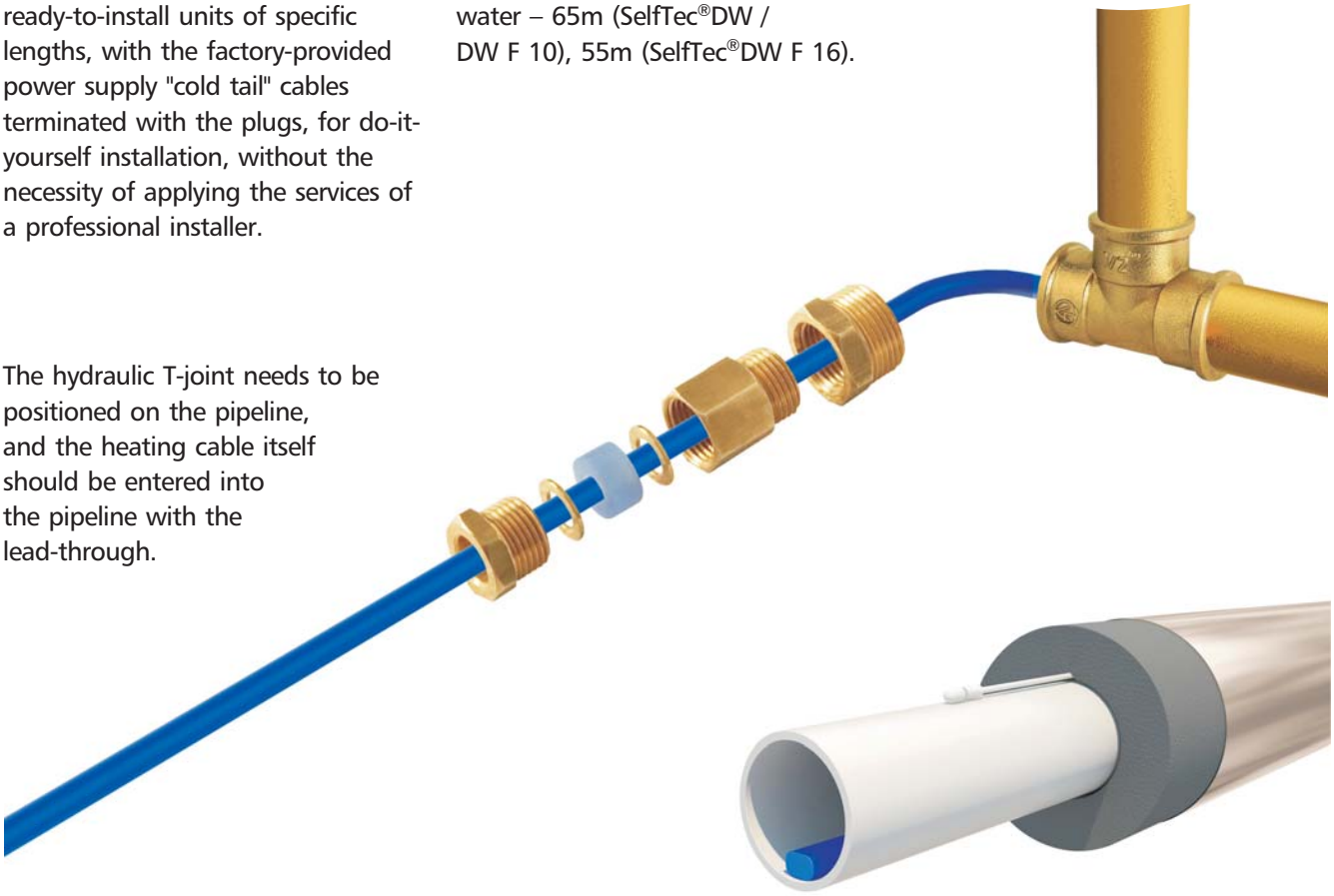


Power supply protected by an RCD ensures proper anti-shock protection.

SelfTec®DW / DW F heating cables are powered at 10 or 16W/m at the temperature of +10°C (see chapter 7.2.2).

The cable power has been adjusted to account for water heat capacity. Maximum heating circuit length in water – 65m (SelfTec®DW / DW F 10), 55m (SelfTec®DW F 16).

The hydraulic T-joint needs to be positioned on the pipeline, and the heating cable itself should be entered into the pipeline with the lead-through.



7.6 Control

When heating a pipeline with the constant resistance cables (ELEKTRA VC and VCD), there should be a controller equipped with an external temperature sensor. The recommended controllers should be designed for DIN rail mounting, e.g. ETI-1544, ETN4-1999 or ETV-1991.

Self-regulating heating cables require a temperature controller to reduce the operating costs. When heating a pipeline with constant wattage heating cables (ELEKTRA VC and VCD), there should be a controller equipped with an external temperature sensor. The recommended controllers should be designed for DIN rail mounting, e.g. ETI-1544, ETN4-1999 or ETV-1991. In temperatures above 0°C, self-regulating cables still consume electrical energy (see the chart of the self-regulating cables' power as the temperature function, chapter 7.2.2).

In systems with plastic pipes, using temperature controllers is obligatory.

The ELEKTRA SelfTec® self-regulating cables do not require a cooperating temperature controller, but it necessary to switch the system off manually when the ambient temperature exceeds 0°C.

ELEKTRA FreezeTec® heating cables do not require an additional controller, as they have a built-in thermostat.

ELEKTRA ETV

DIN-rail mounting

Equipped with an external temperature sensor. Quite small dimensions (2 modules). LED indicates if the system is turned on.

ETV-1991 temperature controller and temperature sensor

ELEKTRA ETI

DIN-rail mounting

Equipped with an external temperature sensor. Adjustable hysteresis allows to set-up the accuracy of the temperature measurement. LED indicates if the system is turned on. Quite small dimensions (2 modules).

ETI-1544 temperature controller and temperature sensor

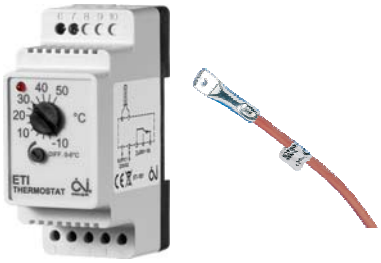
ELEKTRA ETN4

DIN-rail mounting

Temperature controller supporting two temperature sensors, including a limiting one. Large backlit display presents the operating parameters of the controller. Adjustable hysteresis allows to define precision of the temperature measurements. Equipped with the on/off switch.

ETN4-1999 temperature controller and temperature sensor

In particular cases like e.g. greasy pipes or when the inside pipe temperature exceeds +70°C for instance while washing or rinsing, the ETI-1552 with a special heat resistant temperature sensor (operational temperature range between -40°C and +120°C) should be used.



ETI-1522 temperature controller and special temperature sensor

ELEKTRA TDR 4022-PRO

DIN-rail mounting

Temperature controller equipped with the temperature sensor. The controller gives the possibility to set two temperature levels and to adjust the hysteresis which enables the estimation of the temperature measurement's precision. The controller cooperates directly with BMS systems via ModBus or Televis protocols using RS-485, or as an analog system, via a relay operating in the alarm mode. The display shows simultaneously the current temperature of the sensor, set temperature, status of the relays and possible alarm switch-on.

ELEKTRA 4022-PRO temperature controller (equipped with temperature sensor)

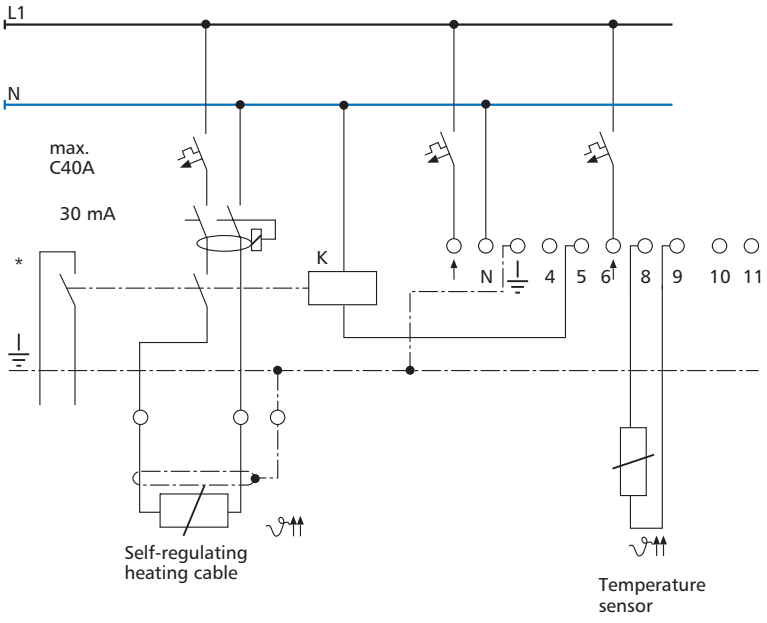
UTR 60-PRO temperature controller (equipped with temperature sensor)

UTR 60-PRO

Surface mounting

Temperature controller designed for pipe heating systems utilising the SelfTec®PRO 10, 20 and 33 self-regulating heating cables. Equipped with a temperature sensor for on-pipe mounting, with the operational ambient temperature between -40°C and +120°C. Adjustable hysteresis allows to set-up the accuracy of the temperature measurement. LED diodes indicate system's operation.

Connection diagram of the ELEKTRA UTR-PRO temperature controller with an auxiliary contactor



* Auxiliary contacts for connecting BMS

Alternatively, auxillary contacts can be mounted on residual current devices to send heating circuit breakdown signals to BMS.

						Heating Cables												
						Constant wattage			Self-regulating									
						Basic applications								Advanced applications				
Application	Systems	Cable output (Q)	Pipe material	Cable positioning	Pipe diameter [mm]	VC10	VCD10	FreezeTec®	SelfTec® DW 10 / DW F 10	SelfTec® DW ready2heat	SelfTec® DW F 16	SelfTec® 16	SelfTec® 16 ready2heat	SelfTec® PRO 10	SelfTec® PRO 20	SelfTec® PRO 33	SelfTec® PRO TC 30	Coefficient of arrangement*
Protection of pipelines against freezing	Hydrant, sprinkling, cold water, rain drain, sanitary sewage	According to the formula result, or the table reading	Steel	Outside the pipe	<50	-	+	+	+	+	+	+	+	+	+	+	-	1
					50-150	-	+	-	+	+	+	+	+	+	+	+	-	1
					>150	+	+	-	-	-	-	-	-	+	+	+	-	2
				Inside the pipe	<50	-	-	-	+	+	-	-	-	-	-	-	-	-
					50-150	-	-	-	-	-	+	-	-	-	-	-	-	1
			Plastic	Outside the pipe	<50	-	+	+	+	+	+	+	+	+	-	-	-	1
					50-150	-	+	-	-	-	+	+	+	+	+	-	-	1
					>150	+	+	-	-	-	-	-	-	+	+	-	-	2
				Inside the pipe	<50	-	-	-	+	+	-	-	-	-	-	-	-	-
					50-150	-	-	-	-	-	+	-	-	-	-	-	-	1
	Central heating		Steel / Plastic	Outside the pipe	<50	-	-	-	-	-	-	-	-	-	-	-	+	1
					50-150	-	-	-	-	-	-	-	-	-	-	-	+	1
					>150	-	-	-	-	-	-	-	-	-	-	-	+	2
Temperature maintenance	Process heat		Steel	Outside the pipe	<50	-	-	-	-	-	-	-	-	+**	+**	+**	+	1
					50-150	-	-	-	-	-	-	-	-	+**	+**	+**	+	1
					>150	-	-	-	-	-	-	-	-	+**	+**	+**	+	2
	Fat sewage system				<50	-	-	-	-	-	-	-	-	-	-	+	+	1
					50-150	-	-	-	-	-	-	-	-	-	-	+	+	1
					>150	-	-	-	-	-	-	-	-	-	-	+	+	2
	Other				<50	-	-	-	-	-	-	-	-	+	+	+	-	1
					50-150	-	-	-	-	-	-	-	-	-	+	+	-	1
					>150	-	-	-	-	-	-	-	-	-	-	+	-	2
						ETI-1544, ETN4-1999, ETV-1991								ETI-1522, UTR 60-PRO, TDR 4022-PRO				
						Control												

*) minimal number of arrangements of a cable's straight segment, securing the even heat distribution inside a pipeline, independent of the heat demand

**) max. working temperature 65°C.

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8. Special Frost Protection Systems

8.1 Ground and Foundation Protection for Cold Stores

Long periods of low temperatures in cold stores can cause frost to penetrate building foundations. This causes floor deformations and damages foundations. Fortunately, this can be prevented with floor heating systems.

Depending on the temperature inside a cold store and the thickness and the type of thermal insulation, the heating system power can range from 15-30W/m^2.

The power rating of the heating cables cannot exceed 10W/m and the distance between cables cannot exceed 500mm.

For ground and foundation frost protection, the following cables may be used:

- Single-side supplied ELEKTRA VCD10 heating cable
- Double-side supplied ELEKTRA VC10 heating cable

Heating cables with a unit power under 10W/m can be manufactured as a special order.

8.1.1 Floor Construction

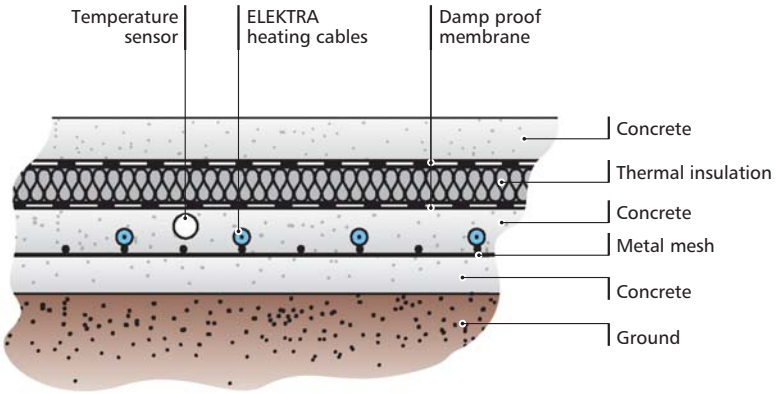
Heating cables should be installed under the thermal insulation of the floor to stop freeze penetration.

The cables should be installed:

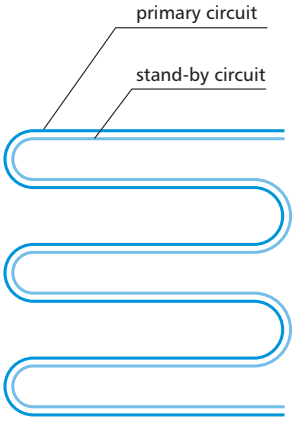
- Directly in the concrete
- In a layer of sand above the concrete

If installing directly in the concrete, it is important that the expansion joints cannot be crossed by heating cables.

The number of cables should be equal to the number of areas created by expansion joints.

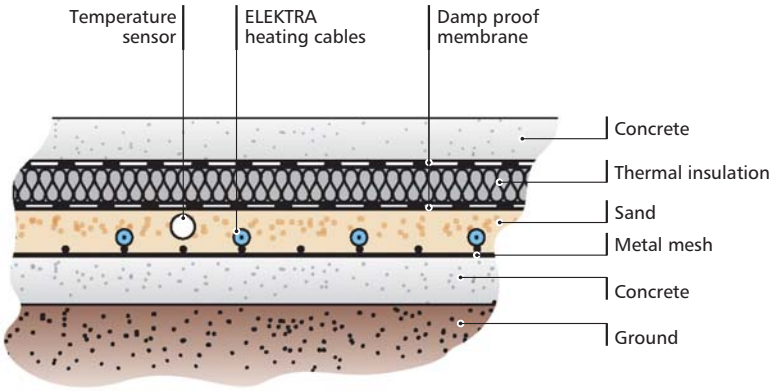


Heating cables installed in concrete



Scheme for laying stand-by circuits

For emergency reasons, it is recommended that two parallel systems are installed (primary and stand-by) because it will not be possible to access the heating system, once the cold store is operating.



Heating cables installed above concrete in sand layer

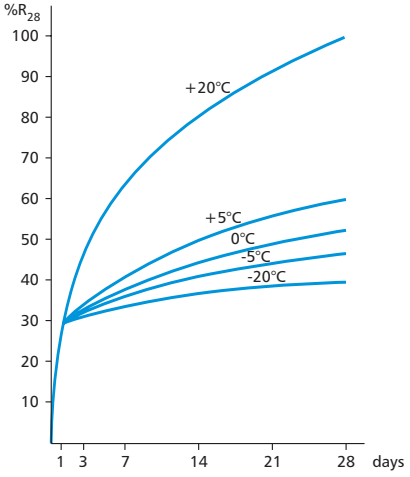
8.1.2 Installation

Installing a heating system under cold stores should be done in the same manner as regular floor heating (see 2.2.3).

8.2 Pouring Concrete

Short, tight construction deadlines force contractors to execute construction works regardless of current weather conditions. When executing concrete works or pouring concrete in temperatures below 0°C, it becomes vital to protect freshly poured concrete mixtures against freezing to ensure optimal conditions for the chemical reactions between cement and water, which constitute a crucial factor influencing resulting mechanical strength of concrete.

Temperatures of concrete surfaces should not drop below 0°C until the mechanical strength of concrete has reached a min. value of 5 MPa, which provides concrete resistance against freezing. After the required mechanical strength has been reached, the concrete – even frozen – will not reduce its ultimate mechanical strength. The optimal value of ultimate mechanical strength, however, will be reached later, as in the freezing period, the increase in mechanical strength is hindered.
ELEKTRA BET heating cables are installed when not only protection against freezing becomes crucial, but also when a contractor is required the mechanical strength of the concrete to be achieved in the optimum time.



Increment of mechanical strength of concrete curing in various temperatures

8.2.1 Design Stage

Freezing of concrete elements in temperatures below 0°C begins on their surfaces. When warming up concrete mixtures curing in temperatures below 0°C, it is required to assess the necessary value of heating power per m² of the concrete area. The required heating power depends on:

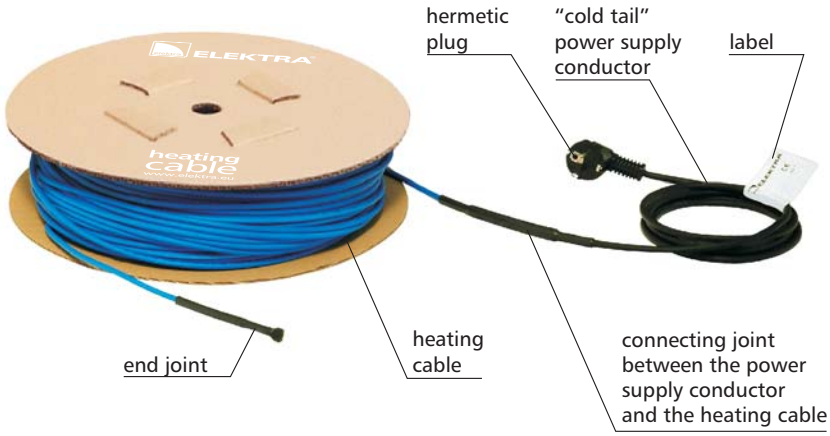
- application of covers, such as tarpaulin, foil or non-woven fabrics to shelter formwork or directly concrete mixtures, protecting concrete surface against wind,
- application of thermal protection with insulation material preventing heat loss from concrete surface,
- the material formwork is made of (plywood, steel).

The place especially vulnerable to freezing in case of concrete mixture is the contact surface touching the previously poured concrete element. In such places, decrease the cable spacing recommended in the table by half.

Suggested heating power of the heating cables per m² of the heated surface of a concrete element

Type of formwork	Method of protection of the concrete mixture surface against heat loss	Specific heating power	Spacing between cables
		[W/m²]	[cm]
plywood	insulating material 50mm thick, covered with tarpaulin or non-woven fabric	75	**50**
steel	insulating material 50mm thick, covered with tarpaulin or non-woven fabric	100	**40**
plywood	no protection*	150	**25**
steel	no protection*	200	**20**

*) For forecasts of wind velocity exceeding 6 m/s by temperatures below -10°C, it is required to apply covers such as tarpaulin, foil or non-woven fabrics, until concretes have reached their optimal mechanical strength protecting against freezing (3-4 days).



ELEKTRA BET heating cable

Negative influence of frozen concrete elements where concrete mixtures will be poured can be limited by:

- application of warm concrete mixtures of min. temperature +15°C,
- spot unfreezing of the frozen concrete element with hot air.

Heating cables in concrete elements should be placed symmetrically (if possible). It influences positively the even temperature distribution, and therefore does not cause appearance of stresses.

Pouring concrete mixtures in temperatures below 0°C is only possible for warm concrete mixtures.

Durability against freezing of concrete mixtures depends on:

- the class of cement (CEM) used for manufacturing concrete mixtures,
- when pouring concrete mixtures in poorly insulated formwork, it is recommended to apply Portland cement CEM 1 characterised by high hydration heat and providing optimal temperature to the fresh concrete,
- water/cement (w/c) ratio which should not exceed 0.5,
- application of anti-freezing additives (additives lowering freezing point of batched water).

Calculating the area of a concrete element

The area of a pole, beam or pillar to be heated should be calculated as their perimeter multiplied by their height (length).

In concrete walls, heating cables should be laid on both sides of the wall.

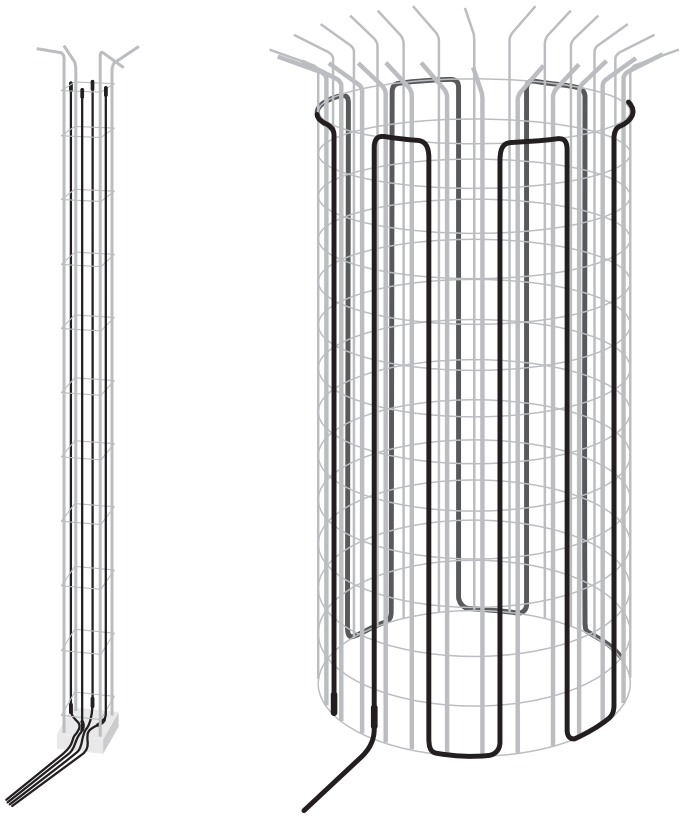
In ceilings with bottom reinforcement only, heating cables should be laid on bottom reinforcement, and the upper surface of the ceiling must be protected, at least with a cover. Reinforcement of ceiling, located on poles or concrete walls executed earlier – therefore significantly cooled down, are especially vulnerable to freezing. In such places it is recommended to lay heating cables with decreased spacing.

In ceilings thicker than 25 cm, also the upper part of the ceiling must be heated – if possible (upper ceiling reinforcement present), otherwise, it is necessary (except for the cover) to provide thermal insulation laid on the surface of the ceiling.

8.2.2 Installation

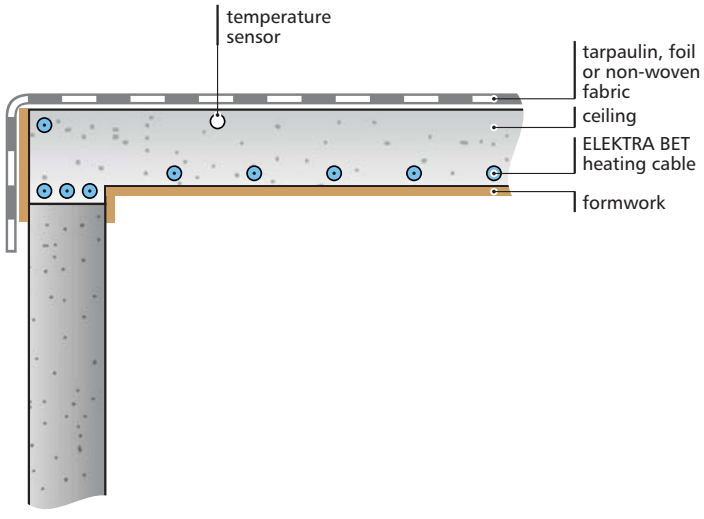
Attach ELEKTRA BET heating cables to stirrups, distribution bars or construction reinforcement. Maintain previously determined spacing between cables. The cables should be fixed so that the distance from the formwork surface is not lower than 25 mm.

Heating cables can cross with construction reinforcement, but must not be laid along reinforcement bars in the distance less than the required thickness of the lagging of reinforcement bars.



Installing heating cables in a concrete pillar

On a pole or beam the number of cables must not be lower than 4. The cables must be laid to maintain axial symmetry.



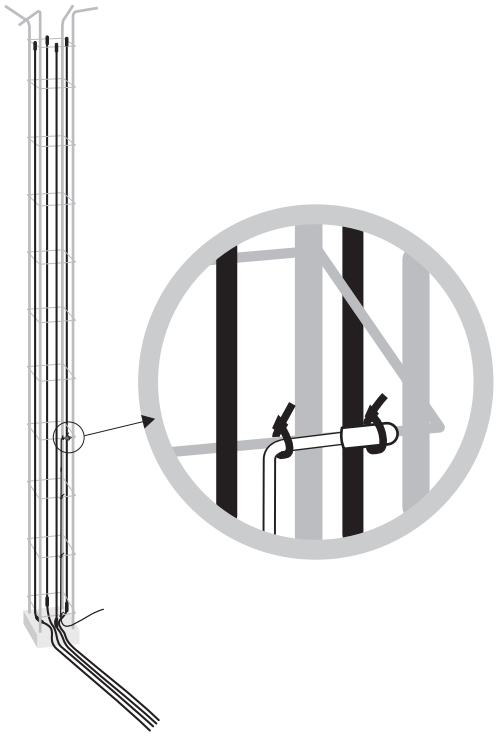
Laying heating cables in a ceiling based on an earlier executed concrete wall

8.2.3 Positioning of a Temperature Sensor

The temperature sensor's wire should be attached to reinforcement with cable ties.

The temperature sensor should be positioned as close as possible to the surface of the concrete element, between heating cables.

In ceilings where the heating cables are positioned on bottom reinforcement, the temperature sensor should be positioned directly under the ceiling's surface.



Installation of a temperature sensor

8.2.4 Operation

Warming concrete commences with setting the required temperature on the controller. Warming concrete mixtures should be already performed during the pouring process. Do not allow heated up concrete mixtures to cool down.

After concrete mixtures have cured, switch off the power supply and cut off the power supply conductors. The heating cables remain in concrete. The controllers can be reused.

Demounting of formwork should only be executed after the heating is completed and concrete elements gradually cooled down. Sudden cool down of an element might result in the increase of stresses in concrete.

8.3 Portable heating mats

8.3.1 ELEKTRA MMV

Problems occurring due to prolonged frost and snow can influence safety, building operations and house systems installation works, or early farming activities, therefore a solution is required providing immediate reaction.

ELEKTRA MMV heating mats have been developed as an answer to hindrances caused by harsh winter conditions.

ELEKTRA MMV heating mats are multifunctional, flexible, waterproof and frostproof. Their design principle is comfortable, efficient and multiple application, thus enabling continuation of works and avoidance of costly delays. Mats provide heat to objects located directly underneath, and this direct action means faster and more secure warm-up in comparison to conventional methods, such as burners or heaters positioned in tarpaulin tunnels or tents.

Heating with ELEKTRA MMV heating mats does not require any additional actions dedicated to either designing or selecting the heating system's type, nor additional accessories. The mats are equipped with a thermal protection, as well as an IP44-rated plug, enabling mains connection through a power generator or building switchboard.

Yellow tint of the upper cover makes the mats visible from a distance, which is especially important when defreezing soil, stairs or passageways.

ELEKTRA MMV heating mats are dedicated to the following applications:

- ground works – to facilitate drilling works for filter systems for drinking water, as well as excavation works for plumbing systems, electrical and telecommunication systems,
- to remove icing from external surfaces such as: passageways, stairs, roof throughs or roof surfaces, technological process lines on external units of fan coils, chillers or heat pumps,
- installation works – to restore flexibility of cables on drums, facilitate unwinding, enable installation works on power cables or telecom cables, gardening and farming works – to support plant growth in soil, defreeze haylage in bales,
- protection against freezing – of water tanks, to protect storage tanks dedicated for animal feed/sand/road salt.

ELEKTA MMV heating mat

8.3.2 ELEKTRA MMR

Portable heating mats

ELEKTRA MMR heating mats will find application as a kind of heated anti-slip elastomer doormats facilitating snow melt, to be positioned out of the external door leading to residential or office buildings.

Grooved surface of heating mats contribute to increased safety, effective snow melt and water evaporation, owing to this the entrance surface is dry and provides good adhesion, and the snow does not block the entry door.

ELEKTRA MMR heating mats are manufactured of vulcanized rubber, thus featuring high mechanical resistance properties, as well as high resistance against attrition. They can be easily used as anti-slip heating mats dedicated to unheated workstations or operator workstations. This easy-to-implement solution will increase the overall workplace comfort and safety level. The mats are equipped with a 3m-long power supply conductor with an IP44-rated plug.

ELEKTRA MMR heating mat

8.4 Industrial Tanks

Heating cables are capable of maintaining required temperatures to prevent tanks of water, oils, chemicals, and other liquids from freezing and maintaining the required temperatures / consistency.

The cables can also be used to heat silos with grains, sugars, and other such items.

ELEKTRA VC/VCD heating cables cannot be installed on tanks where the cables can be exposed to greases, oils, or other chemicals and where there is a risk of the temperature reaching more then 90°C .

To choose an appropriate heating cable, it is important to determine the possible heat losses of the tank. Such losses are dependant on the tank size, type, thermal insulation, the required temperature, and the minimum outside temperature. The following formula can be used to calculate heat losses:

$$\phi = 1.25 \times A \times \Delta\theta / R$$

where:

- ϕ – heat loss [W]
- A – total surface area of the tank [m^2]
- $\Delta\theta$ – temperature difference (liquid temperature versus outer temperature) [°C]
- R = d / λ [m^2K / W]
- R – heat resistance of thermal insulation
- λ – heat penetration of the thermal insulation factor [W/mK]
- d – thickness of the thermal insulation [m]
- 1.25 – safety margin

For tanks with foundations, heat losses from the underside of the tank should be taken into consideration. The exact heat loss per tank varies due to the variety of shapes (cylindrical, rectangular, and conical), the type of foundation (with legs or solid), and any additional equipment required (access opening, ladders, level indicators).

For advanced projects, when the application of the dedicated industrial ELEKTRA SelfTec®PROi heating systems are advisable, please consult the Technical Department: industry@elektra.eu

Heating cables assembled on tanks

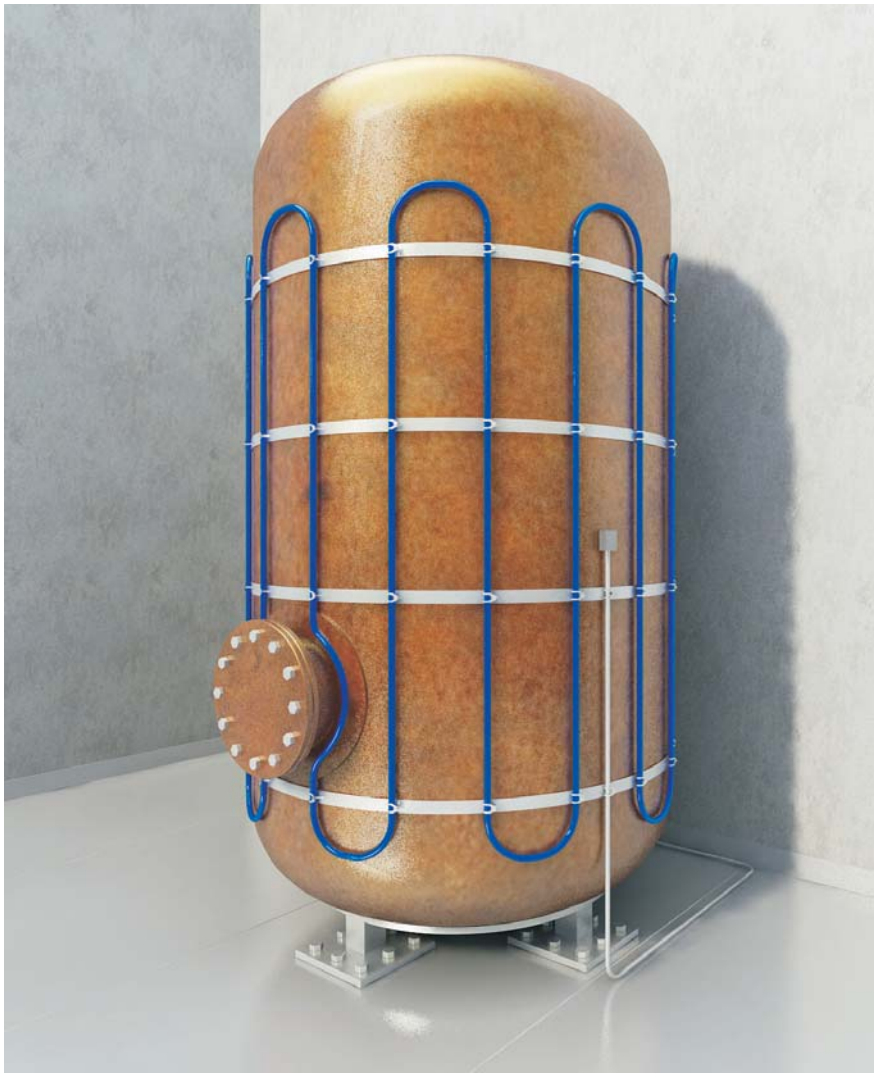
8.4.1 Installation

Cables should be fixed to the tank with ELEKTRA TME installation tapes. The heating cables should be entirely covered with aluminum tape – it improves performance and helps to transfer the heat directly to the tank.

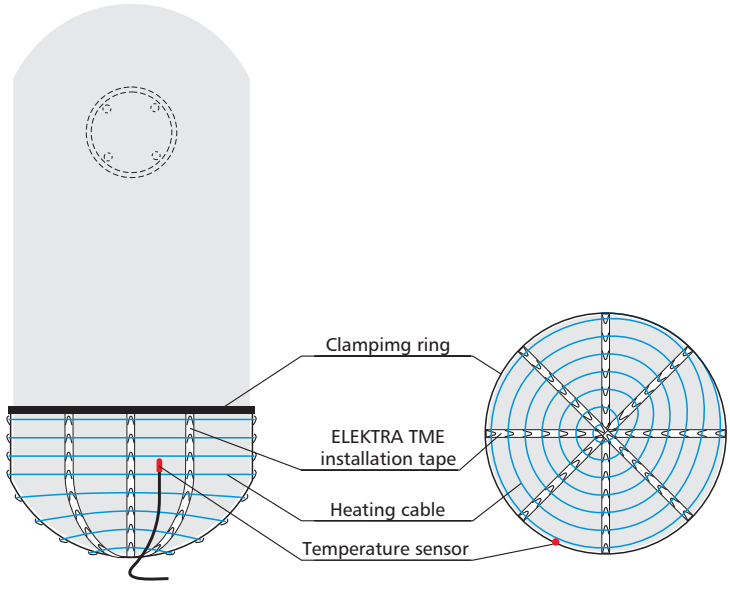
In addition, the aluminum tape acts as a barrier between the heating cable and thermal insulation. It also prevents the cable from overheating.

It is important to remember that heating cables must not cross, touch, or be exposed to sharp edges.

The minimum bend radius of the cable is 3.5 x outer diameter of the cable.



Example installation of ELEKTRA heating cables on a tank



Fastening of ELEKTRA heating cables and temperature sensor on a tank

8.5 Aerial Masts

Snow and ice deposits on satellite dishes, aerial masts, and antenna supports create an additional mechanical load, and in many cases, may damage the equipment. Installing heating cables effectively protects these structures from any such negative effects.

A single-side supplied ELEKTRA VCDR with a unit power of 20W/m are the most common cables for this sort of installation. The total installed capacity ranges from 200-300W/m^2.

Cables are laid on the external (convex) surface of satellite dishes . For aerial masts, the layout is dependant of the diameter of the structure. The heating cables can either spiral around the mast or be laid out in a vertical manner.

Satellite dish protection against snow and ice

The cables are then attached with the use of self-adhesive AL foil, which helps to transfer heat from the cable directly to the structure.

8.6 Control

Heating in cold stores, on tanks and aerial masts, as well as heating up concrete mixtures, should be controlled by a DIN rail mounted temperature controller equipped with a temperature sensor.
The sensor wire can be extended with a 2 x 1.5 mm² diameter installation cable.

In cold stores, due to specific operation conditions of the heating system, controllers with adjustable hysteresis are recommended – ELEKTRA ETN4-1999 or ELEKTRA ETI-1544. In individual cases, e.g. for small cold stores in shops, ETV-1991 controller can be utilised.
Each heating circuit (primary and backup) should be equipped with a separate temperature controller.
Temperature sensors should be installed in protective conduits facilitating their replacement in case of a failure.

For the control of BET heating cables warming concrete mixtures, ETI-1544 controller should be utilised. The controller will perform the temperature measurement of concrete mixtures with a temperature sensor and only switch the heating system on when the temperature of already poured concrete drops e.g. below 10°C, and switch it off when the temperature exceeds the given level.

The required number of heating cables can be switched by the controller by using a contactor, ensuring that you do not exceed the maximum demand of the power supply for the concrete heating system.

ELEKTRA ETV
DIN-rail mounting
Equipped with an external temperature sensor. Quite small dimensions (2 modules). LED indicates if the system is turned on.

ETV-1991 temperature controller and temperature sensor

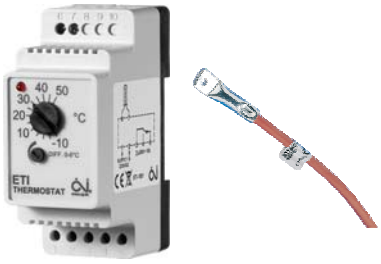
ELEKTRA ETN4
DIN-rail mounting
Temperature controller supporting two temperature sensors, including a limiting one. Large backlit display presents the operating parameters of the controller. Adjustable hysteresis allows to define precision of the temperature measurements. Equipped with the on/off switch.

ETN4-1999 temperature controller and temperature sensor

ELEKTRA ETI
DIN-rail mounting
Equipped with an external temperature sensor. Adjustable hysteresis allows to set-up the accuracy of the temperature measurement. LED indicates if the system is turned on. Quite small dimensions (2 modules).

ETI-1544 temperature controller and temperature sensor

Model ETI-1522 is especially recommended for installation of a temperature sensor on elements covered with grease, or when temporary temperature, e.g. during washing or rinsing, exceeds +50°C (e.g. tanks). The controller is equipped with a dedicated sensor suitable for operation in temperatures from -40°C up to +120°C.



ETI-1522 temperature controller and special temperature sensor

8.7 Product Selection Guide

Application	Heating Power [W/m²]	Heating Cables						Control
		VC10	VC15	VC20	VCD10	VCDR20	BET	
Cold stores	15-30	+	–	–	+	–	–	ETN4-1999 ETV-1991 ETI-1544 ETI-1522
Industrial tanks	As per calculation	+	+	–	+	–	–	
Aerial masts	200-300	–	–	–	–	+	–	
Concrete curing	75-200	–	–	–	–	–	+	ETI-1544

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9. Agricultural Heating Systems

9.1 Pigsties and Cowsheds

Pig pens should be warm, ventilated, properly lighted, and appropriate for each stage of life. Microclimatic conditions are vital in relation to the health, comfort, and productivity of the animals.

Such conditions are as follows:

- Humidity
- Temperature
- Lighting
- Air pollution

Of these conditions, the most important are humidity and temperature.

Depending on the quality of the building, these conditions are subject to vary, and therefore have substantial influence on the animals.

Pigs that are subjected to colder temperatures are at risk to breathing problems, increased food rations, and lower birth weights. During the time where pigs gain most of their weight (35-70kg), this body mass increase is diminished by 15-20g per day at a 1°C decrease of required air temperature.

Temperature requirements for pigs:

- Piglets: 24-26°C
- Pigs: 17-24°C
- Fattening pigs: 14-22°C
- Boars: 12-20°C
- Sows (little or no piglets): 12-20°C
- Sows (many piglets): 15-25°C
- Feeding sows: 18-26°C

Due to these temperature requirements, floor heating should be used to adapt to the needs of each type of pig. The system should be installed under the entire pen or where the pigs reside the most.

The required power per m^2 depends on the body weight of the animal:

- Pigs below 20kg: 200W/m^2
- Pigs 20-50kg: 150W/m^2
- Pigs above 50kg: 100W/m^2

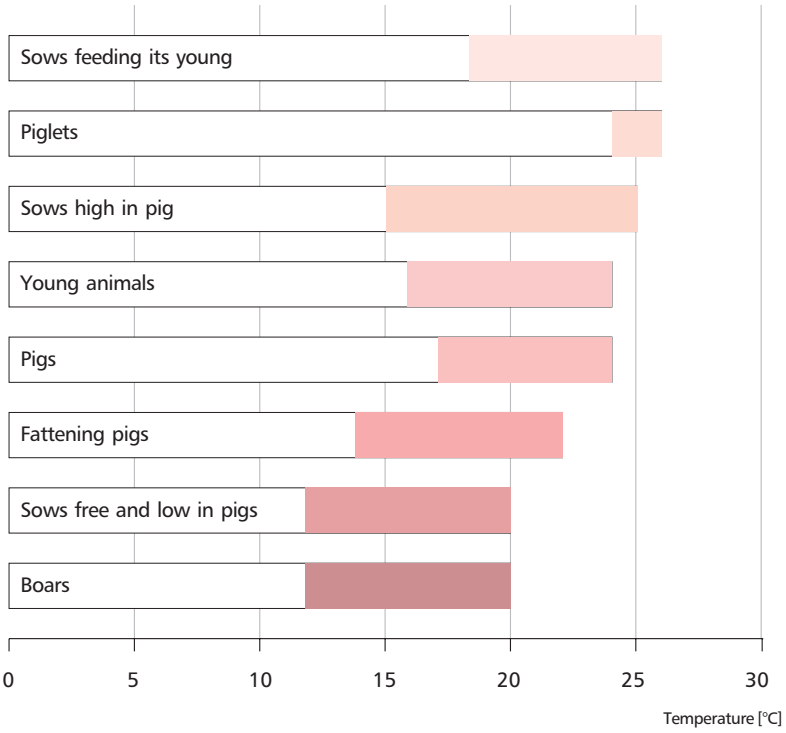
Floor heating may be installed only where the need for heat is required the most, to decrease the costs of heating. Piglets have a need for higher temperatures, as opposed to full-grown animals which can be the lower temperature of 18°C.

Floor heating ensures:

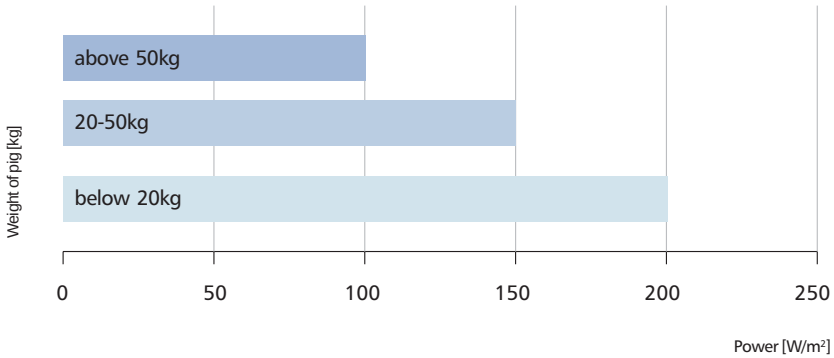
- Temperature control through means of a temperature controller with a floor temperature sensor
- Regular temperature distribution
- Individual control of each pen
- High flexibility with heating cables location
- Dry floors (bedding is advised for excrement removal)

Heating pigsties requires a two cold tail heating cable with a power of 20W/m. Cables should be installed using an assembly net and submerged in 50mm of concrete.

Thermal standards for individual production groups



Heating power at 1 m² of surface according to weight of individual

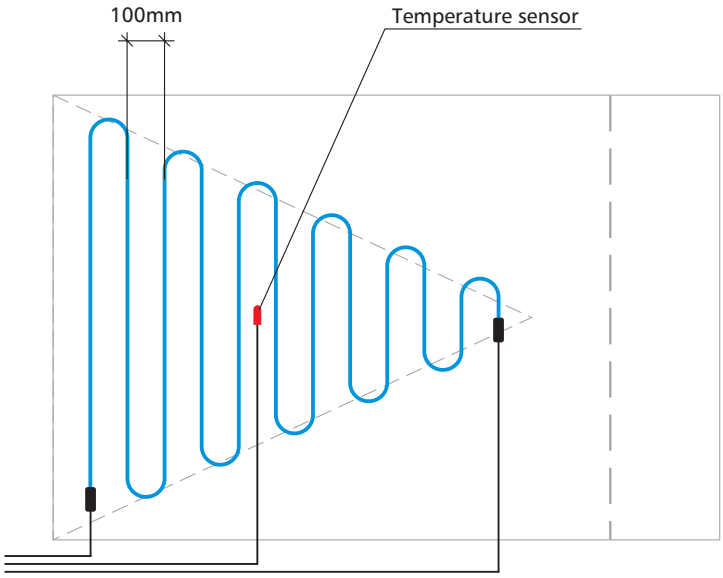


9.1.1 Selecting Heating Cables
Example: A 1.6 m² pig penn for pregnant pigs

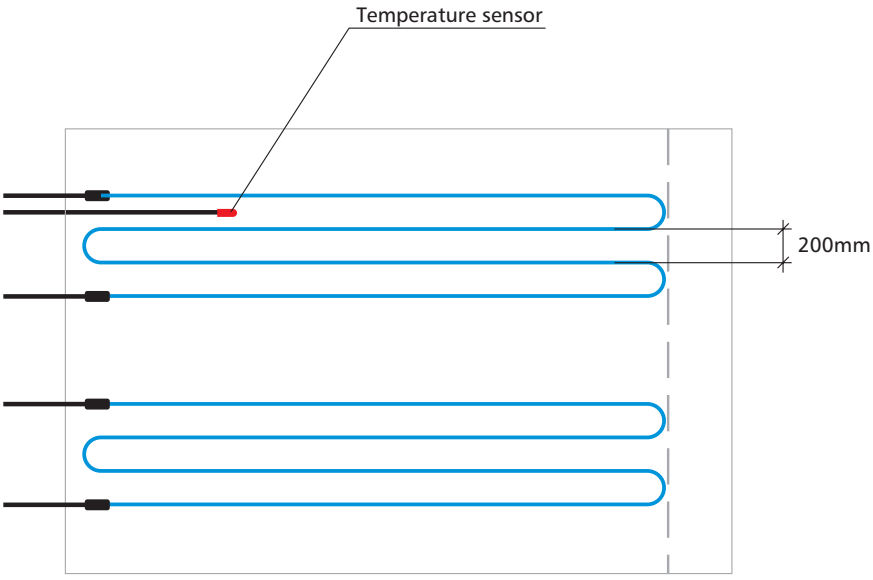
A power rating of 200W/m² is required. The area requiring heat (bedding) is 1.7m².
The power of the heating cable should be 330W.

For this installation, a two cold tail ELEKTRA VC heating cable with a power rating of 20W/m² should be selected. The ELEKTRA VC 20/330 has a length of 17m, and a distance of a-a = 1.7m²/ 17m = 0.1m = 100mm should be maintained.
A controller with a floor temperature sensor is recommended.

The drawing depicts the layout of the heating cables in the pig penn. The only area heated is the sleeping area.



Layout of heating cable in a pig penn



Layout of heating in a cowshed

Cowsheds
Heating cables installed across cowsheds with a width of 600-800mm, in accordance to the direction in which the animals sleep in. The unit power of the surface should be 50-80W/m².

9.1.2 Control
ELEKTRA ETN4-1999, ELEKTRA ETI-1544 or ELEKTRA ETV-1991 DIN-rail controllers with external temperature sensors are recommended.

9.2 Plant Propagation

Due to easy installation and low running costs, heating cables are used to aid the growth of plants. Plants grown with warm soil are healthier and produce a better yield, it is possible to speed up the vegetation and production of yield. Greenhouses that are heated this way can be used till late autumn.

Basic application of heating cables in propagation:

1. To heat plant beds for seedlings:
   - for fruit growing
   - for flowers
2. For vegetable growing, to speed up growth

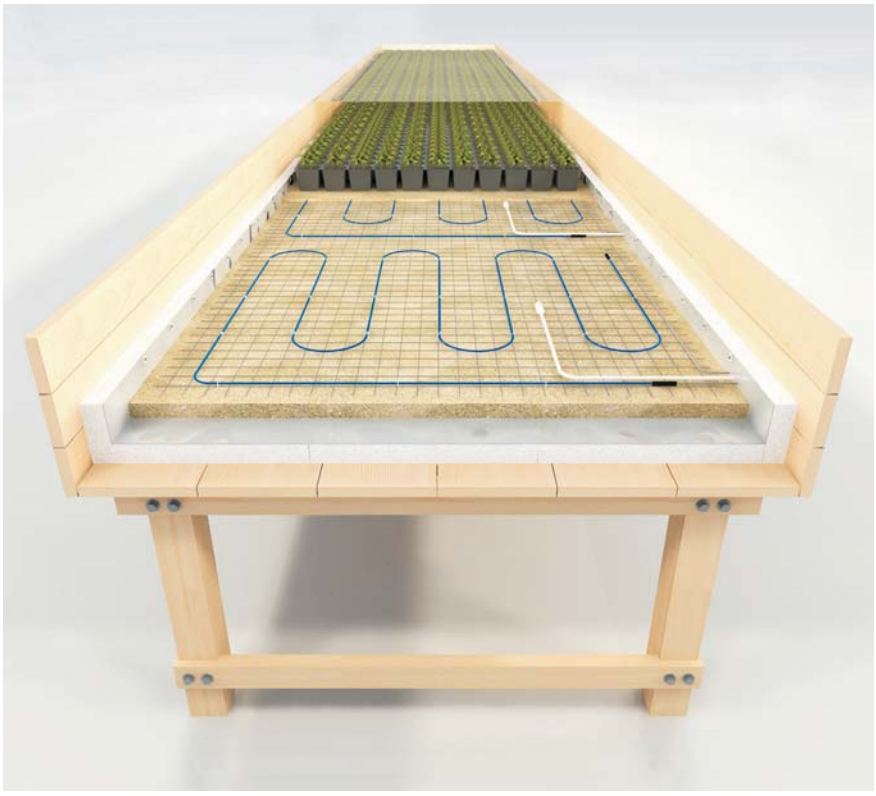
Installing Heating Cables

The power required is dependant on the type of plant and the construction of the plant bench. Cables with a power of 10W/m are the most common, and effectively should provide a power of 60-70W/m^2.

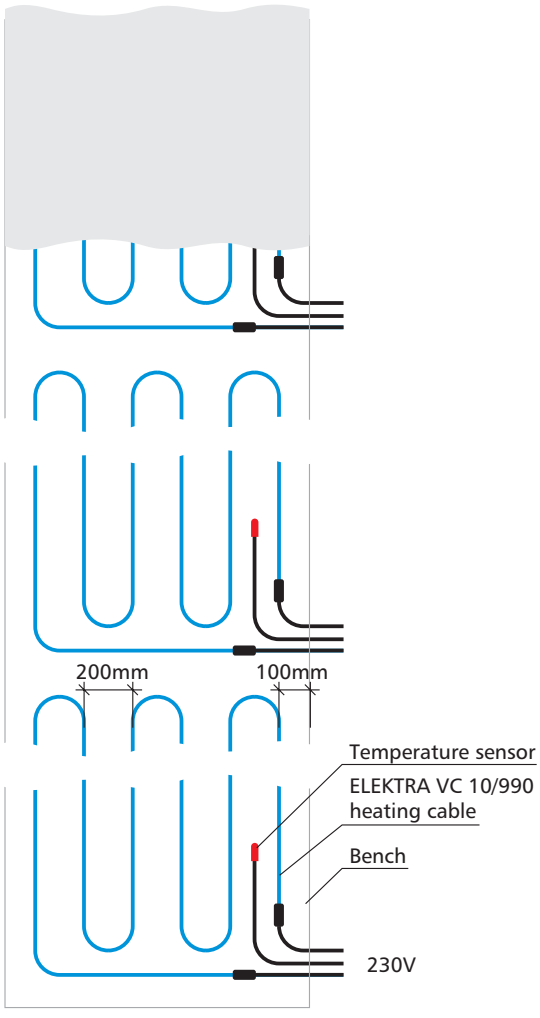
Example: 50m^2 Bench Area

Heating power:	60W/m^2
Installed heat power:	2970W
Amount:	3 cables
Type:	ELEKTRA VC 10/990
Single cable length:	100m
Distance between cables:	200mm
Supply:	230V
Temperature controller:	ETV 1991

Selecting an appropriate cable for propagation and keeping a set temperature makes a large impact on the health of the plants.



Cross section of gardening bench



Layout of ELEKTRA heating cables, on a propagation bench of 42m length and 1.2m width

9.3 Product Selection Guide

Application	Heating Power [W/m²]	Heating Cables		Control
		VC10	VC20	
Pigsties	100-200	–	+	ETV-1991
Cowshed	50-80	–	+	ETN4-1999
Propagation	60-70	+	–	ETI-1544

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10. Sports Fields

Installing ELEKTRA heating cables on sport fields allows them to be used all year round. Heating increases the hardiness of the grass roots and the ability to withstand intensive use.

Depending on the climatic conditions, the installed power range should range from 50-120W/m^2. A lower power is required when the field is covered by a sheet during frost, snow, or rainfall. The sheet is composed of high density polyethylene (HDPE), and is reinforced with a glass yarn net. By using the sheet, the heating required and snow deposit is de-creased, and it is easier to maintain a proper humidity for the grass.

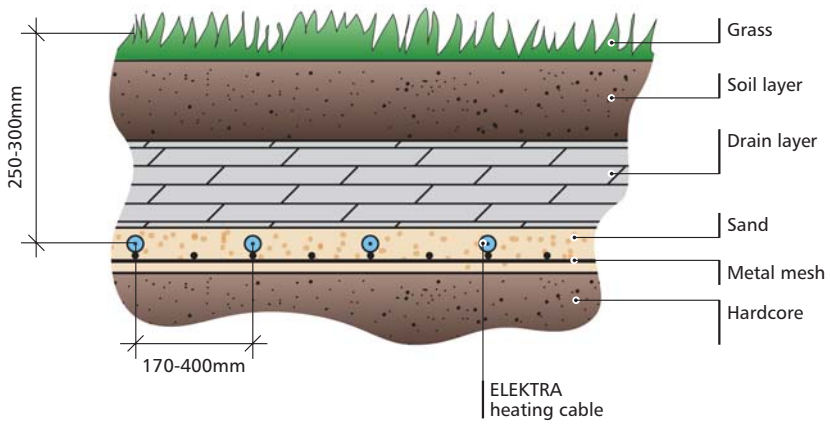
According to FIFA recommendations, football pitches should have the following dimensions:
Length: 100-120m
Width: 64-90m
A standard pitch is 105 x 72m = 7560m^2 and requires 380-910kW of power.

Heating systems do not require any additional electrical installations or separate transformer stations because of the possibility of utilizing the existing floodlight system.
The heating and lighting cables can be used interchangeably. Illumination is used during games, and due to large thermal inertia, switching off the heating for a few hours will not have a significant affect on the temperature of the turf.

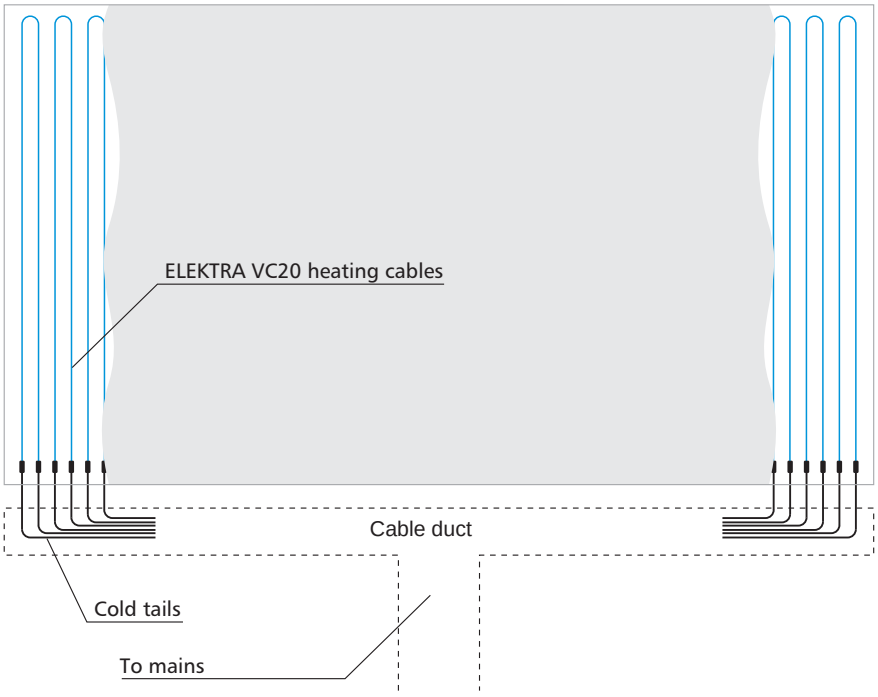
Installation

Heating fields consists of dividing the area into zones. Each zone should be independently controlled through the use of an individual controller (i.e. ELEKTRA ETN4-1999, ELEKTRA ETI-1544 or ELEKTRA ETV-1991) with the temperature sensor being located at the same level of the grass roots.
A double-side supplied heating cable ELEKTRA VC with a voltage rating of 230V and a power rating of 20W/m or an ELEKTRA VCD with a power rating of 25W/m would be appropriate cables for this sort of installation.

The cables should be installed in a layer of sand, 250-300mm under the level of grass, and fastened through means of an assembly net or ELEKTRA TME installation tape. The distance between the cables is dependant on the type and unit power of the cable, but should be approximately 250mm.



Cross section of sport field with heating installation

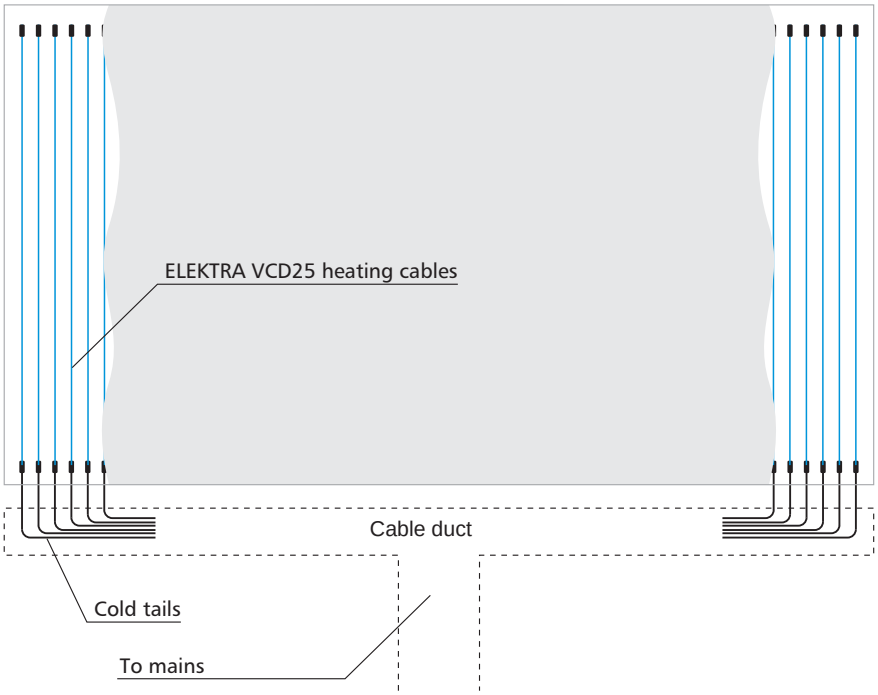


Example layout utilizing ELEKTRA VC20 heating cables with two cold tails

Installing the heating cables at a depth of 250-300mm prevents any mechanical damages during grass maintenance and/or possible removal, and it also guarantees a uniform distribution of heat at root level.

The set temperature should be approximately +10°C, as it is proven to be the most favourable with regards to growth and will not overheat the roots.

Heating cables are commonly laid along the shorter side of the field and the supply cables are led along one side in a cable duct with a connection to the power supply.



Example layout of ELEKTRA VCD25 heating cables with one cold tail

ELEKTRA®

electric
heating systems

product catalogue

SOLUTIONS FOR EVERYONE




1 2 3 4 5 6 7



1 2 3 4 5 6 7




1 2 3 4 5 6 7

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Headquarters

ELEKTRA 35 YEARS

ELEKTRA Leading Brand

ELEKTRA specializes in electric heating systems for both residential and commercial buildings, as well as for industrial facilities. Established in 1985, the company is currently the largest and most reputable producer of floor heating systems in Central Europe. From the beginning product quality has been the first priority for the company. This is the only way to satisfy all customers and achieve and maintain leadership in the market.

ELEKTRA Stock Availability

Throughout the EU and around the world, ELEKTRA products are readily available through a network of approved and authorized distributors, installers and even dedicated websites.

Distribution in dozens of countries across Europe, Asia, North America and Australia

1

Know-how & Experience

Many years of continuous operation combined with the latest technology ensures the expert ELEKTRA engineers constantly develop new and innovative solutions. ELEKTRA products remain at the forefront, providing the highest level of quality and customer satisfaction.

2

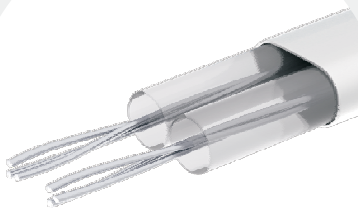
Raw Material Control

The rigorous selection, approval and use of an established and qualitative raw material supply chain including: Isabellenhütte, Sandvik, 3M & Borealis, ensures the quality and integrity of ELEKTRA products.

3

Multi-wire Construction

The heightened mechanical durability and flexibility of ELEKTRA heating cables is achieved through the use of multi-stranded wire construction of the cores.



4

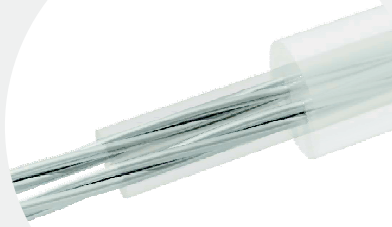
Dual Heating Cores

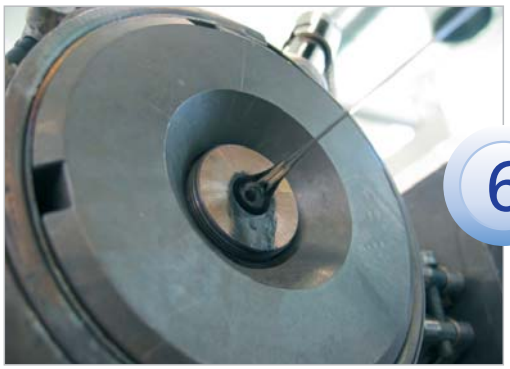
Both cores are heating, allowing equal power distribution of 50% to each core.
This significantly lowers the actual operating temperatures of the heating cores which prolongs the life span of the products.

Double-layer Insulation

5

The use of double-layer insulation in products especially designed for extremely demanding operating conditions ensures superior thermal and electric features, thus significantly enhancing durability of the products.





6

Precise Extrusion

Precise parameter settings are achieved with computer controlled extrusion processes, ensuring correct structure and necessary quality of the extruded insulation and outer sheath.

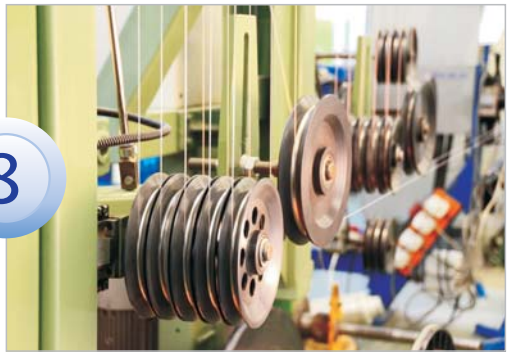
7

Laser Measurement

Laser measurement equipment in extrusion lines guarantees insulation and outer sheath thickness to within a tolerance of 0.05mm, and maintains uniform cable centricity.

Uniformity of Resistance

The necessary maintenance of uniform cable tension and therefore stability of resistance is achieved through the use of modern production machines at each stage of the production process. This uniformity and stability is confirmed with 6 individual measurements of heating wire resistance during production.

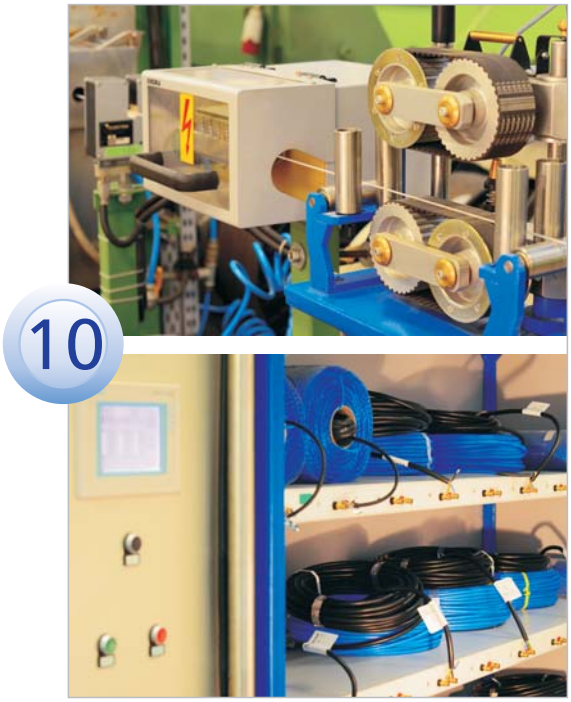


Faultless Joint

Only modern precision calibrated pneumatic devices guaranteeing adequate uniform force of joint clamping are used. The material and construction of joints to the level of IPX7 minimum, guarantees the protection of connections in products.

High Voltage Control

Production defects are wholly eliminated by rigorous high voltage control monitoring in the production line, and an additional final high voltage test of every single product, not random testing.



11

Unique Code

The marking of each product with a unique production code, means the history of the entire production process and materials used in manufacture can be traced.

CERTIFICATE

No. J - 151/11/2021

ELEKTRA
Włodzimierz Nyc, Witold Nyc Spółka Jawna
ul. Kazimierza Kamińskiego 4, 05-850 Ożarów Mazowiecki
and
Locations
listed in Annex to the certificate

is in conformance with
PN-EN ISO 9001:2015-10

in the following scope of activities:
production, design, consulting and distribution of heating systems as well as distribution of ventilation systems and electrical equipment

The audit carried out by the Polish Centre of Testing and Certification has offered evidence of the above.
This Certificate shall remain valid provided that above standard are respected by the Organization.
This certificate is valid:
From 04.09.2021 to 03.09.2024

Issued under the Contract No. 01/PLJS/2021
Date of certification decision: 01.09.2021
Certificate bears a qualified signature.
Warsaw, 08.09.2021

PCA IAF

Member of the Board

Polish Centre For Testing and Certification

ANNEX TO THE CERTIFICATE

VALID ONLY IN CONNECTION WITH THE CERTIFICATE

No. J - 151/11/2021

This is to certify that the following Locations:

- ELEKTRA Włodzimierz Nyc, Witold Nyc Spółka Jawna
  ul. Kazimierza Kamińskiego 4, 05-850 Ożarów Mazowiecki
  In the following scope of activities:
  production, design, consulting and distribution of heating systems as well as distribution of ventilation systems
- ELEKTRA Oddział Ursus - Hurtownia
  ul. Dzieci Warszawy 13, 02-495 Warszawa
  In the following scope of activities:
  sale of heating systems and ventilation systems, power cables and electrical equipment as well as production of heating mats
- ELEKTRA Magazyn - Panattoni Park Konotopa II
  ul. Rajdowa 9, 05-850 Konotopa
  In the following scope of activities:
  storage, completion and shipment of heating and ventilation systems

meet the requirements of the standard listed on the certificate.

Issued under the Contract No. 01/PLJS/2021
Date of certification decision: 01.09.2021
Certificate bears a qualified signature.
Warsaw, 08.09.2021

PCA IAF

Member of the Board

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Polish Centre For Testing and Certification

12

IQNet
THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

PCBC as an IQNet Partner hereby states that the organization:

ELEKTRA
Włodzimierz Nyc, Witold Nyc Spółka Jawna
ul. Kazimierza Kamińskiego 4, 05-850 Ożarów Mazowiecki
and Locations
listed in the Annex to the certificate

has implemented and maintains a
Quality Management System
for the following scope:
production, design, consulting and distribution of heating systems as well as distribution of ventilation systems and electrical equipment
which fulfils the requirements of the following standard:
PN-EN ISO 9001:2015-10

Issued on: 04.09.2021
Expires on: 03.09.2024

This attestation is directly linked to the IQNet Partner's original certificate and shall not be used as a stand-alone document

Registration Number: PL - J - 151/11/2021

Alex Stoichitchi
President of IQNet

Member of the Board

IQNet Partners*:
AENOR Spain, AFNOR Certification France, APCER Portugal, CCC Cyprus, CQC Italy, CQM China, CQS Czech Republic, Cro Cert Croatia, DQS Holding GmbH Germany, EAGLE Certification Group USA, FCAV Brazil, FONDONORMA Venezuela, ICONTEC Colombia, Inspecta Sertifiointi Oy Finland, INTECO Costa Rica, IRAM Argentina, JQA Japan, KFQ Korea, MIRTEC Greece, MSZT Hungary, Nemko AS Norway, NSAI Ireland, PCBC Poland, Quality Austria Austria, RR Russia, SII Israel, SIQ Slovenia, SIRIM QAS International Malaysia, SQS Switzerland, TEST St Petersburg Russia, TSE Turkey, YUQS Serbia

* The list of IQNet partners is valid at the time of issue of this certificate. Updated information is available under www.iqnet-certification.com

IQNet
THE INTERNATIONAL CERTIFICATION NETWORK

Annex to IQNet Certificate Number PL - J - 151/11/2021

This is to certify that the following Locations:

ELEKTRA Włodzimierz Nyc, Witold Nyc Spółka Jawna
ul. Kazimierza Kamińskiego 4, 05-850 Ożarów Mazowiecki
for the following scope:
production, design, consulting and distribution of heating systems as well as distribution of ventilation systems

ELEKTRA Oddział Ursus - Hurtownia
ul. Dzieci Warszawy 13, 02-495 Warszawa
for the following scope:
sale of heating systems and ventilation systems, power cables and electrical equipment as well as production of heating mats

ELEKTRA Magazyn - Panattoni Park Konotopa II
ul. Rajdowa 9, 05-850 Konotopa
for the following scope:
storage, completion and shipment of heating and ventilation systems

meet the requirements of the standard listed on the certificate.

This annex is valid in connection with the above-mentioned certificate.

Page 1 of 1

Alex Stoichitchi
President of IQNet

Member of the Board

IQNet Partners*:
AENOR Spain, AFNOR Certification France, APCER Portugal, CCC Cyprus, CQC Italy, CQM China, CQS Czech Republic, Cro Cert Croatia, DQS Holding GmbH Germany, EAGLE Certification Group USA, FCAV Brazil, FONDONORMA Venezuela, ICONTEC Colombia, Inspecta Sertifiointi Oy Finland, INTECO Costa Rica, IRAM Argentina, JQA Japan, KFQ Korea, MIRTEC Greece, MSZT Hungary, Nemko AS Norway, NSAI Ireland, PCBC Poland, Quality Austria Austria, RR Russia, SII Israel, SIQ Slovenia, SIRIM QAS International Malaysia, SQS Switzerland, TEST St Petersburg Russia, TSE Turkey, YUQS Serbia

* The list of IQNet partners is valid at the time of issue of this certificate. Updated information is available under www.iqnet-certification.com

Quality Confirmed

ELEKTRA quality confirmed by the research results and certificates of VDE and EAC, as well as certificates issued by, among others, Predom OBR, BBJ, Bureau Veritas and PZH.

ELEKTRA Heating Mats

Single-side power supply MD

ELEKTRA MD Heating Mats are ready-to-install heating elements which are produced in accordance with EN 60335-2-96. Consisting of a thin heating cable attached to a self-adhesive glass fibre mesh, the system is designed for indoor use and direct heating. It should be installed directly under the surface to be heated, in either flexible tile adhesive or self-levelling compound.

This package contains:

- **ELEKTRA heating mat,**
- **'cold tails' flexible conduit,**
- **flexible conduit for the temperature sensor, capped on one end,**
- **recessed distribution box Ø 60 mm for the temperature controller,**
- **instruction manual.**

> Technical data:

Power output:	100, 160 or 200 W/m² (200 W/m² applicable in the UK only)
Power supply:	230 V ~ 50/60 Hz
Mat thickness:	~ 3.9 mm
Min. installation temperature:	–5°C
Max. working temperature:	+105°C
Conduit cables:	1 x 4 m; 3 x 1.0 mm²
Type of heating cable:	double-core of diameter ~ 3.4 mm, single-side power supply
Screen of heating cables:	100% coverage, tinned copper braiding
Power output of heating cable:	~ 7 W/m (MD100), ~ 10 W/m (MD160), ~ 12 W/m (MD200)
Insulation:	double layer, FEP + XLPE
Outer sheath:	XLPE
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	5 D
Deformation strength:	> 600 N
Pulling strength:	> 120 N
Ingress protection:	IPX7
Product certificates:	VDE, EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

SHIELDED

TWIN CONDUCTOR

MULTI WIRE CONDUCTOR

TWIN INSULATION

FLUORO POLYMER INSULATION

PVC FREE

ALLERGY friendly

100 W/m^2

TYPE	DIMENSIONS	SURFACE	POWER
-	m x m	m^2	W
MD 100/1.0	0.5 x 2.0	1.00	100
MD 100/1.5	0.5 x 3.0	1.50	150
MD 100/2.0	0.5 x 4.0	2.00	200
MD 100/2.5	0.5 x 5.0	2.50	250
MD 100/3.0	0.5 x 6.0	3.00	300
MD 100/3.5	0.5 x 7.0	3.50	350
MD 100/4.0	0.5 x 8.0	4.00	400
MD 100/4.5	0.5 x 9.0	4.50	450
MD 100/5.0	0.5 x 10.0	5.00	500
MD 100/6.0	0.5 x 12.0	6.00	600
MD 100/8.0	0.5 x 16.0	8.00	800
MD 100/10.0	0.5 x 20.0	10.00	1000
MD 100/12.0	0.5 x 24.0	12.00	1200

160 W/m^2

TYPE	DIMENSIONS	SURFACE	POWER
-	m x m	m^2	W
MD 160/0.5	0.5 x 1.0	0.50	80
MD 160/1.0	0.5 x 2.0	1.00	160
MD 160/1.5	0.5 x 3.0	1.50	240
MD 160/2.0	0.5 x 4.0	2.00	320
MD 160/2.5	0.5 x 5.0	2.50	400
MD 160/3.0	0.5 x 6.0	3.00	480
MD 160/3.5	0.5 x 7.0	3.50	560
MD 160/4.0	0.5 x 8.0	4.00	640
MD 160/5.0	0.5 x 10.0	5.00	800
MD 160/6.0	0.5 x 12.0	6.00	960
MD 160/7.0	0.5 x 14.0	7.00	1120
MD 160/8.0	0.5 x 16.0	8.00	1280
MD 160/9.0	0.5 x 18.0	9.00	1440
MD 160/10.0	0.5 x 20.0	10.00	1600

200 W/m^2 (applicable in the UK only)

TYPE	DIMENSIONS	SURFACE	POWER
-	m x m	m^2	W
MD 200/1.0	0.5 x 2.0	1.00	200
MD 200/1.5	0.5 x 3.0	1.50	300
MD 200/2.0	0.5 x 4.0	2.00	400
MD 200/2.5	0.5 x 5.0	2.50	500
MD 200/3.0	0.5 x 6.0	3.00	600
MD 200/3.5	0.5 x 7.0	3.50	700
MD 200/4.0	0.5 x 8.0	4.00	800
MD 200/4.5	0.5 x 9.0	4.50	900
MD 200/5.0	0.5 x 10.0	5.00	1000
MD 200/6.0	0.5 x 12.0	6.00	1200
MD 200/7.0	0.5 x 14.0	7.00	1400
MD 200/8.0	0.5 x 16.0	8.00	1600
MD 200/10.0	0.5 x 20.0	10.00	2000

> Accessories:

Temperature controllers: MWD5 WiFi, MCD5, OTN, ELR20, ETN4

ELEKTRA Heating Mats

Double-side power supply MG

ELEKTRA MG Heating Mats are ready-to-install heating elements which are produced in accordance with EN 60335-2-96. Consisting of a thin heating cable attached to a self-adhesive glass fibre mesh, the system is designed for indoor use and direct heating. It should be installed directly under the surface to be heated, in either flexible tile adhesive or self-levelling compound.

This package contains:

- **ELEKTRA heating mat,**
- **'cold tails' flexible conduit,**
- **flexible conduit for the temperature sensor, capped on one end,**
- **recessed distribution box Ø 60 mm for the temperature controller,**
- **instruction manual.**

> Technical data:

Power output:	100 or 160 W/m^2
Power supply:	230 V ~ 50/60 Hz
Mat thickness:	~ 3 mm
Min. installation temperature:	–5°C
Max. working temperature:	+105°C
Conduit cables:	2 x 4 m; 2 x 1.0 mm^2
Type of heating cable:	one-core of diameter ~ 2.5 mm, double-side power supply
Screen of heating cables:	100% coverage, tinned copper braiding
Power output of heating cable:	~ 7 W/m (MG100), ~ 10 W/m (MG160)
Insulation:	double layer, FEP + HDPE
Outer sheath:	XLPE
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	5 D
Deformation strength:	> 600 N
Pulling strength:	> 120 N
Ingress protection:	IPX7
Product certificates:	VDE, EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

SHIELDED

TWIN INSULATION

MULTI WIRE CONDUCTOR

FLUORO POLYMER INSULATION

PVC FREE

ALLERGY friendly

100 W/m^2*

TYPE	DIMENSIONS	SURFACE	POWER
-	m x m	m^2	W
MG 100/3.0	0.5 x 6.0	3.00	300
MG 100/3.5	0.5 x 7.0	3.50	350
MG 100/4.5	0.5 x 9.0	4.50	450
MG 100/9.0	0.5 x 18.0	9.00	900

160 W/m^2*

TYPE	DIMENSIONS	SURFACE	POWER
-	m x m	m^2	W
MG 160/1.0	0.5 x 2.0	1.00	160
MG 160/1.5	0.5 x 3.0	1.50	240
MG 160/2.0	0.5 x 4.0	2.00	320
MG 160/2.5	0.5 x 5.0	2.50	400
MG 160/3.0	0.5 x 6.0	3.00	480
MG 160/3.5	0.5 x 7.0	3.50	560
MG 160/4.0	0.5 x 8.0	4.00	640
MG 160/5.0	0.5 x 10.0	5.00	800
MG 160/6.0	0.5 x 12.0	6.00	960
MG 160/7.0	0.5 x 14.0	7.00	1120
MG 160/8.0	0.5 x 16.0	8.00	1280
MG 160/9.0	0.5 x 18.0	9.00	1440
MG 160/10.0	0.5 x 20.0	10.00	1600

* Available while stock lasts.

Accessories:

Temperature controllers: MWD5 WiFi, MCD5, OTN, ELR20, ETN4

ELEKTRA Heating Mats

Single-side power supply SnowTec®

ELEKTRA SnowTec® Heating Mats are ready-to-install heating elements, composed of an ELEKTRA VCD heating cable produced in accordance with EN 60335-1. The cable is secured with unique tape in the mat shape. This system is designed for outdoor use to protect against snow and ice on driveways, walkways, ramps, etc.

This package contains:

- **ELEKTRA SnowTec® heating mat,**
- **instruction manual.**

> Technical data:

Power output:	300 W/m²
Power supply:	230 V, 400 V ~ 50/60 Hz
Mat thickness:	~ 7.5 mm
Min. installation temperature:	–5°C
Max. working temperature:	+95°C
Conduit cables:	1 x 4 m; 3 x 1.5 mm² or 3 x 2.5 mm²
Type of heating cable:	double-core of diameter ~ 5 x 7 mm, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Power output of heating cable:	30 W/m
Insulation:	XLPE
Outer sheath:	heat resistant PVC
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	5 D
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Ingress protection:	IPX7
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

230V

TYPE	DIMENSIONS	POWER
-	m x m	W
SnowTec® 300/2	0.6 x 2.00	400
SnowTec® 300/3	0.6 x 3.00	520
SnowTec® 300/4	0.6 x 4.00	670
SnowTec® 300/5	0.6 x 5.00	930
SnowTec® 300/7	0.6 x 7.00	1140
SnowTec® 300/10	0.6 x 10.00	1860
SnowTec® 300/13	0.6 x 13.00	2560
SnowTec® 300/16	0.6 x 16.00	2890
SnowTec® 300/21	0.6 x 21.00	3730

TYPE	DIMENSIONS	POWER
-	m x m	W
SnowTec® 300/3.1/0.4	0.4 x 3.10	370
SnowTec® 300/4.3/0.4	0.4 x 4.30	520
SnowTec® 300/5.0/0.4	0.4 x 5.00	590
SnowTec® 300/7.7/0.4	0.4 x 7.70	930
SnowTec® 300/9.6/0.4	0.4 x 9.60	1150
SnowTec® 300/12.5/0.4	0.4 x 12.50	1500
SnowTec® 300/15.0/0.4	0.4 x 15.00	1830
SnowTec® 300/16.5/0.4	0.4 x 16.50	2000
SnowTec® 300/20.0/0.4	0.4 x 20.00	2360
SnowTec® 300/24.0/0.4	0.4 x 24.00	2840

400V

TYPE	DIMENSIONS	POWER
-	m x m	W
SnowTec® 300/2 400V	0.6 x 2.00	400
SnowTec® 300/3 400V	0.6 x 3.00	600
SnowTec® 300/4 400V	0.6 x 4.00	820
SnowTec® 300/5 400V	0.6 x 5.00	950
SnowTec® 300/7 400V	0.6 x 7.00	1360
SnowTec® 300/9 400V	0.6 x 9.00	1680
SnowTec® 300/11 400V	0.6 x 11.00	2100
SnowTec® 300/13 400V	0.6 x 13.00	2360
SnowTec® 300/15 400V	0.6 x 15.00	2650
SnowTec® 300/20 400V	0.6 x 20.00	3550
SnowTec® 300/25 400V	0.6 x 25.00	4600

> Accessories:

Temperature controllers: ETOG2, ETR2G

ELEKTRA Heating Mats

Single-side power supply SnowTec®Tuff

ELEKTRA SnowTec®Tuff Heating Mats are ready-to-install heating elements, dedicated to special applications, composed of an ELEKTRA TuffTec™ heating cable produced in accordance with EN 60335-1. The cable is secured with unique tape in the mat shape. This system is designed for outdoor use to protect against snow and ice on driveways, walkways, ramps, etc.

Exceptional mechanical and thermal resistance allows for the application in spots especially exposed to harsh installation and operation conditions. Very high temporary exposure temperature (240°C) will make it possible to install the SnowTec®Tuff heating mats even directly in asphalt.

This package contains:

- **ELEKTRA SnowTec®Tuff heating mat,**
- **instruction manual.**

> Technical data:

Power output:	400 W/m²
Power supply:	230 V, 400 V ~ 50/60 Hz
Mat thickness:	~ 7.5 mm
Min. installation temperature:	–25°C
Max. working temperature:	+110°C
Max. exposure temperature (10 min.):	+240°C
Conduit cables:	1 x 4 m; 3 x 1.5 mm² or 3 x 2.5 mm²
Type of heating cable:	double-core of diameter ~ 6.8 mm, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Power output of heating cable:	~ 40 W/m
Insulation:	double layer, FEP + HDPE
Outer sheath:	HFFR
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	3.5 D
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Ingress protection:	IPX7
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

230V

TYPE	DIMENSIONS	POWER
-	m x m	W
SnowTec®Tuff 400/1.5	0.6 x 1.50	310
SnowTec®Tuff 400/3.0	0.6 x 3.00	730
SnowTec®Tuff 400/4.5	0.6 x 4.50	1100
SnowTec®Tuff 400/6.0	0.6 x 6.00	1350
SnowTec®Tuff 400/7.5	0.6 x 7.50	1800
SnowTec®Tuff 400/9.0	0.6 x 9.00	2150
SnowTec®Tuff 400/10.0	0.6 x 10.00	2350
SnowTec®Tuff 400/12.0	0.6 x 12.00	2800
SnowTec®Tuff 400/14.0	0.6 x 14.00	3400
SnowTec®Tuff 400/16.0	0.6 x 16.00	3650
SnowTec®Tuff 400/18.0	0.6 x 18.00	4400

400V

TYPE	DIMENSIONS	POWER
-	m x m	W
SnowTec®Tuff 400/2.5 400V	0.6 x 2.50	560
SnowTec®Tuff 400/5.0 400V	0.6 x 5.00	1260
SnowTec®Tuff 400/8.0 400V	0.6 x 8.00	1940
SnowTec®Tuff 400/10.0 400V	0.6 x 10.00	2350
SnowTec®Tuff 400/13.0 400V	0.6 x 13.00	3100
SnowTec®Tuff 400/15.0 400V	0.6 x 15.00	3870
SnowTec®Tuff 400/17.0 400V	0.6 x 17.00	4150
SnowTec®Tuff 400/20.0 400V	0.6 x 20.00	4910
SnowTec®Tuff 400/22.0 400V	0.6 x 22.00	5310
SnowTec®Tuff 400/25.0 400V	0.6 x 25.00	5800
SnowTec®Tuff 400/27.0 400V	0.6 x 27.00	6480

Accessories:

Temperature controllers: ETOG2, ETR2G

ELEKTRA Heating Foils

Single-side power supply WoodTec2™

ELEKTRA WoodTec2™ Heating Foils are ready-to-install heating elements which are produced in accordance with EN 60335-2-96. Consisting of a very thin heating cable attached to a glass fibre mesh and aluminum foil, the system is designed for indoor use and direct heating. It should be installed directly under laminate flooring and/or engineered wood.

This package contains:

- **ELEKTRA WoodTec2™ heating foil,**
- **'cold tails' flexible conduit,**
- **flexible conduit for the temperature sensor,**
- **recessed distribution box Ø 60 mm for the temperature controller,**
- **aluminum adhesive tape,**
- **instruction manual.**

Technical data:

Power output:	70 or 140 W/m^2
Power supply:	230 V ~ 50/60 Hz
Mat thickness:	~ 2.8 mm
Min. installation temperature:	–5°C
Max. working temperature:	+95°C
Conduit cables:	1 x 4 m; 3 x 1.0 mm^2
Type of heating cable:	double-core of diameter ~ 2.3 mm, single-side power supply
Power output of heating cable:	~ 3 W/m (WoodTec2™ 70), ~ 6 W/m (WoodTec2™ 140)
Insulation:	double layer, FEP + XLPE
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	5 D
Screen of heating foils:	PET covered aluminum foil
Deformation strength:	> 600 N
Pulling strength:	> 120 N
Ingress protection:	IPX1
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

SHIELDED

TWIN CONDUCTOR

MULTI WIRE CONDUCTOR

TWIN INSULATION

FLUORO POLYMER INSULATION

PVC FREE

ALLERGY friendly

70 W/m^2

TYPE	DIMENSIONS	SURFACE	POWER
-	m x m	m^2	W
WoodTec$_2$™ 70/2.0	0.5 x 4.0	2.00	140
WoodTec$_2$™ 70/3.0	0.5 x 6.0	3.00	210
WoodTec$_2$™ 70/4.0	0.5 x 8.0	4.00	280
WoodTec$_2$™ 70/6.0	0.5 x 12.0	6.00	420
WoodTec$_2$™ 70/8.0	0.5 x 16.0	8.00	560
WoodTec$_2$™ 70/11.0	0.5 x 22.0	11.00	770
WoodTec$_2$™ 70/13.0	0.5 x 26.0	13.00	910

140 W/m^2

TYPE	DIMENSIONS	SURFACE	POWER
-	m x m	m^2	W
WoodTec$_2$™ 140/3.0	0.5 x 6.0	3.00	420
WoodTec$_2$™ 140/4.0	0.5 x 8.0	4.00	560
WoodTec$_2$™ 140/5.0	0.5 x 10.0	5.00	700
WoodTec$_2$™ 140/6.0	0.5 x 12.0	6.00	840
WoodTec$_2$™ 140/8.0	0.5 x 16.0	8.00	1120
WoodTec$_2$™ 140/10.0	0.5 x 20.0	10.00	1400

Accessories:

Temperature controllers: MWD5 WiFi, MCD5, OTN, ELR20, ETN4

ELEKTRA Heating Foils

Double-side power supply WoodTec1™

ELEKTRA WoodTec1™ Heating Foils are ready-to-install heating elements which are produced in accordance with EN 60335-2-96. Consisting of a very thin heating cable attached to a glass fibre mesh and aluminum foil, the system is designed for indoor use and direct heating. It should be installed directly under laminate flooring and/or engineered wood.

This package contains:

- **ELEKTRA WoodTec1™ heating foil,**
- **'cold tails' flexible conduit,**
- **flexible conduit for the temperature sensor,**
- **recessed distribution box Ø 60 mm for the temperature controller,**
- **2 electrical connectors,**
- **aluminum adhesive tape,**
- **instruction manual.**

> Technical data:

Power output:	60 W/m^2
Power supply:	230 V ~ 50/60 Hz
Mat thickness:	~ 1.9 mm
Min. installation temperature:	–5°C
Max. working temperature:	+95°C
Conduit cables:	2 x 4 m; 2 x 1.0 mm^2
Type of heating cable:	one-core of diameter ~ 1.3 mm, double-side power supply
Power output of heating cable:	~ 3 W/m
Insulation:	double layer, FEP + HDPE
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	5 D
Screen of heating foils:	PET covered aluminum foil
Deformation strength:	> 600 N
Pulling strength:	> 120 N
Ingress protection:	IPX1
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

SHIELDED

MULTI WIRE CONDUCTOR

TWIN INSULATION

FLUORO POLYMER INSULATION

PVC FREE

ULTRA THIN

ALLERGY friendly

60 W/m²*

TYPE	DIMENSIONS	SURFACE	POWER
-	m x m	m^2	W
WoodTec1™ 60/2.0	0.5 x 4.0	2.00	120
WoodTec1™ 60/3.0	0.5 x 6.0	3.00	180
WoodTec1™ 60/4.0	0.5 x 8.0	4.00	240
WoodTec1™ 60/6.0	0.5 x 12.0	6.00	360
WoodTec1™ 60/8.0	0.5 x 16.0	8.00	480
WoodTec1™ 60/10.0	0.5 x 20.0	10.00	600
WoodTec1™ 60/12.0	0.5 x 24.0	12.00	720

* Available while stocks lasts.

Accessories:

Temperature controllers: MWD5 WiFi, MCD5, OTN, ELR20, ETN4

ELEKTRA Heating Cables

Single-side power supply UltraTec

ELEKTRA UltraTec Heating Cables are ready-to-install heating units which are produced in accordance with EN 60335-1. They consist of an ultra-thin, high temperature resistant cable, terminated with a cold tail. This system is designed for indoor use and direct heating. It should be installed directly under the surface to be heated, in either flexible tile adhesive or self-levelling compound.

This package contains:

- **ELEKTRA heating cable (on a spool),**
- **self-adhesive installation tape,**
- **'cold tails' flexible conduit,**
- **flexible conduit for the temperature sensor, capped on one end,**
- **recessed distribution box Ø 60 mm for the temperature controller,**
- **instruction manual.**

Technical data:

Power output:	10 W/m
Power supply:	230 V ~ 50/60 Hz
External dimension of cable:	~ 2 x 3 mm
Min. installation temperature:	–20°C
Max. working temperature:	+150°C
Conduit cables:	1 x 2.5 m; 2 x 1.0 mm²
Type of heating cable:	double-core, single-side power supply
Screen of heating cables:	100% coverage, tinned copper braiding
Insulation:	FEP
Outer sheath:	FEP
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	5 D
Deformation strength:	> 600 N
Pulling strength:	> 120 N
Ingress protection:	IPX8
Product certificates:	B, EAC
Certificate of ISO 9001:	IQNET, PCBC
Produkt mark:	CE

TYPE	LENGTH	POWER
-	m	W
UltraTec 10/90	8.50	90
UltraTec 10/135	13.50	135
UltraTec 10/145	15.00	145
UltraTec 10/220	22.50	220
UltraTec 10/285	28.50	285
UltraTec 10/320	32.00	320
UltraTec 10/400	40.00	400
UltraTec 10/450	45.00	450
UltraTec 10/555	55.00	555
UltraTec 10/690	70.00	690
UltraTec 10/780	78.00	780
UltraTec 10/980	98.00	980
UltraTec 10/1100	110.00	1100
UltraTec 10/1320	132.00	1320
UltraTec 10/1650	165.00	1650
UltraTec 10/2050	203.00	2050

Accessories:

Temperature controllers: MWD5 WiFi, MCD5, OTN, ELR20, ETN4

ELEKTRA Heating Cables

Single-side power supply DM

ELEKTRA DM Heating Cables are ready-to-install heating units which are produced in accordance with EN 60335-1. A thin heating cable of the length depending on the model, has factory connected cold tail cable. This system is designed for indoor use and direct heating. It should be installed directly under the surface to be heated, in either flexible tile adhesive or self-levelling compound.

This package contains:

- **ELEKTRA heating cable (on a spool),**
- **self-adhesive installation tape,**
- **'cold tails' flexible conduit,**
- **flexible conduit for the temperature sensor, capped on one end,**
- **recessed distribution box Ø 60 mm for the temperature controller,**
- **instruction manual.**

Technical data:

Power output:	10 W/m
Power supply:	230 V ~ 50/60 Hz
Diameter of cable:	~ 4.3 mm
Min. installation temperature:	–5°C
Max. working temperature:	+105°C
Conduit cables:	1 x 2.5 m; 2 x 1.0 mm^2
Type of heating cable:	double-core, single-side power supply
Screen of heating cables:	100% coverage, tinned copper braiding
Insulation:	double layer, FEP + XLPE
Outer sheath:	heat resistant PVC
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	5 D
Deformation strength:	> 600 N
Pulling strength:	> 120 N
Ingress protection:	IPX7
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Produkt mark:	CE

SHIELDED

TWIN CONDUCTOR

MULTI WIRE CONDUCTOR

TWIN INSULATION

FLUORO POLYMER INSULATION

ALLERGY friendly

TYPE	LENGTH	POWER
-	m	W
DM 10/90	8.50	90
DM 10/135	13.50	135
DM 10/145	15.00	145
DM 10/220	22.50	220
DM 10/285	28.50	285
DM 10/320	32.00	320
DM 10/400	40.00	400
DM 10/450	45.00	450
DM 10/555	55.00	555
DM 10/690	70.00	690
DM 10/780	78.00	780
DM 10/980	98.00	980
DM 10/1100	110.00	1100
DM 10/1320	132.00	1320
DM 10/1650	165.00	1650
DM 10/2050	203.00	2050

Accessories:

Temperature controllers: MWD5 WiFi, MCD5, OTN, ELR20, ETN4

ELEKTRA Heating Cables

Single-side power supply VCD

ELEKTRA VCD Heating Cables are ready-to-install heating units which are produced in accordance with EN 60335-1. Heating cable of the length depending on the model, has factory connected cold tail cable.

Typical use:

VCD7 - floor heating (installation in mortar).
VCD10 - floor heating (installation in mortar), antifrost protection of pipes.
VCD17 - floor heating (installation in mortar).
VCD25 - protection against snow and ice of external surfaces e.g. driveways, walkways, ramps, etc.

This package contains:

- **ELEKTRA heating cable (on a spool),**
- **instruction manual.**

> Technical data:

Power output:	7, 10, 17 or 25 W/m
Power supply:	230 V and 400 V (VCD25 only) ~ 50/60 Hz
External dimension of cable:	~ 5 x 7 mm
Min. installation temperature:	–5°C
Max. working temperature:	+95°C
Conduit cables:	1 x 2.5 m; 3 x 1.0 mm², 3 x 1.5 mm² or 3 x 2.5 mm²
Type of heating cable:	double-core, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Insulation:	XLPE
Outer sheath:	heat resistant PVC
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	3.5 D
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Ingress protection:	IPX7
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

SHIELDED

TWIN CONDUCTOR

MULTI WIRE CONDUCTOR

ALLERGY friendly

7 W/m*

TYPE	LENGTH	POWER
-	m	W
VCD 7/75	11,0	75
VCD 7/115	16,0	115
VCD 7/140	20,0	140
VCD 7/195	28,0	195
VCD 7/265	38,0	265
VCD 7/305	44,0	305
VCD 7/350	50,0	350
VCD 7/475	68,0	475
VCD 7/590	84,0	590
VCD 7/770	109,0	770
VCD 7/925	132,0	925
VCD 7/1020	145,0	1020
VCD 7/1210	173,0	1210
VCD 7/1320	186,0	1320
VCD 7/1460	208,0	1460
VCD 7/1610	228,0	1610
VCD 7/1700	243,0	1700

* Non-stock items.

10 W/m

TYPE	LENGTH	POWER
-	m	W
VCD 10/70	7.50	70
VCD 10/90	9.00	90
VCD 10/110	11.00	110
VCD 10/135	13.50	135
VCD 10/170	16.50	170
VCD 10/200	20.00	200
VCD 10/235	23.50	235
VCD 10/265	27.00	265
VCD 10/315	32.00	315
VCD 10/370	36.50	370
VCD 10/415	42.00	415
VCD 10/460	46.00	460
VCD 10/570	57.00	570
VCD 10/700	70.00	700
VCD 10/910	92.00	910
VCD 10/1100	111.00	1100
VCD 10/1220	122.00	1220
VCD 10/1450	144.00	1450
VCD 10/1560	156.00	1560
VCD 10/1740	174.00	1740
VCD 10/1920	191.00	1920
VCD 10/2030	203.00	2030
VCD 10/2260	225.00	2260

17 W/m

TYPE	LENGTH	POWER
-	m	W
VCD 17/100	5.50	100
VCD 17/140	8.50	140
VCD 17/180	10.00	180
VCD 17/215	13.00	215
VCD 17/260	15.50	260
VCD 17/305	18.00	305
VCD 17/350	20.50	350
VCD 17/410	24.50	410
VCD 17/480	28.00	480
VCD 17/545	32.00	545
VCD 17/610	35.00	610
VCD 17/745	43.00	745
VCD 17/910	54.00	910
VCD 17/1200	70.00	1200
VCD 17/1430	85.00	1430
VCD 17/1590	93.00	1590
VCD 17/1900	110.00	1900
VCD 17/2030	120.00	2030
VCD 17/2280	133.00	2280
VCD 17/2490	147.00	2490
VCD 17/2660	155.00	2660
VCD 17/2950	172.00	2950

25 W/m

TYPE	LENGTH	POWER
-	m	W
VCD 25/120	4.50	120
VCD 25/170	7.00	170
VCD 25/265	10.50	265
VCD 25/320	12.50	320
VCD 25/365	15.00	365
VCD 25/420	17.00	420
VCD 25/505	20.00	505
VCD 25/585	23.00	585
VCD 25/655	26.50	655
VCD 25/725	29.50	725
VCD 25/890	36.00	890
VCD 25/1120	44.00	1120
VCD 25/1450	58.00	1450
VCD 25/1740	70.00	1740
VCD 25/1910	77.00	1910
VCD 25/2270	92.00	2270
VCD 25/2480	98.00	2480
VCD 25/2730	110.00	2730
VCD 25/3030	120.00	3030
VCD 25/3300	130.00	3300
VCD 25/3550	142.00	3550

25 W/m 400V

TYPE	LENGTH	POWER
-	m	W
VCD 25/200 400V	8.00	200
VCD 25/300 400V	12.00	300
VCD 25/470 400V	18.00	470
VCD 25/550 400V	22.00	550
VCD 25/635 400V	26.00	635
VCD 25/720 400V	30.00	720
VCD 25/870 400V	35.00	870
VCD 25/1020 400V	40.00	1020
VCD 25/1170 400V	45.00	1170
VCD 25/1280 400V	50.00	1280
VCD 25/1570 400V	62.00	1570
VCD 25/1930 400V	77.00	1930
VCD 25/2530 400V	100.00	2530
VCD 25/3070 400V	120.00	3070
VCD 25/3350 400V	135.00	3350
VCD 25/3970 400V	160.00	3970
VCD 25/4280 400V	172.00	4280
VCD 25/4820 400V	190.00	4820
VCD 25/5260 400V	210.00	5260
VCD 25/5600 400V	225.00	5600
VCD 25/6150 400V	250.00	6150

> Accessories:

Temperature controllers: **MWD5 WiFi, MCD5, OTN, ELR20, ETOG2, ETR2G, ETV, ETN4, ETI**

Installation accessories: **page 51 and 52**

ELEKTRA Heating Cables

Single-side power supply TuffTec™

ELEKTRA TuffTec™ Heating Cables are ready-to-install heating units, dedicated to special applications, which are produced in accordance with EN 60335-1. Heating cable of the length depending on the model, has factory connected cold tail cable. The major use is the snow and ice protection of external surfaces e.g. garage drives, pavements, also roofs, gutters and down pipes.

Exceptional mechanical and thermal resistance allows for the application in spots especially exposed to harsh installation and operation conditions. Very high temporary exposure temperature (240°C) will make it possible to install the TuffTec™ cables even directly in asphalt.

This package contains:

- **ELEKTRA TuffTec™ heating cable (on a spool),**
- **instruction manual.**

> Technical data:

Power output:	30 W/m
Power supply:	230 V, 400 V ~ 50/60 Hz
Cable diameter:	~ 6.8 mm
Min. installation temperature:	–25°C
Max. working temperature:	+110°C
Max. exposure temperature (10 min.):	+240°C
Conduit cables:	1 x 4 m; 3 x 1.5 mm^2 or 3 x 2.5 mm^2, rubber outer jacket
Type of heating cable:	double-core, single-side power supply
Screen of heating cables:	100% coverage, tinned copper braiding
Insulation:	double layer, FEP + HDPE
Outer sheath:	HFFR, UV resistant
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	3.5 D
Deformation strength:	> 2000 N
Pulling strength:	> 300 N
Ingress protection:	IPX7
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

230V

TYPE	LENGTH	POWER
-	m	W
TuffTec™ 30/290	9.5	290
TuffTec™ 30/465	15.5	465
TuffTec™ 30/640	21.0	640
TuffTec™ 30/980	33.0	980
TuffTec™ 30/1230	40.0	1230
TuffTec™ 30/1580	53.0	1580
TuffTec™ 30/1920	64.0	1920
TuffTec™ 30/2110	70.0	2110
TuffTec™ 30/2520	83.0	2520
TuffTec™ 30/2710	90.0	2710
TuffTec™ 30/3030	100.0	3030
TuffTec™ 30/3320	110.0	3320
TuffTec™ 30/3650	122.0	3650
TuffTec™ 30/3900	130.0	3900
TuffTec™ 30/4260	142.0	4260

400V

TYPE	LENGTH	POWER
-	m	W
TuffTec™ 30/500 400 V	17.0	500
TuffTec™ 30/1100 400 V	37.0	1100
TuffTec™ 30/1710 400 V	57.0	1710
TuffTec™ 30/2120 400 V	70.0	2120
TuffTec™ 30/2760 400 V	92.0	2760
TuffTec™ 30/3350 400 V	110.0	3350
TuffTec™ 30/3660 400 V	122.0	3660
TuffTec™ 30/4360 400 V	145.0	4360
TuffTec™ 30/4700 400 V	157.0	4700
TuffTec™ 30/5230 400 V	175.0	5230
TuffTec™ 30/5760 400 V	192.0	5760
TuffTec™ 30/6800 400 V	226.0	6800

> Accessories:

Temperature controllers: ETOG2, ETOR2, ETR2G, ETR2R

Installation accessories: **page 51 and 52**

ELEKTRA Heating Cables

Single-side power supply VCDR

ELEKTRA VCDR Heating Cables are ready-to-install heating units which are produced in accordance with EN 60335-2-83. Heating cable of the length depending on the model, has factory connected cold tail cable. A system designed for outdoor use to protect roofs, gutters and downpipes against snow and ice.

This package contains:

- **ELEKTRA heating cable (on a spool),**
- **instruction manual.**

> Technical data:

Power output:	20 W/m
Power supply:	230 V ~ 50/60 Hz
External dimension of cable:	~ 5 x 7 mm
Min. installation temperature:	–5°C
Max. working temperature:	+95°C
Conduit cables:	1 x 4 m; 3 x 1.5 mm² or 3 x 2.5 mm², rubber outer jacket
Type of heating cable:	double-core, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Insulation:	XLPE
Outer sheath:	heat and UV resistant PVC
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	3.5 D
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Ingress protection:	IPX7
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

TYPE	LENGTH	POWER
-	m	W
VCDR 20/190	9.50	190
VCDR 20/235	12.00	235
VCDR 20/330	16.50	330
VCDR 20/380	19.00	380
VCDR 20/520	26.00	520
VCDR 20/600	29.00	600
VCDR 20/800	40.00	800
VCDR 20/1000	50.00	1000
VCDR 20/1140	57.00	1140
VCDR 20/1300	65.00	1300
VCDR 20/1560	78.00	1560
VCDR 20/1720	86.00	1720
VCDR 20/2050	102.00	2050
VCDR 20/2360	118.00	2360
VCDR 20/2710	135.00	2710
VCDR 20/3000	150.00	3000
VCDR 20/3450	175.00	3450

Other types available on special order.

Accessories:

Temperature controllers: ETOR2, ETR2R

Installation accessories: **page 51**

ELEKTRA Heating Cables

Double-side power supply VC

ELEKTRA VC Heating Cables are ready-to-install heating units which are produced in accordance with EN 60335-1. Heating cable of the length depending on the model, has factory connected cold tail cable.

Typical use:

VC10 - floor heating (installation in mortar), antifrost protection of pipes.

VC15 - floor heating (installation in mortar).

VC20 - floor heating (installation in mortar), protection against snow and ice of external surfaces e.g. driveways, walkways, ramps, etc.

This package contains:

- **ELEKTRA heating cable (on a spool),**
- **instruction manual.**

> Technical data:

Power output:	10, 15 or 20 W/m
Power supply:	230 V ~ 50/60 Hz
Diameter of cable:	~ 5 mm
Min. installation temperature:	–5°C
Max. working temperature:	+95°C
Conduit cables:	2 x 2.5 m; 2 x 1.0 mm², 2 x 1.5 mm² or 2 x 2.5 mm²
Type of heating cable:	one-core, double-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Insulation:	XLPE
Outer sheath:	heat resistant PVC
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	3.5 D
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Ingress protection:	IPX7
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

SHIELDED

MULTI WIRE CONDUCTOR

ALLERGY friendly

10 W/m*

TYPE	LENGTH	POWER
-	m	W
VC 10/80	7.50	80
VC 10/105	10.00	105
VC 10/130	13.00	130
VC 10/155	15.50	155
VC 10/190	19.50	190
VC 10/240	23.50	240
VC 10/285	28.50	285
VC 10/330	33.00	330
VC 10/375	38.00	375
VC 10/450	45.00	450
VC 10/515	52.00	515
VC 10/590	59.00	590
VC 10/655	65.00	655
VC 10/805	80.00	805
VC 10/990	100.00	990
VC 10/1290	130.00	1290
VC 10/1720	172.00	1720
VC 10/2040	205.00	2040
VC 10/2210	220.00	2210
VC 10/2460	246.00	2460
VC 10/2710	270.00	2710
VC 10/2850	290.00	2850
VC 10/3170	320.00	3170

15 W/m*

TYPE	LENGTH	POWER
-	m	W
VC 15/90	6.50	90
VC 15/125	8.50	125
VC 15/160	10.50	160
VC 15/190	12.50	190
VC 15/230	15.50	230
VC 15/285	19.50	285
VC 15/350	23.00	350
VC 15/405	27.00	405
VC 15/460	31.00	460
VC 15/545	37.00	545
VC 15/640	42.00	640
VC 15/725	48.00	725
VC 15/800	53.00	800
VC 15/985	65.00	985
VC 15/1230	80.00	1230
VC 15/1590	105.00	1590
VC 15/2100	140.00	2100
VC 15/2500	167.00	2500
VC 15/2700	180.00	2700
VC 15/3030	200.00	3030
VC 15/3320	220.00	3320
VC 15/3510	235.00	3510
VC 15/3900	260.00	3900

20 W/m*

TYPE	LENGTH	POWER
-	m	W
VC 20/110	5.50	110
VC 20/140	7.50	140
VC 20/185	9.00	185
VC 20/215	11.00	215
VC 20/265	13.50	265
VC 20/330	17.00	330
VC 20/400	20.00	400
VC 20/465	23.50	465
VC 20/530	27.00	530
VC 20/630	32.00	630
VC 20/730	37.00	730
VC 20/830	42.00	830
VC 20/930	46.00	930
VC 20/1130	57.00	1130
VC 20/1410	70.00	1410
VC 20/1820	92.00	1820
VC 20/2460	120.00	2460
VC 20/2880	145.00	2880
VC 20/3140	155.00	3140
VC 20/3440	175.00	3440
VC 20/3830	190.00	3830
VC 20/4130	207.00	4130
VC 20/4480	225.00	4480

* Available while stocks lasts.

> Accessories:

Temperature controllers: **MWD5 WiFi, MCD5, OTN, ELR20, ETOG2, ETR2G, ETV, ETN4, ETI**

Installation accessories: **page 51 and 52**

ELEKTRA Heating Cables

Single-side power supply FreezeTec®

ELEKTRA FreezeTec® Heating Cables are ready-to-install heating units. They consist of the ELEKTRA VCD heating cable with integrated thermostat ending in conduit cable with hermetic plug. An antifrost protection system for pipes and other objects which may be damaged by low temperatures.

This package contains:

- **ELEKTRA FreezeTec® heating cable,**
- **5, 10 or 20 m of self-adhesive installation tape,**
- **instruction manual.**

Technical data:

Power output:	12 W/m
Power supply:	230 V ~ 50/60 Hz
External dimension of cable:	~ 5 x 7 mm
Min. installation temperature:	–5°C
Max. working temperature:	+70°C
Conduit cables:	1 x 1.5 m; 3 x 0.75 mm^2; with the plug
Type of heating cable:	double-core, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Insulation:	XLPE
Outer sheath:	heat resistant PVC
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	3.5 D
Control:	built-in bimetallic thermostat
ON:	+3°C
OFF:	+10°C
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Ingress protection:	IPX7
Product certificates:	EZU, EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

TYPE	LENGTH	POWER
-	m	W
FreezeTec® 12/2	2.00	24
FreezeTec® 12/3	3.00	36
FreezeTec® 12/5	5.00	60
FreezeTec® 12/7	7.00	84
FreezeTec® 12/10	10.00	120
FreezeTec® 12/15	15.00	180
FreezeTec® 12/21	21.00	252
FreezeTec® 12/30	30.00	360
FreezeTec® 12/42	42.00	504

ELEKTRA Heating Cables

Single-side power supply BET

ELEKTRA BET Heating Cables are ready-to-install heating units. They consist of a heating cable terminated at one end with a power supply conductor with a hermetic plug. This system is designed for direct installation on reinforcement, and they are dedicated to construction concrete curing in low temperatures.

This package contains:

- **ELEKTRA BET heating cable (when longer on a spool),**
- **instruction manual.**

> Technical data:

Power output:	32, 40 W/m
Power supply:	230 V ~50/60 Hz
Diameter of cable:	~ 5.0 mm
Min. installation temperature:	-5°C
Max. working temperature:	+80°C
Conduit cables:	1 x 2.0 m; 3 x 1.0 mm^2 or 3 x 1.5 mm^2; with 16A hermetic plug
Type of heating cable:	double-core, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, two tinned copper wires
Insulation:	XLPE
Outer sheath:	PVC
Rated power output tolerance:	+5%, -10%
Min. radius of bending cable:	5 D
Deformation strength:	> 600 N
Pulling strength:	> 120 N
Ingress protection:	IPX7
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

SHIELDED

TWIN CONDUCTOR

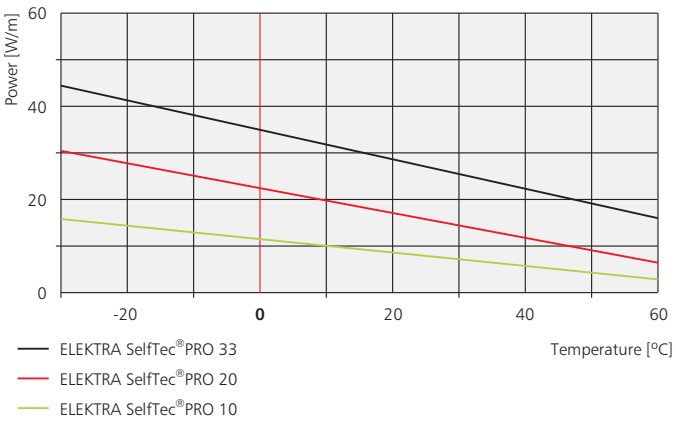
TYPE	LENGTH	POWER
-	m	W
BET 32/105	3.30	105
BET 40/540	13.50	540
BET 40/1360	34.00	1360
BET 40/3320	83.00	3320

ELEKTRA Heating Cables

Self-regulating SelfTec®PRO

ELEKTRA SelfTec®PRO Self-regulating Heating Cables on a spool. An advanced antifrost protection system for pipes, gutters, downpipes, valves and other objects which may be damaged by low temperatures.

ELEKTRA SelfTec®PRO

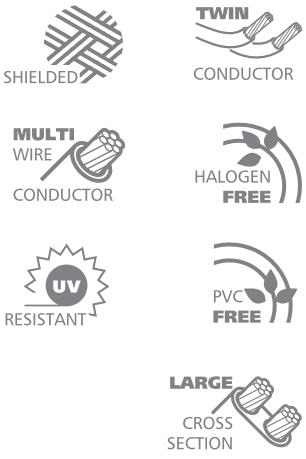


This package contains:

- **ELEKTRA SelfTec®PRO heating cable on a spool.**

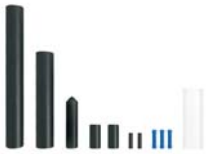
> Technical data:

Power output (+10°C):	10, 20 or 33 W/m
Power output (0°C in ice water):	30 W/m (SelfTec®PRO20) 45 W/m (SelfTec®PRO33)
Power supply:	230 V ~ 50/60 Hz
External dimension of cable:	~ 7 x 11 mm (10, 20 W/m), ~ 7 x 13 mm (33 W/m)
Min. installation temperature:	-30°C
Max. working temperature:	+65°C
Max. exposure temperature:	+85°C power-off
Type of heating cable:	self-regulating, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Conductor:	tin-coated copper 2 x 1.1 mm² (10, 20 W/m), 2 x 1.35 mm² (33 W/m)
Insulation:	modified polyolefin
Outer sheath:	UV resistant, halogen free polyolefin
Min. radius of bending cable:	3.5 D
Max. cable length per circuit:	see next page
Max. circuit-breaker, C-type:	see next page
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE



TURN-ON TEMPERATURE	SelfTec®PRO 10			SelfTec®PRO 20				SelfTec®PRO 33			
	CIRCUIT-BREAKER, C-TYPE										
	10A	16A	20A	10A	16A	20A	32A	16A	20A	32A	40A
	MAX. CABLE LENGTH PER CIRCUIT [m]										
-20°C	85	125	180	45	65	90	120	50	65	85	100
-15°C	100	145	190	50	75	105	125	55	70	90	105
0°C	115	170	205	60	90	120	135	60	75	95	110
+10°C	130	205	–	80	110	135	–	70	70	110	120
0°C in ice water	–	–	–	40	55	70	85	40	55	70	90

EC-PRO joint set



S-TWIN-PRO twin splice connection

KF 0404-PRO junction box with M25 gland

ECM25-PRO joint set with M25 gland

EK-PRO Insulation entry kit for self-regulating heating cables

BT-PRO mounting bracket for the UTR 60-PRO controller

BKF-PRO mounting bracket for the KF 0404-PRO installation box

CL-PRO caution label

Accessories:

Temperature controllers: ETOR2, ETR2R, UTR 60-PRO, ETI, TDR 4022-PRO, ETV

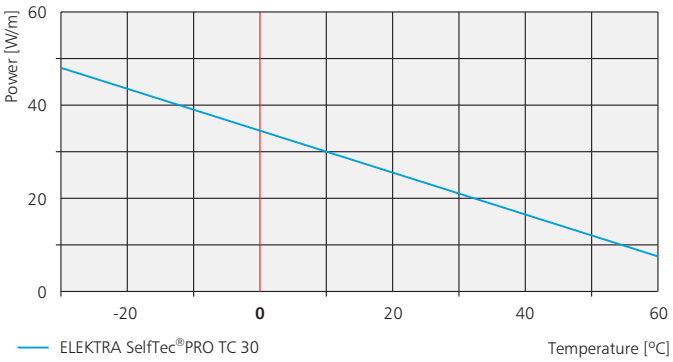
Installation accessories: page 51 and 52

ELEKTRA Heating Cables

Self-regulating SelfTec®PRO TC

Self-regulating ELEKTRA SelfTec®PRO TC Heating Cables. An advanced anti frost protection system for objects which may be damaged by low temperatures: central heating and process heat pipelines, also valves during pauses in operation. The cable is high-temperature resistant during normal operation, as well as when switched off.

ELEKTRA SelfTec®PRO TC



This package contains:

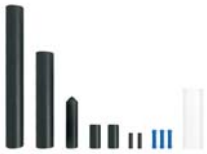
- **ELEKTRA SelfTec®PRO TC heating cable on a spool.**

> Technical data:

Power output (+10°C):	30 W/m
Power supply:	230 V ~ 50/60 Hz
External dimension of cable:	~ 6 x 13.5 mm
Min. installation temperature:	-50°C
Max. working temperature:	+100°C
Max. exposure temperature:	+135°C power-off
Type of heating cable:	self-regulating, single-side power supply
Screen of heating cables:	tinned copper braiding
Conductor:	nickel-coated copper 2 x 1.3 mm²
Insulation:	XLEVA
Outer sheath:	HFFR
Min. radius of bending cable:	35 mm
Product certificates:	EAC
Max. cable length per circuit:	see next page
Max. circuit-breaker, C-type:	see next page
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

TURN-ON TEMPERATURE	SelfTec®PRO TC 30			
	CIRCUIT-BREAKER, C-TYPE			
	16A	20A	32A	40A
	MAX. CABLE LENGTH PER CIRCUIT [m]			
-20°C	69	91	103	103
-15°C	73	94	103	103
0°C	80	100	106	106
+10°C	96	109	109	109
0°C in ice water	–	–	–	–

EC-PRO joint set



S-TWIN-PRO twin splice connection

KF 0404-PRO junction box with M25 gland

ECM25-PRO joint set with M25 gland

EK-PRO Insulation entry kit for self-regulating heating cables

BT-PRO mounting bracket for the UTR 60-PRO controller

BKF-PRO mounting bracket for the KF 0404-PRO installation box

CL-PRO caution label

Accessories:

Temperature controllers: ETOG2, ETR2G, ETI, UTR 60-PRO, TDR 4022-PRO

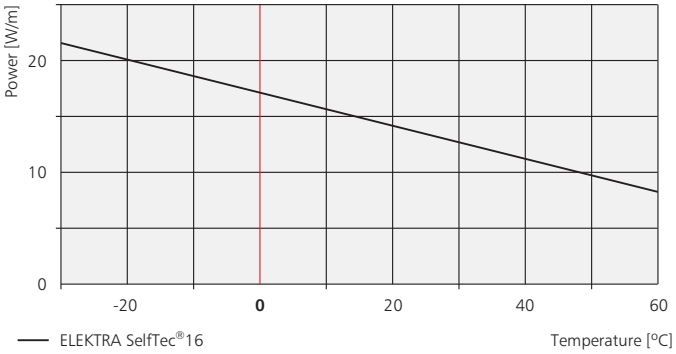
Installation accessories: page 51 and 52

ELEKTRA Heating Cables

Self-regulating SelfTec®16

ELEKTRA SelfTec®16 Self-regulating Heating Cables on a spool. An antifrost protection system for pipes, gutters, down-pipes, valves and other objects which may be damaged by low temperatures.

ELEKTRA SelfTec®16



This package contains:

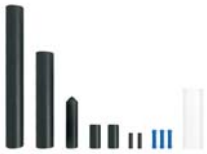
- **ELEKTRA SelfTec®16 heating cable on a spool.**

> Technical data:

Power output (+10°C):	16 W/m
Power output (0°C in ice water):	22 W/m
Power supply:	230 V ~ 50/60 Hz
External dimension of cable:	~ 6 x 9 mm
Min. installation temperature:	–25°C
Max. working temperature:	+65°C
Max. exposure temperature:	+65°C
Type of heating cable:	self-regulating, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Conductor:	tin-coated copper 2 x 0.6 mm^2
Insulation:	modified polyolefin
Outer sheath:	UV resistant, halogen free polyolefin
Min. radius of bending cable:	3.5 D
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

TURN-ON TEMPERATURE	SelfTec®16 on a spool	
	CIRCUIT-BREAKER, C-TYPE	
	10A	16A
	MAX. CABLE LENGTH PER CIRCUIT [m]	
-20°C	55	75
-15°C	60	80
0°C	70	90
+10°C	80	100
0°C in ice water	40	55

EC-PRO joint set



S-TWIN-PRO twin splice connection

KF 0404-PRO junction box with M25 gland

ECM25-PRO joint set with M25 gland

EK-PRO Insulation entry kit for self-regulating heating cables

BT-PRO mounting bracket for the UTR 60-PRO controller

BKF-PRO mounting bracket for the KF 0404-PRO installation box

CL-PRO caution label

Accessories:

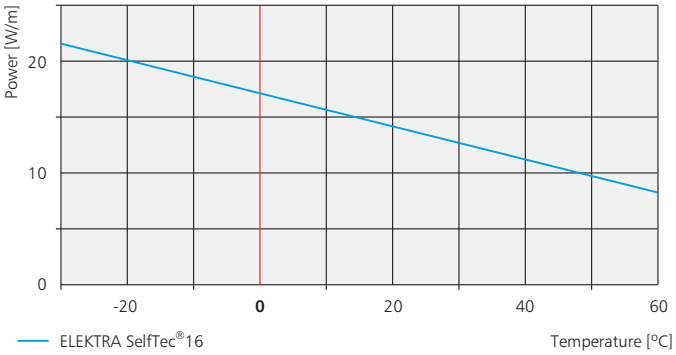
EC-PRO joint set
Temperature controllers: ETOR2, ETR2R, ETV, ETI
Installation accessories: **page 51 and 52**

ELEKTRA Heating Cables

Self-regulating SelfTec®16 ready2heat

ELEKTRA SelfTec®16 ready2heat Self-regulating Heating Cables are ready-to-install heating units. They consist of heating cable ending in conduit cable with hermetic plug. An antifrost protection system for pipes, gutters, downpipes, valves and other objects which may be damaged by low temperatures.

ELEKTRA SelfTec®16



This package contains:

- **ELEKTRA SelfTec®16 ready2heat heating cable,**
- **5 or 10 m of self-adhesive installation tape,**
- **instruction manual.**

> Technical data:

Power output (+10°C):	16 W/m
Power output (0°C in ice water):	22 W/m
Power supply:	230 V ~ 50/60 Hz
External dimension of cable:	~ 6 x 9 mm
Min. installation temperature:	–25°C
Max. working temperature:	+65°C
Max. exposure temperature:	+65°C
Conduit cables:	1 x 3 m; 3 x 0.75 mm² or 3 x 1.0 mm², with the plug
Type of heating cable:	self-regulating, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Conductor:	tin-coated copper 2 x 0.6 mm²
Insulation:	modified polyolefin
Outer sheath:	UV resistant, halogen free polyolefin
Min. radius of bending cable:	3.5 D
Deformation strength:	> 1500 N
Pulling strength:	> 300 N
Ingress protection:	IPX7
Product certificates:	EAC
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

TYPE	LENGTH	POWER (+10°C)
-	m	W
SelfTec® 16/1	1	16
SelfTec® 16/2	2	32
SelfTec® 16/3	3	48
SelfTec® 16/5	5	80
SelfTec® 16/7	7	112
SelfTec® 16/10	10	160
SelfTec® 16/15	15	240
SelfTec® 16/20	20	320
SelfTec® 16/X	length acc. to order (up. to 80 m)	

Accessories:

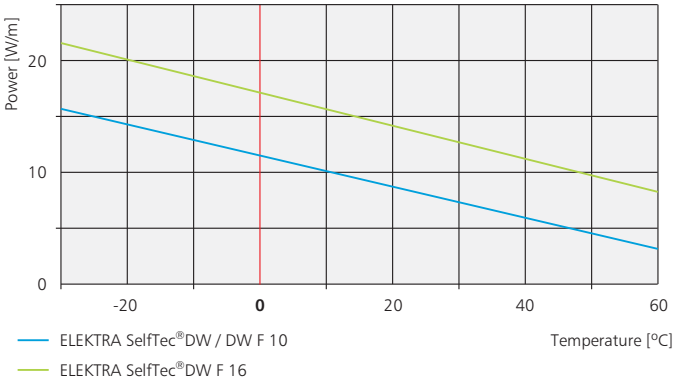
Installation accessories: page 51 and 52

ELEKTRA Heating Cables

Self-regulating SelfTec®DW / DW F

ELEKTRA SelfTec®DW / DW F Self-regulating Heating Cables. Multipurpose antifrost protection system, for applications both outside and inside of pipes. Certified for drinking water applications. Available in a double layer polyolefin + LDPE sheath (SelfTec®DW), as well as a single layer fluoropolymer sheath (SelfTec®DW F).

ELEKTRA SelfTec®DW / DW F



This package contains:

- **ELEKTRA SelfTec®DW / DW F heating cable on a spool.**

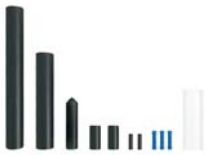
> Technical data:

Power output (+10°C):	10 W/m or 16 W/m
Power output (0°C in ice water):	16 W/m (SelfTec®DW / DW F 10), 22 W/m (SelfTec®DW 16)
Power supply:	230 V ~ 50/60 Hz
External dimension of cable:	~ 7 x 10 mm (SelfTec®DW) ~ 6 x 9 mm (SelfTec®DW F)
Min. installation temperature:	–25°C
Max. working temperature:	+65°C
Max. exposure temperature:	+65°C
Type of heating cable:	self-regulating, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Conductor:	tin-coated copper 0.6 mm²
Insulation:	modified polyolefin
Outer sheath:	double-layer, halogen free polyolefin + external LDPE, certified for drinking water applications (SelfTec®DW); single layer, fluoropolymer, certified for drinking water applications (SelfTec®DW F)
Min. radius of bending cable:	3.5 D
Deformation strength:	> 600 N
Pulling strength:	> 120 N
Product certificates:	EAC, FBUZ, PZH (SelfTec®DW) and NSF 61 (SelfTec®DW F) Hygienic Certificates
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

* applicable to SelfTec®DW
** applicable to SelfTec®DW F

TURN-ON TEMPERATURE	SelfTec®DW / DW F 10		SelfTec®DW F 16	
	CIRCUIT-BREAKER, C-TYPE			
	10A	16A	10A	16A
	MAX. CABLE LENGTH PER CIRCUIT [m]			
-20°C	75	110	55	75
-15°C	80	115	60	80
0°C	95	120	70	90
+10°C	100	125	80	100
+10°C in water	65	70	55	60
0°C in ice water	55	65	40	55

EC-PRO joint set



S-TWIN-PRO twin splice connection
<u>for installation on pipes only.</u>

H-LT lead–through (1/2", 3/4" & 1" set)

> Accessories:

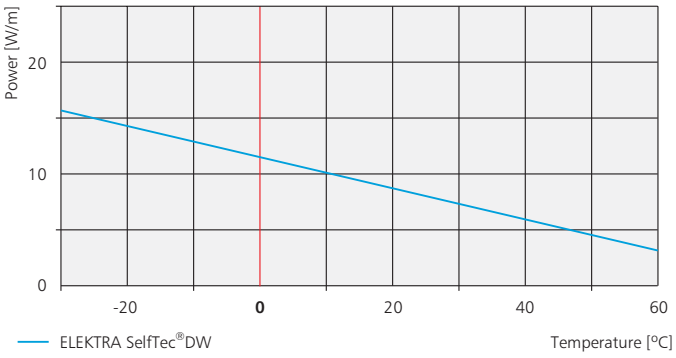
EC-PRO joint set
H-LT lead–through
Temperature controllers: ETV, ETI

ELEKTRA Heating Cables

Self-regulating SelfTec®DW ready2heat

ELEKTRA SelfTec®DW ready2heat Self-regulating Heating Cables are ready-to-install heating units. They consist of heating cable ending in conduit cable with hermetic plug. Multi-purpose antifrost protection system, for applications both outside and inside of pipes. Certified for drinking water applications.

ELEKTRA SelfTec®DW



This package contains:

- **ELEKTRA SelfTec®DW ready2heat heating cable,**
- **5 or 10 m of self-adhesive installation tape,**
- **instruction manual.**

Technical data:

Power output (+10°C):	10 W/m
Power output (0°C in ice water):	16 W/m
Power supply:	230 V ~ 50/60 Hz
External dimension of cable:	~ 7 x 10 mm
Min. installation temperature:	–25°C
Max. working temperature:	+65°C
Max. exposure temperature:	+65°C
Conduit cables:	1 x 3 m; 3 x 0.75 mm² or 3 x 1.0 mm², with the plug
Type of heating cable:	self-regulating, single-side power supply
Screen of heating cables:	100% coverage, PET covered aluminum foil, tinned copper braiding
Conductor:	tin-coated copper 2 x 0.6 mm²
Insulation:	modified polyolefin
Outer sheath:	double-layer, halogen free polyolefin and LDPE certified for drinking water applications
Min. radius of bending cable:	3.5 D
Deformation strength:	> 600 N
Pulling strength:	> 120 N
Ingress protection:	IPX8
Product certificates:	EAC, FBUZ, PZH Hygienic Certificate
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

TYPE	LENGTH	POWER (+10°C)
-	m	W
SelfTec®DW 10/1	1	10
SelfTec®DW 10/2	2	20
SelfTec®DW 10/4	4	40
SelfTec®DW 10/6	6	60
SelfTec®DW 10/8	8	80
SelfTec®DW 10/10	10	100
SelfTec®DW 10/12	12	120
SelfTec®DW 10/15	15	150
SelfTec®DW 10/20	20	200
SelfTec®DW 10/X	length acc. to order (up. to 80 m)	

Accessories:

Installation accessories: page 51 and 52

ELEKTRA Installation Accessories

Installation Tapes
TME 10 (10 m), TME 15 (15 m), TME 25 (25 m)
Thickness: ~ 0.8mm, Substance: aluminium

Installation Tape
TMS 10 (10 m)
Thickness: ~ 1.0 mm, Substance: zinc-coated steel

Roof trough installation strip
RT-L500-S-AL (0.5 m)
Width: 25 mm, Substance: aluminium (0.8 mm)
with special self-adhesive tape suitable for metal and PVC

Gutter spacing wire with clips
GSW-2 (20 m)
The distance between the holders along the wire: 40 cm
Substance: stainless steel and all weather resistant polymer

Downpipe spacing wire with clips
DSW-2 (20 m)
The distance between the holders along the wire: 40 cm
Substance: stainless steel and all weather resistant polymer

Roof trough installation band
RT-IB-1-P (1 m)
Substance: all weather resistant polymer

Gutter holder
GH-2 (25 pcs)
Substance: all weather resistant polymer

Downpipe spacing clip
DSC-2 (25 pcs)
Substance: all weather resistant polymer

Roof edge installation holder
RE-IH-1-ZNTI or RE-IH-1-CU (25 pcs)
Substance: ZnTi or Cu

Flexible cable support
FCS-1-SS (25 x 250mm, 2 pcs)
Substance: stainless steel

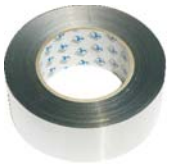
Downpipe spacing wire support bar
DSW-SB-1 (Ø 6 x 325 mm)
Substance: stainless steel

Underfloor heating installation monitor
UH-IM
Monitoring device for detection of damages occurring during heating mats and cables' installation

Self-adhesive installation tape
PG-TAPE-5 (5 m), PG-TAPE-10 (10 m) or PG-TAPE-20 (20 m)
Width: 19 mm

Self-adhesive aluminium foil
AL-TAPE-10 (10 m), AL-TAPE-45 (45 m)
Width: 50 mm

Self-adhesive aluminium foil
of increased mechanical durability
Tape-PRO (50 m)
Width: 50 mm



ELEKTRA Portable Heating Mats

Single-side power supply MMV

ELEKTRA MMV heating mats are portable, specialized heating devices dedicated for instant use which are produced in accordance with EN 60335-1.
Composed of a constant resistant heating cable and insulation layer installed inside PVC mat reinforced by polyester mesh. The mats are designed for universal applications such as defrosting of the ground, defrosting of haylage in prisms or hayballs or retriering flexibility of cables on drums to allow unrolling in winter season.

This package contains:

- **ELEKTRA MMV heating mat,**
- **warranty card,**
- **instruction manual.**

> Technical data:

Power output:	300 W/m^2
Total output power:	1000 W
Power supply:	230 V, ~ 50/60 Hz
Length x width x thickness:	~ 3000 x 1000 x 20 mm
Min. installation temperature:	–30°C
Max. working temperature:	+65°C
Overheating protection:	+80°C
Conduit cables:	1 x 3 m; 3 x 1.5 mm^2 with hermetic plug IP44
Mat fabric:	PVC mat reinforced with polyester mesh
Thermal insulation:	10 mm
Rated power output tolerance:	+5%, -10%
Ingress protection:	IP 67
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

SHIELDED

MULTI WIRE CONDUCTOR

Single-side power supply MMR

ELEKTRA Portable Heating Mats

ELEKTRA MMR heating mats are portable heating devices manufactured in accordance with EN 60335-1 standard. Their construction is based on a constant-resistance heating cable embedded within a layer of a vulcanized elastomer, which lends the mat exceptional resistance against abrasion as well as mechanical durability.

The mats are dedicated to applications in locations where the danger of icing or snow deposition exists, e.g. in front of entrances to buildings, or – alternatively – under unheated workstations, thus ensuring comfort and safety of work.

This package contains:

- **ELEKTRA MMR heating mat,**
- **warranty card,**
- **instruction manual.**

SHIELDED

TWIN CONDUCTOR

FLUORO POLYMER INSULATION

MULTI WIRE CONDUCTOR

PVC FREE

> Technical data:

Power output:	340 W/m^2
Total output power:	300 W
Power supply:	230 V, ~50/60 Hz
Length x width x thickness:	~1180 x 760 x 10 mm
Min. installation temperature:	-35°C
Max. working temperature:	+80°C
Conduit cables:	1 x 3 m; 3 x 1.5 mm^2, with hermetic plug IP44
Mat fabric:	Elastomer
Rated power output tolerance:	+5%, -10%
Ingress protection:	IP 67
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

ELEKTRA Portable Heating Sleeves

Single-side power supply MMT

ELEKTRA MMT heating sleeves are specialized portable heating appliances, enabling immediate reusable application. These plastic sleeves comprise a layer of thermal insulation and a SelfTec®16 ready2heat heating cable terminated with a sealed plug. The sleeves are dedicated to frost protection of long elements, vulnerable to low temperature damage, such as pipes, valves and other objects.

This package contains:

- **ELEKTRA MMT heating sleeve,**
- **instruction manual.**

Technical data:

Power output (+10°C):	16 W/m
Power supply:	230 V ~ 50/60 Hz
Min. installation temperature:	–25°C
Max. working temperature:	+65°C
Max. exposure temperature:	+65°C
Conduit cables:	1 x 3 m; 3 x 0.75 mm^2
	or 3 x 1.0 mm^2 with hermetic plug IP44
Type of heating cable:	self-regulating, single-side power supply
Thermal insulation:	15 mm
Ingress protection:	IPX7
Certificate of ISO 9001:	IQNET, PCBC
Product mark:	CE

TYPE	LENGTH	POWER (+10°C)
-	m	W
MMT 16/5	5	80
MMT 16/10	10	160
MMT 16/15	15	240

ELEKTRA Towel Dryers

CX 700, CX 800, CX 900

ELEKTRA Towel Dryers are adjusted to dry and warm clothes and towels, and to heat up spaces. They are produced in accordance with EN 60335-2-43:2002. The Dryer is composed of ladder shaped metal tubes with heating cable installed inside the tubes.

This package contains:

- **ELEKTRA dryer,**
- **installation set,**
- **instruction manual.**

> Technical data:

Power output:	95 ÷ 230 W
Power supply:	230 V ~ 50/60 Hz
Tubes diameter:	25 mm
Max. working temperature (constant):	60°C
Conduit cables:	1 x 2 m, 3 x 1.5 mm², end of plug (CX xxx) or connection through the bracket without plug (CX xxxN)
Type of heating cable:	one-core silicon insulated
Ingress protection:	IP 44
Certificate of ISO 9001:	PCBC, IQNET
Product mark:	CE

Standard version. Power lead with plug.

TYPE	DIMENSIONS	POWER	COLOUR
-	width x height (mm)	W	-
CX 700	527 x 697	130	White
CX 700r	527 x 697	130	RAL
CX 800	527 x 997	175	White
CX 800r	527 x 997	175	RAL
CX 900	527 x 1227	230	White
CX 900r	527 x 1227	230	RAL

Special version. Power lead without plug. Connection through the bracket.

TYPE	DIMENSIONS	POWER	COLOUR
-	width x height (mm)	W	-
CX 700N	527 x 697	130	White
CX 700Nr	527 x 697	130	RAL
CX 800N	527 x 997	175	White
CX 800Nr	527 x 997	175	RAL
CX 900N	527 x 1227	230	White
CX 900Nr	527 x 1227	230	RAL

ELEKTRA Temperature Controllers

Electronic programmable touch MWD5 WiFi

The electronic 6-event temperature controller ELEKTRA MWD5 WiFi is designed for heating systems, especially electric floor heating. Enriched with the WiFi functionality enabling the users to have each controller individually operated, or combine them in one or more jointly controlled heating zones. Produced in accordance with EN 60730-2-9. The set consists of the controller with a built-in air sensor and a thin floor sensor. Possible configuration of 3 temperature measurement methods: via the air sensor, floor sensor or air and floor (limiting) sensor. Compatible with most commercially available floor sensors. Equipped with a 2-inch colour touch-screen.

This package contains:

Type MWD5-1999

- **controller MWD5 with built-in air temperature sensor,**
- **a thin floor temperature sensor with 3 m tail (ETF-144/99T),**
- **instruction manual (with a link to programming instruction).**

ETF-144/99T

Wi-Fi

PROGRAMMABLE

TOUCH SCREEN

Google play

Available on the App Store

Technical data:

Power supply:	100-240 VAC ~ 50/60 Hz
Max. load:	16A
Installation:	flush mounting
Built-in switch:	2-pole, 16A
Clock functions:	6 programmable events for each day
Comfort temperature range:	+5°C ÷ +40°C for each event
Economical temperature range:	+5°C ÷ +40°C for each event
Open window detection:	system idle for 30 minutes
Hysteresis:	PI*
Ingress protection:	IP 21
Dimensions (H x W x D):	82 x 82 x 40 mm
Display:	176 x 220 pixel (TFT)
Wireless control:	WiFi (cloud)
Applications:	Android, iOS
Certificates:	VDE, BEAB
Product mark:	CE

* Adaptative system (proportional-integral) adjusting the deviation to the set temperature depending on the duration of the temperature's increase or decrease. Due to this feature the controller's operational characteristics is self-adjusted to ambient conditions, in real time.

Possible installation in the common frame:

PRODUCER	PRODUCT
ABB	Basic 55
Berker	B3, S1
Gira	Standard 55, Event, E2, Esprit 55
Hager / Polo	Lumina 2
Jung	A Creation, AS 500, A
Plus	
Legrand	Valena
Merten Schneider	M Smart, Arc, Plan, Star
Simon	82 Nature, Basic Standard

Electronic programmable touch MCD5

ELEKTRA Temperature Controllers

The Electronic 6-event Temperature Controller ELEKTRA MCD5 is designed for heating systems, especially for electric floor heating. Produced in accordance with EN 60730-2-9. It consists of controller with built-in air sensor and a thin floor sensor. Possible configuration of 3 temperature measurement methods: air sensor, floor sensor or air and limitation floor sensor. Compatible with most of floor sensors in the market. Equipped with a 2-inch colour touch-screen.
The calendar installed in the controller enables entering the date of the beginning and ending of your holiday/absence - in this time the heating will be off, or only the required min. set temperature will be maintained. Application of the QR code enables fast preview of the controller's settings in your smartphone.

This package contains:

Type MCD5-1999

- **controller MCD5 with built-in air temperature sensor,**
- **a thin floor temperature sensor with 3 m tail (ETF-144/99T),**
- **instruction manual (with a link to programming instruction).**

ETF-144/99T

PROGRAMMABLE

TOUCH SCREEN

Technical data:

Power supply:	230 V ~ 50/60 Hz
Max. load:	16A
Installation:	flush mounting
Built-in switch:	2-pole, 16A
Clock functions:	6 programmable events for each day
Comfort temperature range:	+5°C ÷ +40°C for each event
Economical temperature range:	+5°C ÷ +40°C for each event
Limitation floor sensor:	
Min.:	+5°C ÷ +25°C
Max.:	+10°C ÷ +40°C
Manual work mode:	
temperature range:	+5°C ÷ +40°C
work time:	to the next event or to the cancellation
Open window detection:	system idle for 30 minutes
Hysteresis:	PI*
Ingress protection:	IP 21
Work signalization:	display function
Dimensions (H x W x D):	82 x 82 x 40 mm
Display:	2'', 176 x 220 pixel TFT
Certificates:	VDE, BEAB
Product mark:	CE

* Adaptative system (proportional-integral) adjusting the deviation to the set temperature depending on the duration of the temperature's increase or decrease. Due to this feature the controller's operational characteristics is self-adjusted to ambient conditions, in real time.

Possible installation in the common frame:

PRODUCER	PRODUCT
ABB	Basic 55
Berker	B3, S1
Gira	Standard 55, Event, E2, Esprit 55
Hager / Polo	Lumina 2
Jung	A Creation, AS 500, A Plus
Legrand	Valena
Merten Schneider	M Smart, Arc, Plan, Star
Simon	82 Nature, Basic Standard

ELEKTRA Temperature Controllers

Electronic programmable ELR20

The Electronic 6-event Temperature Controller ELEKTRA ELR20 with LCD display is designed for heating systems, especially for electric floor heating. Produced in accordance with EN 60730-1 and EN 60730-2-9. Possible configuration of 3 temperature measurement methods through: air sensor, floor sensor or air and limitation floor sensor. Large LCD display ensures users' friendly communication.

This package contains:

Type ELR20

- **ELR20 controller with built-in air temperature sensor,**
- **floor temperature sensor with 3 m tail,**
- **manual and programming instruction.**

Floor temperature sensor

PROGRAMMABLE

> Technical data:

Power supply:	230 V ~ 50/60 Hz
Max. load:	16A
Low energy consumption in the standby mode:	<1W
Installation:	flush mounting
Conduit cables connected to one clamp:	max. 2 conduit cables 1.5 mm^2 or 1 conduit cable 2 mm^2
Clock functions:	6 programmable events for each day
Comfort temperature range:	+5°C ÷ +90°C for each event
Economical temperature range:	+5°C ÷ +90°C for each event
Limitation floor sensor:	+16°C ÷ +60°C
Frost protection temperature control range:	+5°C ÷ +10°C
Manual work mode:	
temperature range:	+5°C ÷ +90°C
work time:	until cancelled
Open window detection:	system idle for 30 minutes
Difference/Hysteresis:	adjustable 0.5°C ÷ 10°C
Ingress protection:	IP 20
Dimensions (H x W x D):	90 x 86 x 45 mm
Display:	46 x 55 mm (LCD)
Product mark:	CE

Elektronic
OTN

ELEKTRA Temperature Controllers

The Electronic Temperature Controller ELEKTRA OTN is designed for heating systems, especially for electric floor heating. Produced in accordance with EN 60730-1 and EN 60730-2-9. It consists of controller and floor sensor.

This package contains:

Type OTN-1991

- controller OTN,
- floor temperature sensor with 3 m tail (ETF-144/99),
- instruction manual.

ETF-144/99

> Technical data:

Power supply:	230 V ~ 50/60 Hz
Max. load:	16A
Installation:	flush mounting
Built-in switch:	1-pole, 16A
Temperature range:	+5°C ÷ +40°C
Setback temperature:	about 5°C
Control of setback temperature:	supply signal 230 V ~ 50/60 Hz
Difference/Hysteresis:	0.4K
Ingress protection:	IP 20
Operation indicator:	LED
Dimensions (H x W x D):	80 x 80 x 50 mm
Certificates:	EAC
Product mark:	CE

Possible installation in the common frame:

PRODUCER	PRODUCT
Busch-Jaeger	Reflex SI
Merten	Atelier & M1
Eljo	Trend

ELEKTRA Temperature Controllers

Electronic DIN-rail ControlTec Smart SMCG

ELEKTRA SMCG Electronic Temperature Controller has been designed for the control of heating systems dedicated to snow and ice protection. Manufactured in accordance with the EN 62368-1 and EN 62311 standards. The device incorporates the controller and the moisture detector integrated with temperature sensor. The ELEKTRA SMCG can independently control two heating zones, or one zone – employing two sensors. Due to this, control in extended applications becomes possible, such as car parks, pedestrian passages or garage driveways.

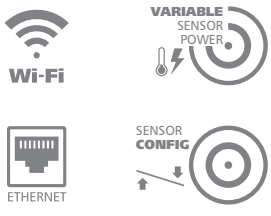
With appropriate connection of sensors (ETOG-56T, ETOR-55 and ETF-744), independent control of two various zones is possible (e.g. gutters and garage driveway). The controller features the WiFi module and Ethernet port for easy software update and remote operation via a web browser, using an user or installer account. The additional advantage of the device is the feature of modification of the characteristics of the moisture detector output power in the function of the ambient temperature, which enables even better adjustment of the controller's operation to the specific ambient environmental conditions. The controller additionally features an analog option of cooperation with the BMS system via a relay infor-ming of alarm situations, and two pairs of clamps for manual switch-on or stand-by of the heating system run from the BMS level.

This package contains:

Type SMCG

- **ControlTec Smart SMC controller,**
- **moisture detector with an integral temperature sensor (ETOG-56T),**
- **ETOK-T installation tube for ETOG-56T sensor,**
- **instruction manual.**

ETOG-56T **ETOK-T**



Technical data:

SMC

Power supply:	230 V ~50/60 Hz
Max. load:	2 x 16 A (potential free relays)
Installation:	DIN rail
Temperature range:	-25°C ÷ +50°C
Hysteresis:	0.3K
Ingress protection:	IP 20
Operation indicator:	LED
User control:	Multi-function knob control, web browser (desktop and mobile)
Working temperature:	-10°C ÷ +40°C
Dimensions (H x W x D):	90 x 177 x 72 mm
Modules:	10
WiFi:	20 MHz and 40 MHz 802.11 b/g/n (n - 2.4 GHz only) - 2400 ÷ 2483.5 MHz 802.11n MCS0-7 for 20 MHz and 40 MHz
Ethernet port:	RJ-45
Product mark:	CE

ETOG-56T

Installation:	in the ground
Ingress protection:	IP 68
Dimensions (H x D):	30 x 60 mm
Measurement:	ground temperature and moisture
Working temperature:	-50°C ÷ +70°C
Heater output:	1-8 W

Electronic
DIN-rail
ControlTec Smart SMCR

ELEKTRA Temperature Controllers

ELEKTRA SMCR Electronic Temperature Controller has been designed for the control of heating systems dedicated to snow and ice protection. Manufactured in accordance with the EN 62368-1 and EN 62311 standards. The device incorporates the controller, the temperature sensor and gutter moisture detector. The ELEKTRA SMCR can independently control two heating zones, or one zone – employing two sensors. Due to this, control in extended applications becomes possible, such as roof runners or roof edges.
With appropriate connection of sensors (ETOG-56T, ETOR-55 and ETF-744), independent control of two various zones is possible (e.g. gutters and a garage driveway). The controller features the WiFi module and Ethernet port for easy software update and remote operation via a web browser, using an user or installer account. The additional advantage of the device is the feature of modification of the characteristics of the moisture detector output power in the function of the ambient temperature, which enables even better adjustment of the controller's operation to the specific ambient environmental conditions in the operation area. The controller additionally features an analog option of cooperation with the BMS system via a relay informing of alarm situations, and two pairs of clamps for manual switch-on or stand-by of the heating system run from the BMS level.

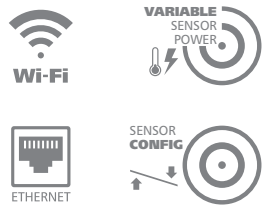
This package contains:

Type SMCR

- **ControlTec Smart SMC controller,**
- **moisture detector (ETOR-55),**
- **air temperature sensor in hermetic housing (ETF-744/99),**
- **instruction manual.**

ETF-744/99

ETOR-55



> Technical data:

SMC

Power supply:	230 V ~50/60 Hz
Max. load:	2 x 16 A (potential free relays)
Installation:	DIN rail
Temperature range:	-25°C ÷ +50°C
Hysteresis:	0.3K
Ingress protection:	IP 20
Operation indicator:	LED
User control:	Multi-function knob control, web browser (desktop and mobile)
Working temperature:	-10°C ÷ +40°C
Dimensions (H x W x D):	90 x 177 x 72 mm
Modules:	10
WiFi:	20 MHz and 40 MHz 802.11 b/g/n (n - 2.4 GHz only) - 2400 ÷ 2483.5 MHz 802.11n MCS0-7 for 20 MHz and 40 MHz
Ethernet port:	RJ-45
Product mark:	CE

ETF-744/99

Installation:	surface mounting, outdoor
Ingress protection:	IP 54
Dimensions (H x W x D):	85 x 50 x 35 mm
Measurement:	air temperature
Working temperature:	-50°C ÷ +70°C

ETOR-55

Installation:	inside the gutter
Ingress protection:	IP 68
Dimensions (H x W x D):	107 x 26 x 15 mm
Measurement:	moisture
Working temperature:	-50°C ÷ +70°C
Heater output:	1-8 W

ELEKTRA Temperature Controllers

Electronic DIN-rail ETOG2

The Electronic Temperature Controller ELEKTRA ETOG2 is designed especially for snow and ice protection electric heating systems. Produced in accordance with EN 60730-1 and EN 60730-2-9. It consists of a controller and a ground moisture detector with an integrated air temperature sensor. ETOG2 controls up to 2 zones or a single zone by means of 2 sensors. It is a solution even for large applications, e.g. car parks or driveways.

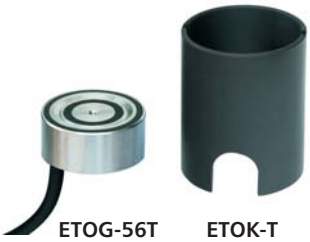
ETOG2 may also control 2 independent areas, e.g. a driveway and gutters (combination of ETOG-56T, ETOR-55 and ETF-744 sensors).

The controller features the possibility to cooperate analogously with a BMS system via a relay informing about the alarm status and two pairs of connectors enabling manual switch on or stand-by of the heating system from the BMS.

This package contains:

Type ETOG2

- **ETO2-4550 controller,**
- **moisture detector with an integral temperature sensor (ETOG-56T),**
- **ETOK-T installation tube for ETOG-56T sensor,**
- **cover for surface mounting,**
- **instruction manual.**



ETOG-56T **ETOK-T**

Surface mounting box

> Technical data:

ETO2-4550

Power supply:	115/240 V ~ 50/60 Hz
Built-in transformer:	24VAC, 6VA
Max. load:	3 x 16A (potential free relays)
Installation:	DIN-rail or surface mounting
Temperature range:	-20°C ÷ +50°C
Difference/Hysteresis:	0.3K
Ingress protection (surface mounting):	IP 21
Operation indicator:	LED
Temperature sensor calibration:	potentiometer
Working temperature:	0°C ÷ +50°C
Dimensions (H x W x D):	90 x 156 x 45 mm
Modules:	9
Certificates:	EAC
Product mark:	CE

ETOG-56T

Installation:	in the ground
Ingress protection:	IP 68
Dimensions (H x D):	30 x 60 mm
Measurement:	moisture and ground temperature
Working temperature:	-50°C ÷ +70°C

Electronic DIN-rail ETOR2

ELEKTRA Temperature Controllers

The Electronic Temperature Controller ELEKTRA ETOR2 is designed for snow and ice protection electric heating systems. Produced in accordance with EN 60730-1 and EN 60730-2-9. It consists of a controller, gutter moisture and air temperature sensors.

ETOR2 controls up to 2 zones or a single zone by means of 2 sensors. It is a solution even for large applications, e.g. roof troughs and roofs.

ETOR2 may also control 2 independent areas, e.g. a driveway and gutters (combination of ETOG-56T, ETOR-55 and ETF-744 sensors).

The controller features the possibility to cooperate analogously with a BMS system via a relay informing about the alarm status and two pairs of connectors enabling manual switch on or stand-by of the heating system from the BMS.

This package contains:

Type ETOR2

- **ETO2-4550 controller,**
- **moisture detector (ETOR-55),**
- **air temperature sensor in hermetic housing (ETF-744/99),**
- **cover for surface mounting,**
- **accessories for installation,**
- **instruction manual.**

ETF-744/99

ETOR-55

Surface mounting box

> Technical data:

ETO2-4550

Power supply:	115/240 V ~ 50/60 Hz
Built-in transformer:	24 VAC, 6 VA
Max. load:	3 x 16A (potential free relays)
Installation:	DIN-rail or surface mounting
Temperature range:	-20°C ÷ +50°C
Difference/Hysteresis:	0.3K
Ingress protection (surface mounting):	IP 21
Operation indicator:	LED
Temperature sensor calibration:	potentiometer
Working temperature:	0°C ÷ +50°C
Dimensions (H x W x D):	90 x 156 x 45 mm
Modules:	9
Certificates:	EAC
Product mark:	CE

ETF-744/99

Installation:	surface mounting, outdoor
Ingress protection:	IP 54
Dimensions (H x W x D):	85 x 50 x 35 mm
Measurement:	air temperature
Working temperature:	-50°C ÷ +70°C

ETOR-55

Installation:	inside the gutter
Ingress protection:	IP 68
Dimensions (H x W x D):	107 x 26 x 15 mm
Measurement:	moisture
Working temperature:	-50°C ÷ +70°C

ELEKTRA Temperature Controllers

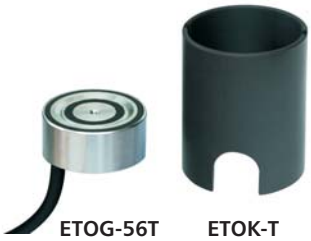
Electronic DIN-rail ETR2G

The Electronic Temperature Controller ELEKTRA ETR2G is designed specifically for snow and ice protection electric heating systems. Produced in accordance with EN 60730-1 and EN 60730-2-9. It consists of controller and a ground moisture detector with an integrated air temperature sensor.

This package contains:

Type ETR2G

- **ETR2-1550 controller,**
- **moisture detector with an integral temperature sensor (ETOG-56T),**
- **ETOK-T installation tube for ETOG-56T sensor,**
- **instruction manual.**



ETOG-56T ETOK-T

> Technical data:

ETR2-1550

Power supply:	230 V ~ 50/60 Hz
Max. load:	16A (potential free relays)
Installation:	DIN-rail
Temperature range:	0°C ÷ +10°C
Difference/Hysteresis:	0.3K
Ingress protection:	IP 20
Operation indicator:	LED ON (green) : power on LED RELAY (red) : output on LED TEMP (red) : outdoor temperature below setpoint LED MOIST (red) : moisture detected
Timer:	Switch-off delay adjustable 0-6 hours
Working temperature:	-20°C ÷ +50°C
Dimensions (H x W x D):	86 x 52 x 59 mm
Modules:	3
Certificates:	EAC
Product mark:	CE

ETOG-56T

Installation:	in the ground
Ingress protection:	IP 68
Dimensions (H x D):	30 x 60 mm
Measurement:	moisture and ground temperature
Working temperature:	-50°C ÷ +70°C

Electronic
DIN-rail
ETR2R

ELEKTRA Temperature Controllers

The Electronic Temperature Controller ELEKTRA ETR2R is designed specifically for snow and ice protection electric heating systems. Produced in accordance with EN 60730-1 and EN 60730-2-9. It consists of controller, gutter moisture and air temperature sensors.

This package contains:

Type ETR2R

- **ETR2-1550 controller,**
- **moisture detector (ETOR-55),**
- **air temperature sensor in the hermetic cover (ETF-744/99),**
- **instruction manual.**

ETF-744/99

ETOR-55

> Technical data:

ETR2-1550

Power supply:	230 V ~ 50/60 Hz
Max. load:	16A (potential free relays)
Installation:	DIN-rail
Temperature range:	0°C ÷ +10°C
Difference/Hysteresis:	0.3K
Ingress protection:	IP 20
Operation indicator:	LED ON (green): power on LED RELAY (red) : output on LED TEMP (red) : outdoor temperature below setpoint LED MOIST (red) : moisture detected
Timer:	Switch-off delay adjustable 0-6 hours
Working temperature:	-20°C ÷ +50°C
Dimensions (H x W x D):	86 x 52 x 59 mm
Modules:	3
Certificates:	EAC
Product mark:	CE

ETF-744/99

Installation:	surface mounting, outdoor
Ingress protection:	IP 54
Dimensions (H x W x D):	85 x 50 x 35 mm
Measurement:	air temperature
Working temperature:	-50°C ÷ +70°C

ETOR-55

Installation:	inside the gutter
Ingress protection:	IP 68
Dimensions (H x W x D):	107 x 26 x 15 mm
Measurement:	moisture
Working temperature:	-50°C ÷ +70°C

ELEKTRA Temperature Controllers

Electronic
UTR 60-PRO

The ELEKTRA UTR 60-PRO Electronic Temperature Controller is designed for pipe heating systems, including anti-frost protection and maintaining the desired pipeline temperature. Produced in accordance with the EN 60730-1 and EN 60730-2-9 standards. It consists of the controller and a temperature sensor to be mounted on a pipe surface.

This package contains:

UTR 60-PRO

- **UTR 60-PRO controller,**
- **temperature sensor with 1.5 m cable (F 892 002),**
- **instruction manual.**

F 892 002

Technical data:

UTR 60-PRO

Power supply:	230 V ~ 50/60 Hz
Max. load:	16A
Installation:	surface mounting / installation board
Temperature range:	0°C ÷ +60°C
Setback temperature:	about 5°C
Hysteresis:	1 … 10K
Ingress protection:	IP 65
Operation indicator:	LED
Operation temperature:	-20°C ÷ +50°C
Dimensions (H x W x D):	120 x 122 x 56 mm
Certificates:	EAC
Product mark:	CE

F 892 002

Installation:	on pipe
Ingress protection:	IP 67
Working temperature:	-40°C ÷ +120°C

Electronic
DIN-rail
TDR 4022-PRO

ELEKTRA Temperature Controllers

The ELEKTRA TDR 4022-PRO Electronic Temperature Controller is designed for pipe heating systems, including anti-frost protection, and maintaining the desired pipeline temperature. The temperature controller has got two freely configurable relays, the digital input, the port for direct RS-485 bus connection, as well as the analog output. The TTL port gives the optional possibility to connect the configuration Unicard with the USB port. The controller cooperates with BMS systems via ModBus or Televis protocols, or in an analog mode via a relay operating in the alarm mode. Produced in accordance with the EN 60730-1 and EN 60730-2-9 standards. It consists of the controller and a temperature sensor to be mounted on a pipe surface.

This package contains:

Type TDR 4022-PRO

- TDR 4022-PRO controller,
- temperature sensor (886030081500),
- installation manual.

886030081500

> Technical data:

TDR 4022-PRO

Power supply:	100-240 V ~ 50/60 Hz
Max. load:	2 x 8A (potential free relays)
Analog output:	V: 0...1V,0...5V,0...10V, I: 0...20mA, 4...20mA
Installation:	DIN-rail
Temperature range:	-200°C ÷ +800°C
Hysteresis:	0.1 … 30 K
Ingress protection:	IP 20
Operation indicator:	LED
Working temperature:	-5°C ÷ +55°C
Dimensions (H x W x D):	85 x 70 x 61 mm
Modules:	4
Product mark:	CE

886030081500

Mounting:	on pipe
Ingress protection:	IP 67
Working temperature:	-50°C ÷ +110°C

ELEKTRA Temperature Controllers

Electronic DIN-rail ETV

The Electronic Temperature Controller ELEKTRA ETV is designed for heating systems, especially for floor and pipe electric heating. Produced in accordance with EN 60730-1 and EN 60730-2-9. It consists of the controller and an appropriate sensor dependent on the application.

This package contains:

Type ETV-1991

- **ETV-1990 controller,**
- **temperature sensor with 3 m tail (ETF-144/99),**
- **instruction manual.**

Type ETV-1999

- **ETV-1990 controller,**
- **indoor air temperature sensor (ETF-944/99) or (optional) air temperature sensor in the hermetic cover (ETF-744/99),**
- **instruction manual.**

> Technical data:

ETV-1990

Power supply:	230 V ~ 50/60 Hz
Max. load:	16A
Installation:	DIN-rail
Temperature range:	0°C ÷ +40°C
Setback temperature:	about 5°C
Control of setback temperature:	supply signal 230 V ~ 50/60 Hz
Difference/Hysteresis:	0.4K
Ingress protection:	IP 20
Operation indicator:	LED
Working temperature:	0°C ÷ +50°C
Dimensions (H x W x D):	86 x 36 x 58 mm
Modules:	2
Certificates:	EAC
Product mark:	CE

ETF-744/99

Installation:	surface mounting, outdoor
Ingress protection:	IP 54
Dimensions (H x W x D):	85 x 50 x 35 mm
Working temperature:	-50°C ÷ +70°C

ETF-144/99

Installation:	floor or on pipe
Ingress protection:	IP 67
Working temperature:	-20°C ÷ +70°C

ETF-944/99

Installation:	surface mounting, indoor
Ingress protection:	IP 20
Dimensions (H x W x D):	80 x 80 x 16 mm
Working temperature:	-20°C ÷ +70°C

ETF-744/99

ETF-144/99

ETF-944/99

Electronic
DIN-rail
ETN4

ELEKTRA Temperature Controllers

The ELEKTRA ETN4 electronic temperature controller, is suitable for the purposes of electric heating systems' control, anti-frost protection of pipes, protection of buildings' foundations and control in cooling applications. The controller is manufactured in compliance with the EN 60730-1 and EN 60730-2-9 technical standards. One of the features of ETN4 is significantly wide range of set temperature: between -19.5°C and +70°C. Large backlit display emphasises current operating parameters, while three buttons enable easy menu navigation.

This package contains:

Type ETN4-1999

- ETN4 controller,
- thin floor temperature sensor with 3m tail (ETF-144/99T),
- instruction manual,
- programming instruction.

Option:
Depending on the application, the controller can service one or two sensors of the below:
- ETF-144/99T,
- ETF-744,
- ETF-944.

ETF-144/99T

ETF-744/99

ETF-944/99

Technical data:

ETN4-1999

Power supply:	230 V ~ 50/60 Hz
Max. load:	16A
Built-in switch:	2-pole, 16A
Installation:	DIN-rail
Control principle:	ON/OFF or PWM/PI
Temperature range:	-19.5°C ÷ +70°C
Limit sensor control temperature range:	
Min.:	-19.5/+70°C
Max.:	-19.5/+70°C
Temperature setback or increase:	
with connected sensor:	-19.5/+30°C
no connected sensor:	0-100%
Frost protection:	
with connected sensor:	0-10°C
no connected sensor:	0-100%
Control hysteresis:	0.3-10K
Ingress protection:	IP 20
Frost protection and temperature increase or setback:	with the voltage impulse 230 V / ~ 50/60 Hz
Working temperature:	-20 ÷ + 55°C
Dimensions (H x W x D):	86 x 52.5 x 58 mm
Modules:	3
Certificates:	EAC, VDE
Product mark:	CE

ETF-144/99T

Installation:	in-floor or on-pipe
Ingress protection:	IP 67
Working temperature:	-20°C ÷ +70°C

ETF-744/99

Installation:	surface mounting
Ingress protection:	IP 54
Dimensions (H x W x D):	85 x 50 x 35 mm
Working temperature:	-50°C ÷ +70°C

ETF-944/99

Installation:	indoor, surface mounting
Ingress protection:	IP 20
Dimensions (H x W x D):	80 x 80 x 16 mm
Working temperature:	-20°C ÷ +70°C

ELEKTRA Temperature Controllers

Electronic DIN-rail ETI

The Electronic Temperature Controller ELEKTRA ETI is designed for heating and cooling systems, especially basement protection (coolers) and pipelines. Produced in accordance with EN 60730-1 and EN 60730-2-9. It consists of the controller and an temperature sensor.

This package contains:

Type ETI-1544

- **ETI-1551 controller,**
- **temperature sensor with 3m tail (ETF-144/99),**
- **instruction manual.**

ETF-144/99

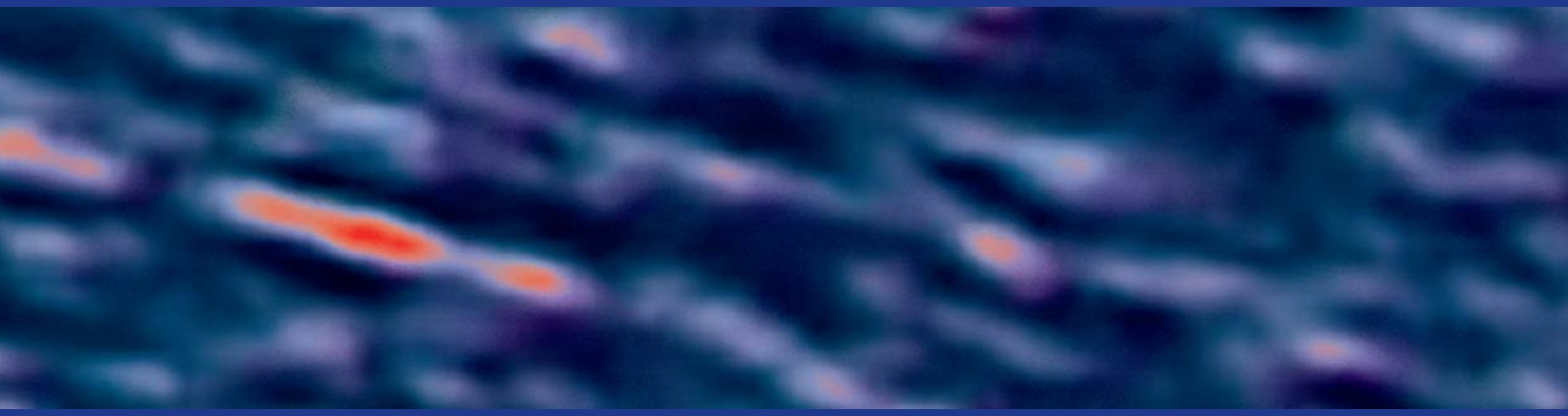
Technical data:

ETI-1551

Power supply:	230 V ~ 50/60 Hz
Max. load:	10A
Built-in switch:	2-pole, 10A
Installation:	DIN-rail
Temperature range:	-10°C ÷ +50°C
Difference/Hysteresis:	0.3 ÷ 6K
Ingress protection:	IP 20
Operation indicator:	LED
Working temperature:	-20°C ÷ +50°C
Dimensions (H x W x D):	86 x 36 x 58 mm
Modules:	3
Certificates:	EAC
Product mark:	CE

ETF-144/99

Installation:	floor or on pipe
Ingress protection:	IP 67
Working temperature:	-20°C ÷ +70°C



The technical specifications and data given in the catalogue are subjects to change without notice. Claimsfor damages resulting from modifications of catalogue information, incorrect data or printing errors will not be acknowledged.

Please note that all domestically applicable standards and safety regulations should be consulted before actual application of catalogue products or solutions, and relevant manuals and instructions should be applied before installation and operation.

Additionally, ELEKTRA reserves the right to implement alterations into processes or materials applied, which willnot disagree with any relevant standards or specifications, without prior notification.

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