ELEKTRA®

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Installation Manual

ELEKTRA SelfTec® PRO

Self-regulating Heating Cables

Installation manual

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1. Applications

ELEKTRA SelfTec®PRO heating cables with heat output **10, 20 and 33 W/m** are intended for

1. **Anti-frost protection of**

- water fixtures,
- sprinkler systems,
- fat drainage pipelines,

2. **maintaining required temperature of transported agent in pipes and pipelines,**
3. **prevention of snow and ice deposition**

- in gutters,
- in downpipes, roof edges and roof runners,
- in roof drains,

additionally, ELEKTRA SelfTec®PRO 33 W/m heating cables can be applied in **linear drainage of drives**.

ELEKTRA SelfTec®PRO TC heating cables are intended for

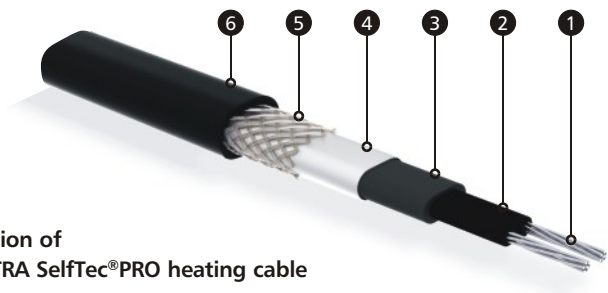
1. the anti-frost protection of central heating pipelines or process heat pipelines during periods of breaks in operation,
2. **the anti-frost protection of fat drainage pipelines** in case any danger of agent leakage exists,
3. **linear drainage of drives**, where petroleum derivate substances are present.

2. Self-regulation: principle of operation

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 lower the core's electrical resistance value and, consequently, the higher heating power of the cable. The higher the ambient temperature, the higher the core's resistance and therefore the lower the heating power of the cable.

Due to their properties, self-regulating heating cables can touch or cross freely, with no danger of spot overheating. Another significant advantage is the possibility to have cables cut into segments of any required length.

Still, the max. permissible length of a heating circuit must be observed, as estimated in table 2.



Construction of the ELEKTRA SelfTec®PRO heating cable

1. Tin-coated multi-wire copper conductor core
2. Self-regulating conductive polymer
3. Modified polyolefin insulation
4. PET covered AL foil shield
5. Tinned copper braiding shield
6. UV resistant halogen free outer sheath

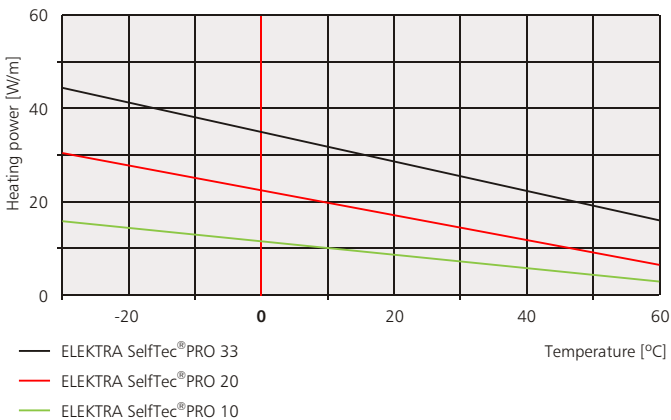
Advantages of self-regulating heating cables:

- they can be cut on construction site into segments of required lengths (max. permissible length values are given in table 2). This feature facilitates the selection of the adequate self-regulating cable's length during planning stage, as well as the process of installation,
- the ambient temperature's drop will cause the automatic increase of the cable's heating power,
- they can touch or cross with no danger of overheating.

Note:

In ambient temperatures above 0°C, self-regulating heating cables will not switch off, and will continue operation according to the characteristics shown in the diagram.

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



3. Characteristics and technical properties

Heating power of ELEKTRA SelfTec®PRO heating cables

- 10 W/m
- 20 W/m
- 33 W/m
- ELEKTRA SelfTec®PRO TC – 30 W/m

Heating power of self-regulating heating cables is the function of temperature, the data from the diagram on page 6 give the heating power value at +10°C. Self-regulating heating cables are available on spools, terminated with a heat shrink cap to protect the cable against moisture. The cable remaining on spool after the adequate cable segment has been cut off, also requires protection by terminating it with the cap.

Self-regulating heating cables applied for installation of the heating system must be terminated and connected to the power supply conductor. To do this, installation joint sets EC-PRO or ECM25-PRO type can be used (installation instructions included in packages).

table 1

type/unit power (10°C)	SelfTec®PRO 10 W/m	SelfTec®PRO 20 W/m	SelfTec®PRO 33 W/m	SelfTec®PRO TC 30 W/m
rated voltage	230 V ~ 50/60 Hz			
external dimensions of the cable	~ 7 x 11 mm		~ 7 x 13 mm	~ 6 x 13.5 mm
min. installation temperature	-25°C		-30°C	-50°C
max. operation temperature	65°C			100°C
max. exposure temperature	85°C power supply off			135°C power supply off
type of heating cable	self-regulating, shielded, single-side power supply			
core cross-section	tin-coated copper 1.1 mm^2			nickel plated copper 1.3 mm^2
insulation	modified polyolefin			XLEVA
outer sheath	UV resistant halogen free polyolefin			HFFR
min. cable bending radius	3.5 D			6 D

SelfTec®PRO TC – heating cables resistant against exposure to petroleum derivate substances

ELEKTRA SelfTec®PRO heating cables feature:

- EAC product certificate,
- IQNET, PCBC system certificate according to ISO 9001,
- CE product marking.

table 2

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

For protection of self-regulating heating cables, it is recommended to use 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 table 2. The values have been assessed for the min. ambient temperature.

4. General information

Protecting pipelines against freezing

When protecting pipelines against freezing, or when maintaining agent temperature, it is necessary to estimate the value of heat output per 1 metre of the pipeline of a particular diameter. The heat output should balance heat losses of the pipeline. The heat losses depend from local climate conditions, i.e.:

- min. ambient temperature,
- thickness of insulation mounted on the pipeline,
- the value of maintained temperature (in case of protection water pipelines against freezing, +5°C is assumed).

Note:

Each heated pipeline must be equipped with thermal insulation. Installation of heating cables should commence after hydraulic pressure tests have been concluded.

table 3 Heat losses

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

ΔT – difference of ambient temperature and required agent temperature (e.g. water) inside the pipeline

$$\text{lenght of the heating cable} = \frac{\text{pipeline heat losses (according to table 3)}}{\text{heating cable power (10, 20, 33 W/m)}} \times \text{lenght of the pipeline}$$

For losses smaller than e.g. 10 W/m, assume 10 W/m.

For protection of valves, elbows, T-joints or flanges, it is required to add extra approx. 0.5 m of the heating cable per each element.

Protection of gutters and downpipes against snow and ice deposition

In the systems of protection against snow and ice deposition, self-regulating ELEKTRA SelfTec®PRO 20 and 33 heating cables are applied which prevent:

- snow and ice deposition on roofs,
- water freezing in gutters and/or downpipes,
- formation of damp patches on building facades,
- formation of icicles.

To ensure max. effectiveness of operation of the heating system, heating power value needs to be assessed depending from local climatic conditions (i.e. min. ambient temperature, snowfall intensity and wind operation). Recommended heating power values are given in table 4:

table 4

ambient temperatures	heating power			
	> -5°C	-5°C ÷ -20°C	-20°C ÷ -30°C	< -30°C
gutters	20 W/m	20 – 40 W/m	40 – 60 W	60 W
downpipes	20 W/m	20 – 40 W/m	20 – 40 W/m	40 W/m
roof runners	200 W/m^2	200 – 250 W/m^2	250 – 300 W/m^2	350 W/m^2
roof edges	~150 W/m^2	~250 W/m^2	~300 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 Ø100-125 mm diameter. Gutters of larger diameters require application of the 20 W/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%.

Selection of the optimal power range depends from the climate zone the building is located in.

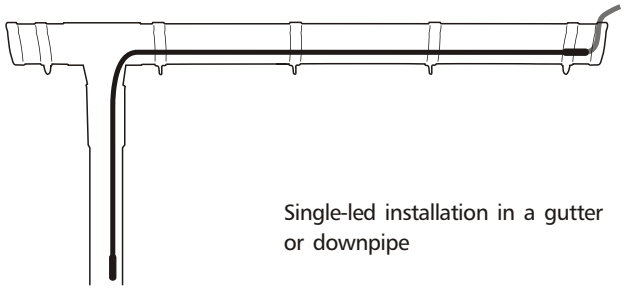
Heating gutters and downpipes of the width (diameter) 150 mm installed in a building located in the climate zone with mild winters requires single-led installation of ELEKTRA SelfTec®PRO 20 or 33 heating cable. For wider gutters (of a diameter larger than 150 mm), double-led installation of ELEKTRA SelfTec®PRO 20 or 33 heating cable is recommended.

Note:

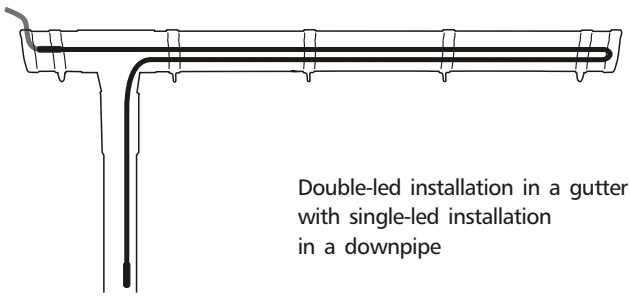
If the downpipe water is led directly to a drainage channel, it is necessary also to heat the downpipe segment from the ground level to the frost penetration depth.

In regions that receive large amounts of snowfall, it is recommended to additionally heat the roof edge adjacent to the heated gutter (suggested width of the heated roof surface is approx. 500 mm).

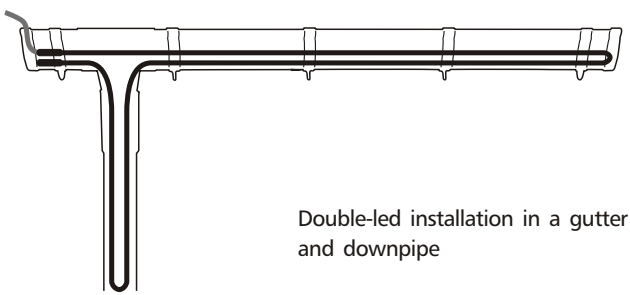
Examples of installation of self-regulating heating cables in gutters and downpipes



Single-led installation in a gutter or downpipe



Double-led installation in a gutter with single-led installation in a downpipe



Double-led installation in a gutter and downpipe

5. Controls

Properly selected controls will ensure efficient and at the same time economical operation of the heating system. Self-regulating heating cables always consume some amount of electric power, even in temperatures above 0°C, therefore application of a controller will ensure switch off of the heating circuit, when required. Controllers maintain the heating system on stand-by, switching it on only when necessary.

Note:

Due to a high value of inrush current of self-regulating heating cables, it is recommended to provide power supply to heating circuits through a contactor.

5.1. Controls of pipeline heating systems

When heating pipelines with heating cables, it is recommended to apply temperature controllers equipped with temperature sensors mounted on the pipeline surfaces. The controllers below will optimally serve this purpose:

ELEKTRA UTR60-PRO controller for on-pipe mounting, load 16A, the maximum total power of directly connected self-regulating heating cables is 1200 W. The controller is equipped with a temperature sensor for on-pipeline mounting, operating within the range of -40°C up to +120°C.
Adjustable hysteresis allows to define precision of temperature measurements.

ELEKTRA ETV-1991 controller
for DIN bus mounting, load 16A, recommended total power of directly connected self-regulating heating cables is 1200 W. The controller is equipped with a temperature sensor for on-pipeline mounting.

ELEKTRA ETI-1544 controller
for DIN bus mounting, load 10A, recommended total power of directly connected self-regulating heating cables is 800 W. The controller is equipped with a dedicated sensor operating within the range of -10°C up to +50°C.

ELEKTRA ETN-4 controller
for DIN bus mounting, load 16A, recommended total power of directly connected self-regulating heating cables is 1200 W. The controller can cooperate with two temperature controllers, where the second one acts as a limiting sensor. Adjustable hysteresis allows to define precision of temperature measurements. Equipped with an "on/off" switch.

ELEKTRA TDR 4022-PRO controller for DIN bus mounting in electric switchboards, applied in extended and complex heating systems, two relays, load 8A each, recommended total power of directly connected self-regulating heating cables is 600 W. The controller allows to set two temperature levels and to adjust hysteresis. The controller cooperates directly with BMS systems via ModBus or Televis protocols or in an analog mode via a relay operating in the alarm mode.

5.2. Controls of gutter, downpipe and roof heating systems

The most efficient and economical heating system will be controlled with a device equipped with a temperature and moisture sensor. The system will be then switched on only when both sensors indicate snowfall, freezing rain or icing. Depending on the size of the system and the number of heating zones, suitable controller should be applied, such as the ELEKTRA ETR2R equipped with one moisture sensor and one external temperature sensor. Alternatively, ELEKTRA SMCR or ETOR2 controllers could be applied, both with two moisture sensors and one external temperature sensor. ELEKTRA SMCR has got the capability of remote (WiFi/LAN) setting of all parameters.

ELEKTRA SMCR controller – max. load up to 2x16A. For applications in extended heating systems. Enables remote operation via a web browser and signaling of operating status or errors. As standard, equipped with one air temperature sensor and moisture sensor. Additional moisture sensor can be connected to this controller, which will enable protection of two independent roof areas.

ELEKTRA ETOR2 controller
for DIN bus mounting, load 3x16A, factory-equipped with one temperature and moisture sensor, allows to connect the second auxiliary moisture sensor for protection of two heated zones.

ELEKTRA ETR2 controller
for DIN bus mounting, load 16A, recommended total power of directly connected self-regulating heating cables is 1200 W. Designed for smaller heating systems, will service one heated zone. Factory-equipped with one temperature and moisture sensor.

6. Materials and tools

required for cable installation on pipes

- ELEKTRA SelfTec®PRO self-regulating heating cable
- ELEKTRA KF 0404-PRO power supply junction box
- ELEKTRA ECM25-PRO termination joint set with M25 gland for installation in the power supply junction box
- ELEKTRA EC-PRO heat shrink termination joint set
- self-adhesive installation tape (available as accessory)
- self-adhesive AL foil min. thickness 0.06 mm, width approx. 50 mm (available as accessory)
- thermal insulation for pipes
- temperature controllers

and

- diagonal cutting pliers
- fitter's knife
- wire stripping pliers
- long nose pliers
- slotted screwdriver
- tube compressor
- hot air blower
- insulation resistance meter

required for cable installation in gutters and downpipes

materials and tools as above, minus self-adhesive installation tape and self-adhesive AL foil, plus:

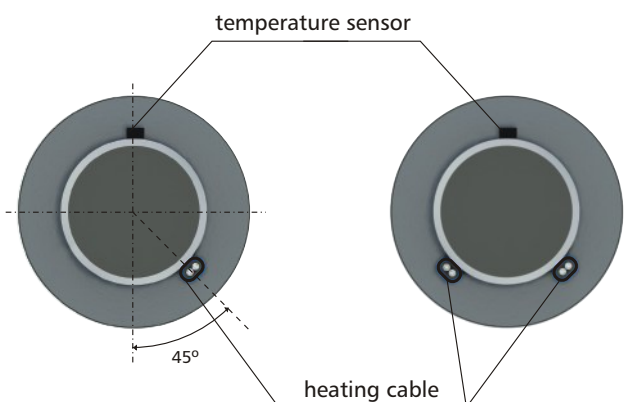
- gutter and downpipe holder or spacing wire with clips (available as accessory)
- spacing wire support bar (available as accessory)
- downpipe spacing wire holder
- copperplate (Cu) or galvanized sheet (ZnTi) installation holder (protection for tiled or tar paper roofs – available as accessory)
- self-adhesive installation tape (protection for metal sheet roofs – available as accessory)

7. Installation

Protection of pipelines against freezing

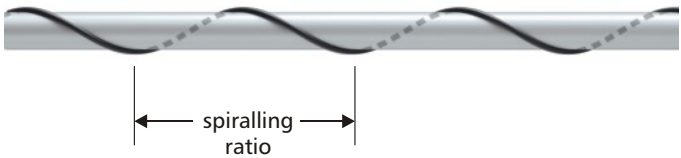
Depending from the selected cable length, the cable should be installed:

- single-led along the pipeline
- spirally
- single-led (multi-led) along the pipeline



Heating cable single-led

Heating cable double-led



Heating cable spirally led along the pipeline

Spiralling ratio for the heating cable will be assessed after the following formula:

$$p = \frac{\pi(D + d)\, L_R}{\sqrt{L_P^2 - L_R^2}}$$

where:

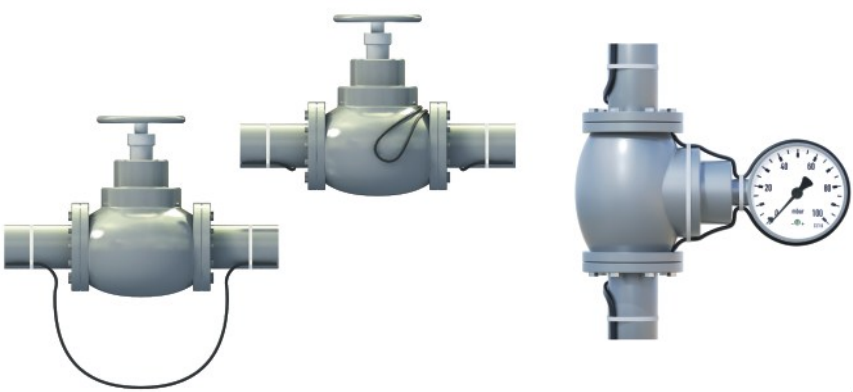
D – diameter of the pipe
d – dimension of the heating cable
L_P – length of the heating cable
L_R – length of the pipe

- ELEKTRA SelfTec®PRO heating cables should be mounted on the pipeline with fiberglass installation tape fixed every 30 cm.

- For plastic pipelines, fix additionally AL tape along the heating cable. This will improve the temperature distribution on the surface of the pipeline.

- Heating cables should be mounted along the heated pipeline in the bottom part of its cross-section. Temperature controller should be placed on the pipe under insulation, max. away from the cable.
- After the installation of the heating cable and sensor has been completed, thermal insulation should be placed on the pipeline.

Installation of a self-regulating heating cable on a valve

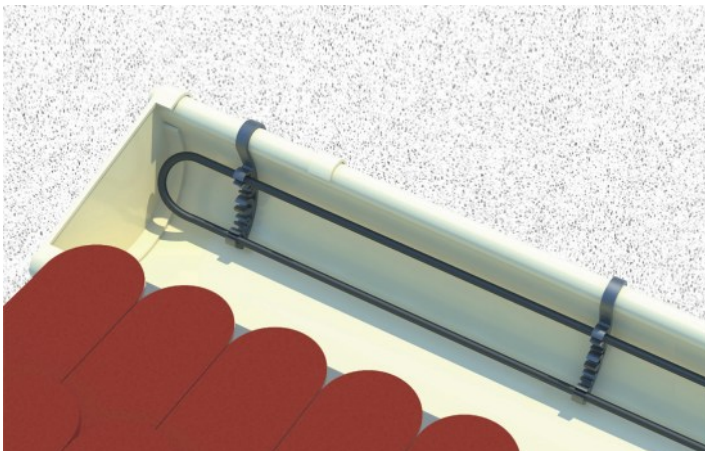


Protection of gutters and downpipes against deposition of snow and ice

Before the installation works on the heating system commence, it is necessary to measure length of gutters and downpipes. Length of the heating cable should be selected according to the local climate conditions, according to table 2 (p. 9).

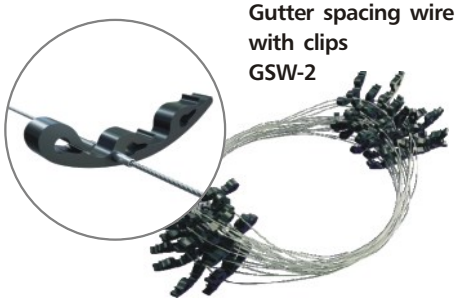
Gutters

Heating cables should be fixed with holders (holder spacing should not exceed 30 cm) or a wire with clips.

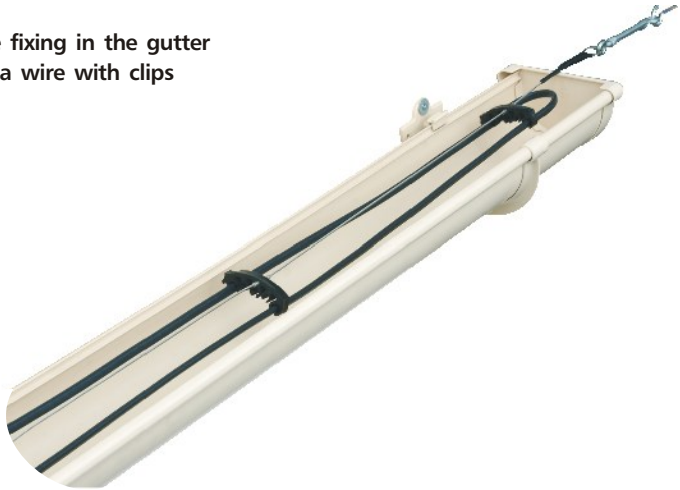


Gutter holder GH-2

Gutter spacing wire with clips GSW-2



Cable fixing in the gutter with a wire with clips

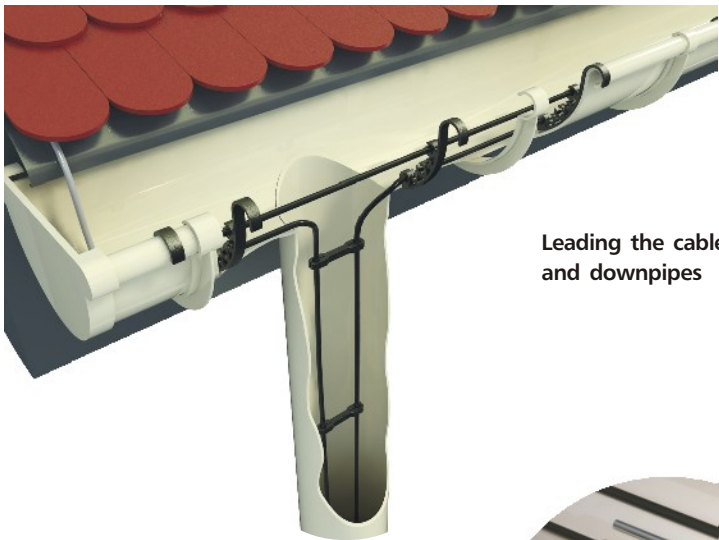


Single-led heating cables – do not require fixing if the length of the heated downpipe does not exceed 6 m.

Double-led heating cables – to be fixed with holders (holder spacing should not exceed 40 cm) or a wire with clips. Wire with clips are applied when the length of the heated downpipe exceeds 6 m.

Downpipe spacing clip DSC-2

Downpipe spacing wire with clips DSW-2



Leading the cables in gutters and downpipes

Protect the joining spot of the gutter and downpipe with a flexible cable support to prevent possible damage to the cable.

If the downpipe water is led directly to a drainage channel, it is necessary also to heat the downpipe segment from the ground level to the frost penetration depth.

Roof edges

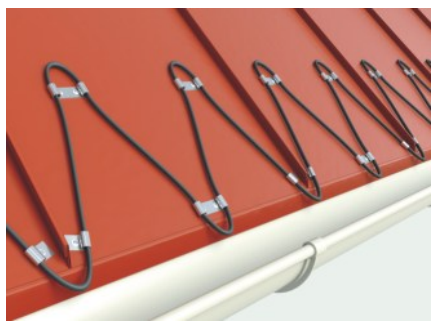
Heating cables need to be fixed to the roof surface with copper or titanium zinc installation holders, depending on the roof finishing type.

RE-IH-1-CU

RE-IH-1-ZNTI

If the roof covering is metal sheet, the holders can be:

- glued to the roof surface,
- fixed with screws (fixing spots needs to be carefully sealed with silicone),
- suspended on the insulated structural wire.



If the roof covering is tiles, the holders can be:

- fixed to the battens,

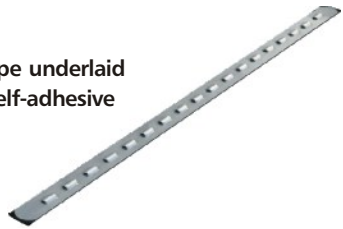
- fixed both to the battens and the structural wire.

Roof runners

Heating cables need to be fixed in roof runners with plastic installation band or AL installation tape underlaid with self-adhesive tape.

Plastic installation band
RT-IB-1-P

Installation tape underlaid with special self-adhesive tape
RT-L500-S-AL



8. Power supply and termination

Power supply for heating cables can be delivered in two ways:

- through a power supply conductor mounted to the heating cable with ELEKTRA EC-PRO termination joint set,
- by leading the heating cable to a power supply junction box ELEKTRA KF 0404-PRO with with ELEKTRA ECM25-PRO termination joint set.

Both sets are equipped with dedicated elements for terminating heating cables.

Note:

Remember to leave cable excess to execute the connection with the power supply conductor (“cold tail”), approx. 0.5 m in total.

Note:

For heating pipelines, the connecting joint of the heating cable and power supply conductor should be positioned on the heated pipeline, under the insulation.

Junction box made of halogen free thermoplast with IP66 protection index

Additional connection accessories available in ELEKTRA's offer:

ELEKTRA ECM25-PRO termination joint set with M25 gland for installation in the power supply junction box

ELEKTRA EC-PRO heat shrink termination joint set

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

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

CL-PRO self-adhesive caution label

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

For thermal insulation protected with a layer of processed metal, the heating cable and temperature sensor's wire should be fed through EK-PRO to provide protection against mechanical damage to the sheath.

9. Power supply system

- Each power supply system for heating cables should be equipped with the residual current device of the sensitivity $\Delta \leq 30mA$, for anti-shock protection. One RCD device should protect electric circuits no longer than 500 m each.
- To protect the power supply system against short circuits, it is required to apply type C characteristics circuit breakers.
- Application of contactors is recommended for the systems with large current load. This will protect controllers and prolong fault-free operation of those devices.

Note:

In case of planned delay in connection of the heating cable to the electrical installation, seal the heating cable or power supply cable of the heating cable against the possibility of internal moisture penetration, (e.g. heat shrinkable or protective end cap).

10. Final check

After the heating cable and thermal insulation have been laid, perform the measurements of the heating cable insulation's resistance, and test-run the heating circuits to assess the correctness and safety of the system's operation.

The heating cable insulation's resistance, as measured with an appliance of the rated voltage 1000 V (megaohmmeter), should not drop below 50 MΩ.
Enter the results into the Warranty Card.

For heating systems executed on:

- pipelines or steel tanks,
- as well as those equipped with insulation made of processed metal

perform the measurements of resistance of the layer (layer tightness) between:

- pipeline, tank or insulation layer of processed metal and
- PE conductor/heating cable's shield to eliminate damage during installation works on the system, or associated metal processing.

11. Warranty Card

ELEKTRA company grants a 5 year-long warranty (from the date of purchase) for the ELEKTRA SelfTec®PRO heating cables.

Warranty Conditions

1. Acknowledging the Warranty claims requires:
   a. that the heating system has been executed in full accordance with the Installation Manual herein,
   b. that the installation has been executed by an authorised electrician,
   c. presentation of the properly completed Warranty Card,
   d. presentation of the proof of purchase of the heating cable under complaint.
2. The Warranty loses validity if any attempt at repair has been undertaken by an installer without the authorisation of ELEKTRA company.
3. The Warranty does not cover the damages inflicted as a result of:
   a. mechanical fault,
   b. incompatible power supply,
   c. lack of adequate overload and differential protection measures,
   d. discord of the domestic heating circuit with the current regulations in force.
4. Within the Warranty herein, ELEKTRA company undertakes to bear exclusively the costs required to cover the necessary repairs to the heating cable itself or the costs required to exchange the cable.

Note: !

The Warranty claims must be registered with the Warranty Card and proof of purchase, in the place of purchase or the offices of ELEKTRA company.

Warranty Card

The Warranty Card must be retained by the Client
for the entire warranty period of 5 years.
The Warranty period starts on the date of purchase.

ELEKTRA
Heating Cables

PLACE OF INSTALLATION			
Address			
Zip code		City/Town	

The Warranty claims must be registered with the Warranty Card and proof of purchase, in the place of purchase

TO BE COMPLETED BY AN INSTALLER					
Name and Surname				Electrical authorisation certificate No:	
Address				E-mail	
Zip code		City/Town		Phone No:	Fax

Heating cable's core and insulation's resistance	
after laying the heating cable, before the insulation is laid (for pipes and pipelines)	MΩ
after the insulation is laid (for pipes and pipelines)	MΩ
after laying the heating cable (other applications)	MΩ

Date	
Installer's signature	
Company's stamp	

Note: The heating cable's insulation resistance, as measured with a megaohmmeter of the rated voltage 1000 V, should not drop below 50 MΩ.