

INSTALLATION MANUAL FOR HEATING CABLES

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INTRODUCTION

This manual deals with installation and maintenance of self-regulating heating cables and parallel heating cables with constant output produced by the company Heat Trace Ltd, which is represented by GENERI, s.r.o., and serial resistance heating cables made by GENERI s.r.o. The warranty for proper functioning of the product is only applicable when the instructions contained in this manual and documentation supplied with the product are observed.

Installation must be conducted in accordance with the standard EN IEC 60079-30-2 and IEC 62086-2 for explosive hazard environment (if present). Also, installation of the system must meet all relevant local and national standards. If you have some additional questions, contact GENERI, s.r.o.

USE

The electric heating cables are used for protection against freezing or for maintaining a stable process temperature in piping, tanks or other equipment. They can be installed in common environments as well as in explosion hazard environments, depending on specific properties of individual cables.

TYPES OF HEATING CABLES

SELF-REGULATING HEATING CABLES:

FSM	FSEw	FSUw
FSLe	FS+	
FSR	FSS	
FSE	FSU	

PARALLEL HEATING CABLES WITH CONSTANT OUTPUT:

MTF
MTFJ
PHT
AHT

SERIAL HEATING CABLES WITH CONSTANT OUTPUT:

CSK
ISK
MIL-FHC

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BASIC PARAMETERS OF THE PRESENTED HEATING CABLES

	Self-regulating heating cables						
	FSM	FSLe	FSR	FSE(w)	FS+	FSS	FSU(w)
Minimum bending diameter:	35 mm	35 mm	35 mm	35 mm	40 mm	35 mm	35 mm
Minimum installation temperature:	-40°C	-40°C	-40°C	-40°C	-40°C	-40°C	-40°C
Maximum holding temperature under voltage:	65°C	85°C	85°C	100°C	225°C	225°C	250°C
Maximum exposure temperature, without voltage:	85°C	85°C	85°C	100°C	225°C	225°C	250°C
	Parallel heating cables with constant output				Serial resistance heating cables		
	MTF	MTFJ	PHT	AHT	CSK	ISK	MIL-FHC
Minimum bending diameter:	35 mm	30 mm	35 mm	25 mm	5xOD*	15-25 mm**	5xOD*
Minimum installation temperature:	-40°C	-40°C	-20°C	-40°C	-50°C	-60°C	-
Maximum holding temperature under voltage:	85-190°C	108-190°C	168-275°C	36-350°C	-	-	600°C
Maximum exposure temperature, without voltage:	200°C	200°C	285°C	425°C	260°C	260°C	650°C
<i>*5 times the cable outside diameter</i> <i>**15 mm for cables with the diameter less than 8 mm; 25 mm for cables with the diameter higher than 8 mm</i>							

Table 1

CAUTION

Similarly to other electric equipment working with grid voltage, a damage to a heating cable or another component or incorrect installation may result in incorrect conducting of electric



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current with subsequent short-circuit or even fire. Do not connect the main conductors of a heating cable as it would cause a short-circuit. Every unconnected end of a heating cable must be sealed with an approved type of terminal sealing. In order to ensure protection against fire or explosion in an explosion hazard environment, make sure that the maximum surface temperature of the heating cable is lower than the self-igniting temperature of gases and vapours that may be present in the heating area.

RECEIPT, STORAGE, HANDLING

1. Check the heating cable description to make sure that you have received the correct type and quantity. All types of cables feature visible marking on the top sheathing, except for the resistance heating cables with mineral wool insulation (MIL-FHC), which are terminated already from production and supplied with a label with stamped marking. Compare the information on the heating cables with the data in packaging documents in the packaging documents and in the order. Check the correctness of the delivery.
2. Visually check that the material has not been damaged during transport. Or submit a report of damage to the freighter to obtain compensation for damage.
3. Store at a dry place.

Caution: Do not connect the heating cable to power supply if it is still wound on coil or packaged in a box!

BEFORE HEATING CABLE INSTALLATION

1. An insulation test must be conducted before using a heating cable. The cable shall be tested with the min. voltage of 500 VDC. Testing voltage of 1000 VDC is recommended for cables with mineral insulation and 2500 VDC for cables with polymer insulation. The minimum resistance value must be higher than 20 MΩ.
The test must be carried out in the following stages of installation:

- When the cable is on coil
- After heating cable installation
- After installation of thermal insulation
- Before connecting to power supply
- As part of regular checking

Inspection before installation		
	What shall be checked	Note:
1	Has the system to be heated been completely constructed and tested? Is the surface free of sharp edges? Have all welds been cleaned and painted?	Any welding or pressure tests after installation of a heating cable could result in damage or non-functionality of the entire system.
2	Is the surface on which a heating cable is to be installed made of standard steel or a non-metal material?	If the surface is of polished steel, thin-walled or non-metal, this fact must be taken into account during installation.

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3	Was installation of an aluminium foil specified before or after installation of the heating cable?	An aluminium foil can facilitate distribution of heat or serve as a protection against ingress of thermal insulation between the heating cable and the heated equipment.
4	Can the heated medium exceed the temperature the heating cable is able to withstand during standard and non-standard conditions?	This information is usually taken into account already during designing, but certain unannounced partial modifications and changes could have taken place during implementation.
5	Is the most up-to-date documentation of the heating system (drawings, calculation table) available?	Any changes of heated equipment should not be arbitrarily conducted without proper calculations and proper inclusion in the implementation documentation.
6	Can the shape of heated equipment change during operation to such an extent that the heating cable would be overloaded?	It is necessary to prevent any damage to the cable.
7	Can sensors of control thermostats be impacted by external influences?	For example, a neighbouring heating circuit can influence a regulator.
8	Are cold ends, if installed, appropriate and thermally resistant against the heated surface?	If a cold end or its part is to be concealed under insulation, it must withstand the maximum possible neighbouring temperature.
9	Are there any additionally installed blind branches, venting, valves, etc. that have not originally been calculated?	It could cause a complication during installation, extending the heating cable, etc.

Table 2

CONSTRUCTION SITE PROVISION

1. Provide protective clothing, personal protective equipment and other protective means necessary for protection of employees against potential electric arcing and electric shock, which are specified in the analysis of potential risks.
2. Ensure training and qualification of competent employees who understand the principle and function of the electric heating system, its power supply, control as well as how to detect and prevent hazards related to the function and maintenance of the circuit.
3. Secure all conductors and circuits, even when under voltage, until the work on electric equipment has been safely completed in the following manner:
 - Identify the circuit or equipment that is to be disconnected from power supply and all power supplies to the relevant circuits or equipment.
 - Use a suitable method to cut the power supply and then disconnect the equipment.
 - Where possible, visually check that the corresponding switch for the equipment is really off.
 - Lock/secure the equipment according to standard and usual procedures.
 - Use a suitable and approved measuring instrument to check for the presence of voltage.

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- Ground the phase conductor or a part of the circuit before touching at the points where induced or cumulated voltage can occur.
- Use a grounding device in the faulty equipment for disconnected conductors or circuits that can be in contact with powered conductors or circuit parts.

HEATING CABLE INSTALLATION

HEATING CABLE HANDLING

When unwinding the heating cable, avoid the following:

- Its contact with sharp edges
- Excessive pull force
- Twisting and bending
- Stepping on or driving over a heating cable

Recommendations for unwinding of the heating cable:

- Position the coil best to one of the ends of the heated piping.
- Use a coil holder to enable smooth rotation of the coil.
- When unwinding the cable, try to trace the route of the heated piping as close as possible.
- Leave enough heating cable for heating of flanges and supports or for spiral winding of the heating cable.
- Leave a sufficient reserve length of the heating cable for connecting it to power supply.
- If not absolutely necessary, avoid cutting the cable from the coil before completing the installation of a given loop.
- Protect all ends of the heating cable against dirt, contamination, mechanical damage, humidity or other influences before the installation of components.

HEATING CABLE INSTALLATION

The heating cable can be installed on piping straight, in a spiral or in several parallel lines, in accordance with the design and the design documentation.

The self-regulating technology permits crossing of the heating cable, but we recommend using such crossing as little as possible.

Observe the minimum permitted diameter of bending of the heating cable (refer to the table: Inspection before installation. Use at least two coils of glass fibre fixing tape or plastic fixing tape with the pitch of 300 mm to attach the heating cable at places where the heating cable does not cling tightly to the piping.

Only use such plastic fixing tapes whose thermal resistance matches the exposure temperature of the given system.

Refrain from using vinyl insulating tapes, installation and zipping tapes or metal fixing bands (except on the mineral insulated resistance heating cable MIL-FHC), because it could result in damage to the cable.

The self-regulating and parallel resistance heating cable shall only be bent in the standing position! (refer to Figure 1).

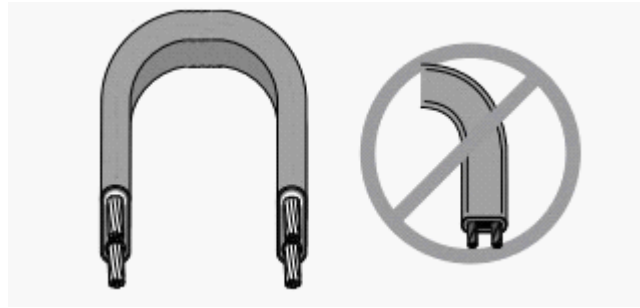


Figure 1

INSTALLATION ON PIPING

The heating cable or cables shall be installed on piping in a straight line (refer to Figure 2), if not specified otherwise by the project. In horizontal sections, install the heating cable in the lower quarter of piping, as illustrated in Figure 2. Avoid installation on the lowest section at the points of flanges and at places where there is a risk of leakage of the medium. There is a risk of damage to the cable as a result of the effect of chemicals contained in the heated medium.

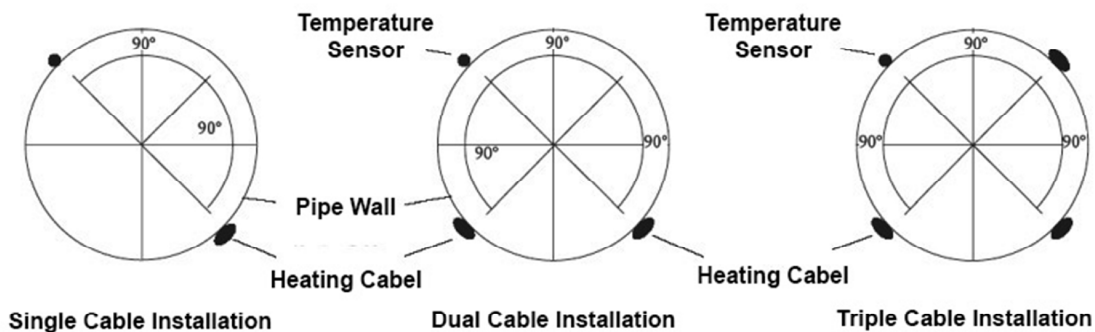


Figure 2: Position of the heating cable with respect to the position of the thermostat sensor

INSTALLATION ON BENDS, FLANGES AND SUPPORTS

Install the heating cable according to Figures 3, 4 and 5. Secure the heating cable by means of a fixing tape. The recommendations below take into account the installation.

Bends

Position the heating cable on the outer section of the bend in order to ensure good transmission of heat to the points with a higher amount of material. Use a fixing tape to attach the cable on the piping on both ends of the bend.

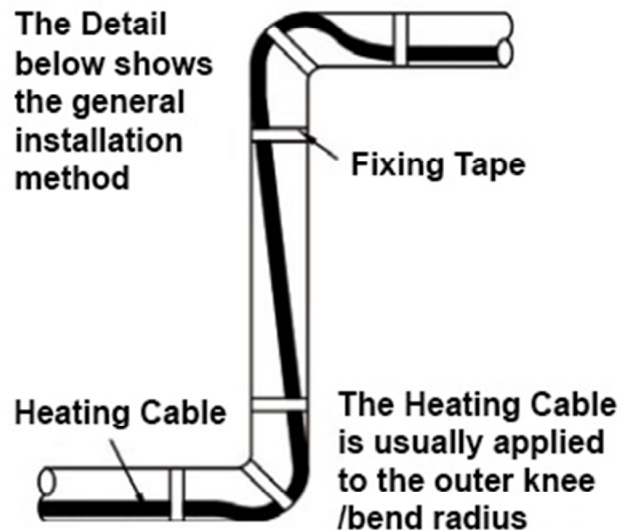


Figure 3

Flanges

Wind the cable around the piping on both ends of the flange. The heating cable must be in contact with the flange in order to efficiently compensate for higher thermal losses. In a situation where two heating cable loops pass over a flange, and in contradiction to a design where just a single loop with the same output is calculated, it is possible, upon agreement with the designer, to minimize the increment for the second loop on the flange.

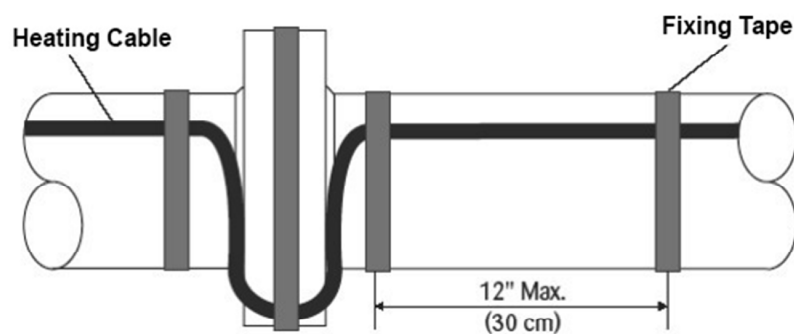


Figure 4

Supports

No increment of the heating cable is necessary in the case of insulated supports or hangers, if it is not required by the design! If a hanger is used, do not pinch the heating cable under the hanger. The heating cable must be laid over the hanger.

If a non-insulated support is used for piping with the diameter $\geq 2"$, it is necessary to add an increment of the heating cable (refer to Figure 5); twice the length of the support plus another 8 cm of the heating cable is added. (in order to maintain a process temperature in piping, supports should be insulated from the piping. We recommend conducting insulation in the case of tempering against freezing, too).

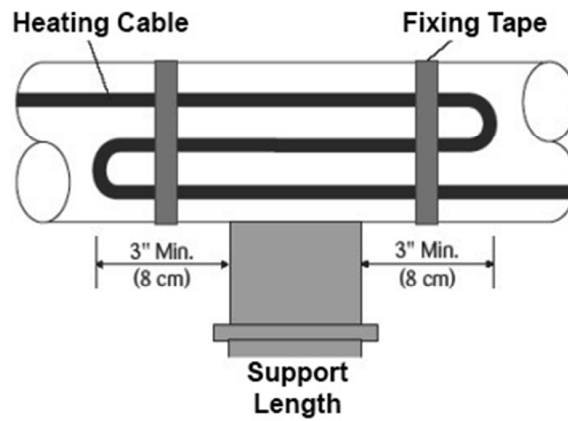


Figure 5

INSTALLATION ON VALVES AND PUMPS

Install the heating cable according to Figure 6 and 7. Secure the heating cable by means of a fixing tape.

Valves

A cable increment is necessary for balancing an increase of equipment-related thermal loss. Additional length of heating cable can be found in design documentation. Also, a loop facilitates replacement of the pump as necessary. The figure shows the recommended method of installation. However, the arrangement can differ according to the shape of a valve, the cable length needed or in the case of multiple installation of the heating cable. Do not exceed the permitted diameter of the heating cable bending defined by the manufacturer.

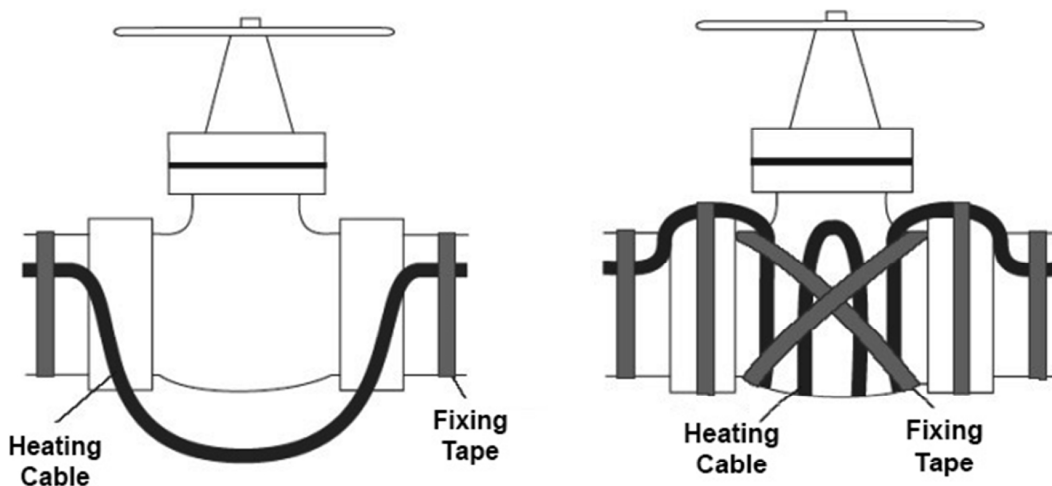


Figure 6

Pumps

Similarly to valves, an increment of the cable is given by compensating the effect of thermal losses. The size of an increment can also differ in dependence to the required holding temperature. The arrangement of the heating cable can differ according to the pump shape or the method of installation, when the pump can be heated either separately or as part of heating of piping. If there is a requirement on higher holding temperature, we recommend paying attention to sufficient heating of the lower section of the support structure, as well as

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to using an aluminium covering tape to achieve better distribution of heat. Do not exceed the permitted diameter of the heating cable bending defined by the manufacturer.

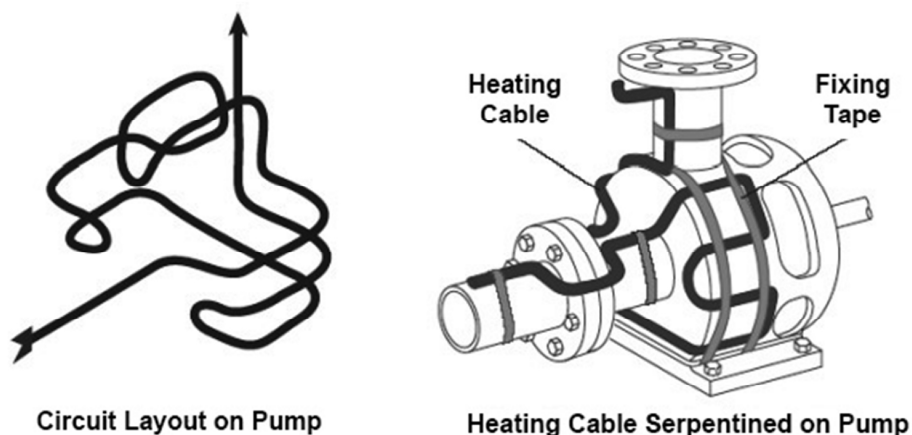


Figure 7

INSTALLATION ON LEVEL GAUGES AND PRESSURE METERS

Install the heating cable according to Figures 8 and 9.

Level gauges

When installing the heating cable on a level gauge, which is usually insulated only partly, we recommend making several heating cable loops as illustrated in the figure. In order to achieve better distribution of heat, it is recommended to cover the cable with aluminium tape.

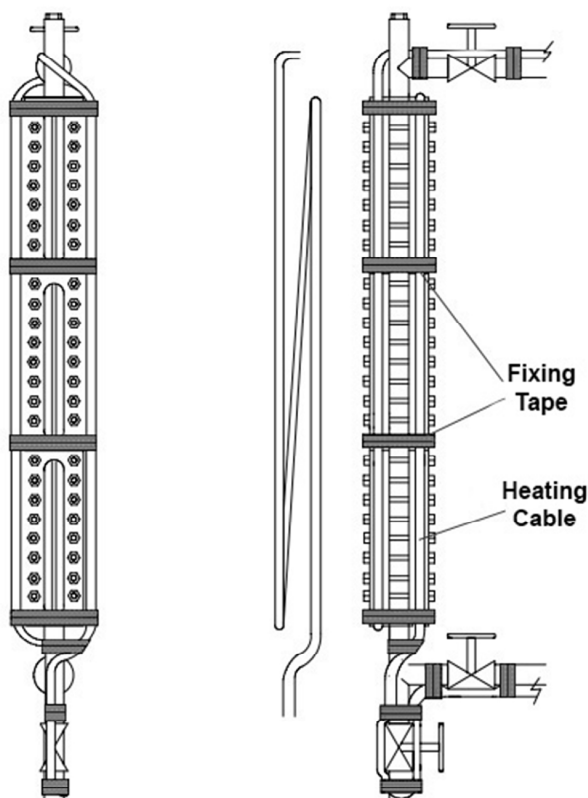


Figure 8

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Pressure gauges

The heating cable shall also be installed on the displaying part of a pressure gauge, which is not thermally insulated.

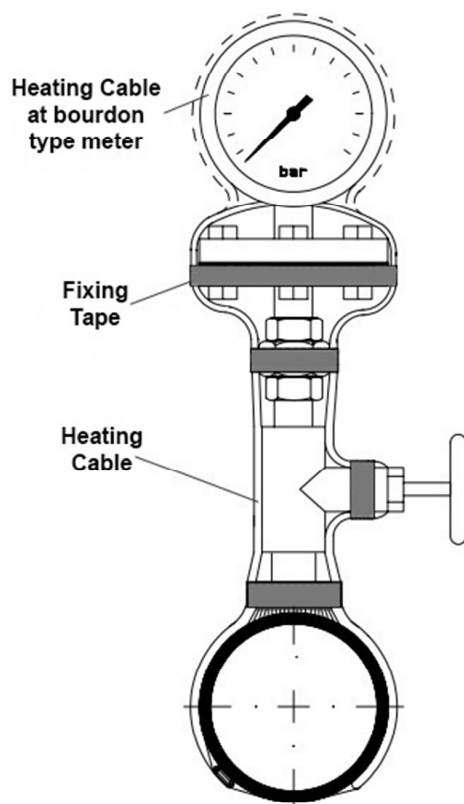


Figure 9

INSTALLATION ON VESSELS AND TANKS

Use an aluminium tape, best in combination with the SNMS fixing tape to install the heating cable. If the character of the heated surface or the quality and type of coating permits, installation can be conducted just with the aluminium tape with good adhesive properties. If the surface is too rough and coarse and the adhesion of the tape insufficient, it is necessary to use auxiliary stainless fixing SNMS bands, which will ensure holding the heating cable in the required position. It is best to tack the SNMS band in designated positions before starting the installation of the heating cable proper. If the situation at construction site does not permit tack welding the bands, it is possible, depending on the character of the vessel, to use SXB attachment bands to tighten the fixing bands, refer to Figure 10.

The procedure for installation of the heating cable according to Figure 10 is as follows:

1. Tighten the fixing band (not too tight) in the upper section of the vessel or tank.
2. Insert the required number of clipping bands of sufficient length between the fixing band and the wall of the vessel. Hang the clipping bands on the fixing band. The open side of the band clip must face down (refer to Detail A). Distribute the clip bands evenly along the circumference of the tank/vessel (max. 75 cm).
3. Tighten the upper fixing band

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4. Twist the clip bands into the centre of the tank/vessel. Pass a binding wire through the last slot in the clip band. Twist the ends of the binding wire until the clip bands are as close to the wall and bottom as possible (refer to Detail B).
5. First attach the fixing band at the lower section of the vessel/tank and the other fixing bands with the max. pitch of 1 metre.
6. Bend the band clips up where the heating cable is to be installed.
7. Position the heating cable into the clips pointed upwards (the clips serve as supports and should not be tight around the cable!!!)
8. The heating cable shall be covered by the aluminium tape along the entire length.
9. Terminate and connect the heating cable into the prepared terminal box according to the cable type.

NOTE: Self-regulating and parallel heating cables are powered from one end only. Serial heating cables shall have both ends connected to power supply!

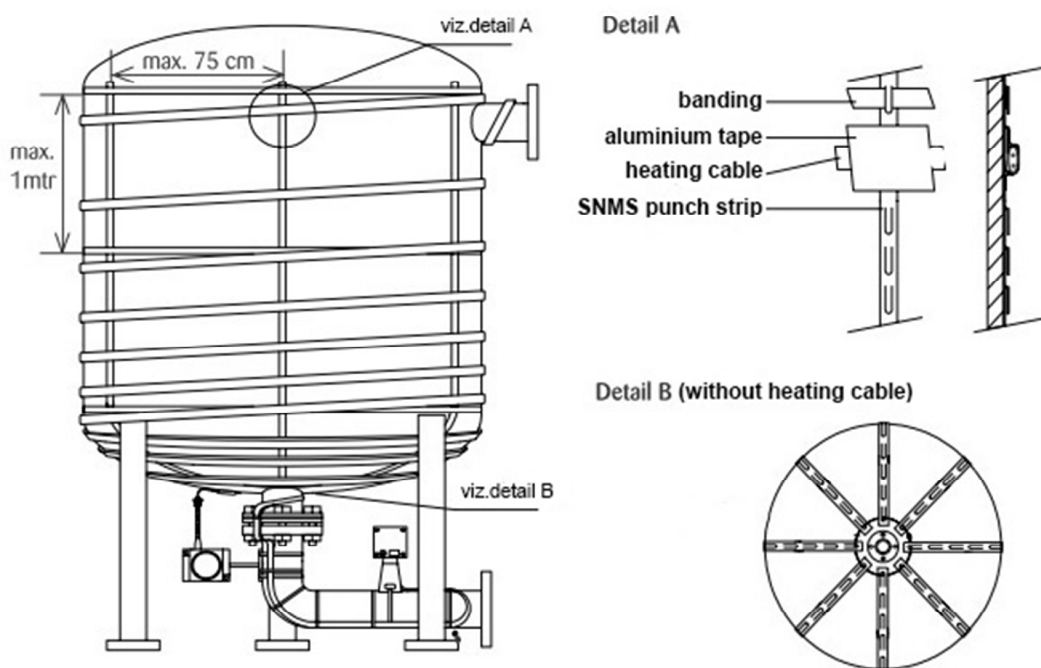


Figure 10

COMPLETION OF HEATING CABLE INSTALLATION

Except the requirement for fixing, the covering by the aluminium foil is required in the following cases:

- Heating of plastic piping - the foil serves to ensure better distribution of heat

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- Sprayed or polyurethane insulation shall be used when there is a risk of the thermal insulation material entering the space between the heating cable and the heated piping.
- According to the design, the use of the foil to ensure better distribution of heat has been designed

Use the corresponding manual to terminate the heating cable on the non-powered side. If the heating cable is to be terminated in the signalling box, proceed according to the instructions for installation of the termination on the powered side. Self-regulating heating cables form a parallel circuit, similarly to parallel heating cables with the constant output. Therefore, do not connect the conductors of heating cables together in order to avoid causing a short circuit.

Repeat the insulation status test before conducting the termination on the powered side. Use the detailed instructions attached to the termination set to install the termination on the powered side. Before starting, do not forget to install insulation on the heating cable entry, provided that it is included. Mineral insulated heating cables are already terminated from production, and therefore it is sufficient to connect the prepared cable entries into the prepared terminal boxes.

The power supply box can be installed directly on piping using an assembly holder or leg, or on the wall. Heating circuits can be switched directly by the areal or capillary thermostat. In such a case it is necessary pay attention to the maximum current load of the switching contact of the given thermostat.

Typical installation of a power-supply terminal block and the corresponding accessories on horizontal piping is illustrated in Figure 11.

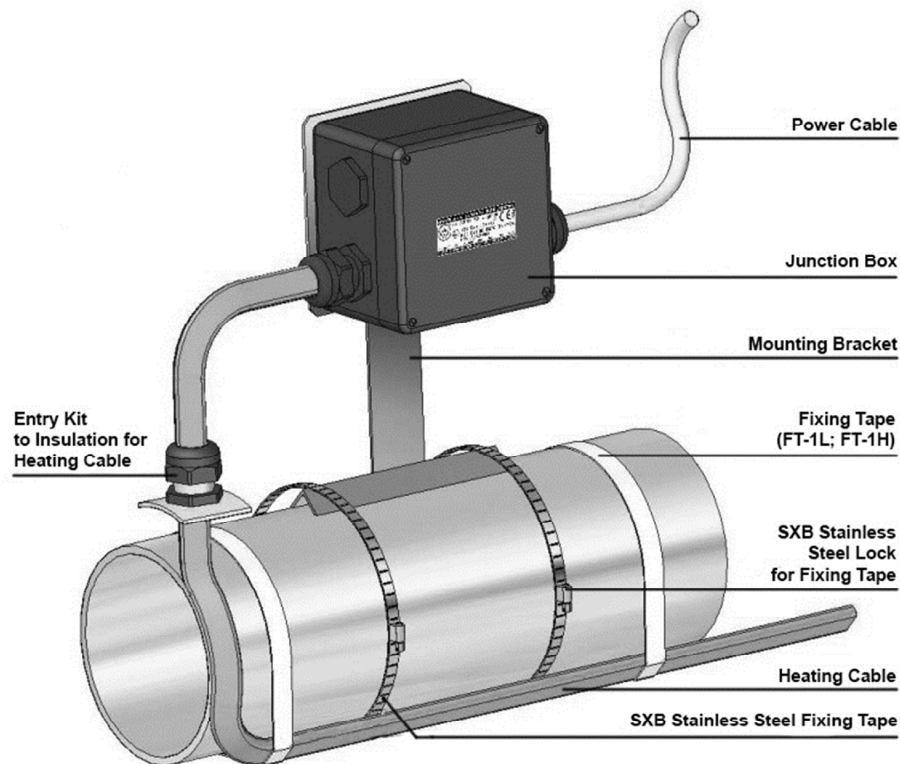


Figure 11

POSITION OF TEMPERATURE SWITCH

Depending on the type of application, a heating system can contain temperature reading by means of areal or capillary thermostats, RTD sensors or thermocouples. The following recommendations shall be observed during installation of the sensor proper.

The sensor can be attached using a fixing band, a special adhesive, an aluminium tape or thermally resistant clips. The sensor shall not be in direct contact with the heater. An exception is heating of a plastic surface, in which case it is recommended to position the sensor directly next to the heater, and reading of temperature of the heating cable proper for the purpose of its guarding. Position the sensor in such a way that it monitors the temperature situation of piping or equipment as truly as possible. You should avoid positioning the sensor directly by an entrance to a building, on the inlet side of the medium or at a place directly impacted by an external source of heat.

Areal thermostats should be installed out of reach of sun rays and at places with the minimum impact of climatic influences if the situation permits.

The sensor must be in reliable contact with heated surface. It is necessary to prevent the thermal insulation material from entering the space between the sensor and heated surface. When conducting installation, it is necessary to pay attention to preventing damage of a capillary or a sensor or a distortion due to incorrect positioning. A designed sensor (detector) should have the corresponding thermal resistance so that it will not get destroyed by the impact of high temperatures.

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Installation of a sensor for temperature regulator or for equipment temperature limiter

A sensor for temperature regulator is installed on the surface of piping or equipment at a place which will provide a temperature representative of an entire circuit. According to the figure, the sensor is installed on the surface of piping or equipment at a place which will provide a temperature representative of an entire circuit.



Figure 12

Installation of a sensor for limiting (guarding) the heating cable temperature

If installation of a temperature limiter is requested in order to ensure safe operation of a heating cable, the sensor must be installed directly on the heating cable. A suitable position must be selected, at a place with the highest expected temperature of the heating cable if possible.

It is important to set the regulator in such a way that the temperature of cable sheathing does not exceed the specified limit temperature of the cable or the temperature of an environment with a risk of explosion defined according to the corresponding temperature class, with at least 10% reserve.

In Figure 12, the temperature sensor is positioned in such a way that it measures an artificial hot spot designed to represent the hottest point on the trace heating. This method can be a suitable alternative when serial trace heating is used.

THERMAL INSULATION

Before installing thermal insulation, conduct a test of the insulation status. The cable shall be tested with the min. voltage of 500 VDC. Testing voltage of 1000 VDC is recommended for cables with mineral insulation and 2500 VDC for cables with polymer insulation. The minimum resistance value must be higher than 20 MΩ.

In order to maintain a required temperature, it is necessary to provide correct and dry thermal insulation whose thermal insulating properties correspond to the original design. Possible problems with insulation then have a direct impact on the function of the system as a whole. In order to minimize the risk of damage to heating cables, conduct installation of thermal insulation as soon as possible after installation of the heating cables.

- Make sure that the entire piping, including all related valves, pumps and flanges, is

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- properly insulated and all its joints sealed.
- Check all heating cable and sensor entries through insulation.
- Make sure that the heating cable was not damaged during installation of insulation sheathing, e.g., by drilling, self-tapping screws or sharp edges of the sheathing.
- **Mark the heated piping by "ATTENTION! Electric Heating" signs with suitable spacing (recommended distance from each other is 3-5 m).**
- When installation of thermal insulation has been completed, conduct a test of the insulation status.

FINAL INSPECTION

When thermal insulation has been installed and connected to power supply, the system must be put in operation in order to test its function.

Check the correct setting and function of the limiting components.

Check the correct setting and function of the temperature regulator.

When the heating system has been connected, we recommend recording the values of voltage, current and ambient temperature and repeating the measurement after 5 minutes. Keep the recorded values.

You can use the forms in Annexes 1 and 2 for recording the required values.

POWER SUPPLY AND PROTECTION

Electric protection must be dimensioned in accordance with design documentation and recommendations of the heating cable manufacturer. If there is a change compared to design documentation or if another circuit breaker is used than originally specified, ask the GENERI representative for documents related to correct dimensioning of the protective elements.

It is always necessary to install a current protection to ensure the maximum safety and health protection. The recommended value of residual current is 30 mA. In case there is a justifiable exceeding of this current, protections with a higher residual current value can be used, but no more than 300 mA.

If a heating cable is installed in an explosion hazard environment, a current protection must be used.

The correct design and implementation of heating cable power supply must be in accordance with the applicable wording of the corresponding standards.

- ČSN EN 60079-14: Design, selection and erection of electric installations
- ČSN EN 60079-30-2: Electrical resistance trace heating systems - Instructions for design, installation and maintenance

OPERATION, MAINTENANCE AND REPAIRS OF PIPING

Self-regulating heating cables can be designed in the stabilized design mode, which enables using the cables for lower temperature classes in accordance with the standard EN 60079-30-2.

Parallel and serial resistance heating Self-regulating heating cables can be designed in the stabilized design mode, which enables using the cables for lower temperature classes in accordance with the standard EN 60079-30-2.

If a stabilized design is used, the end customer must record the system parameters and the specification of temperature classes, and archive these data for the period of functioning of the system.

The exposure temperature must not exceed the value stated in the technical specification of the given heating cable. Exceeding this value shortens the service life of a heating cable and can result in its permanent damage.

Visual check: heating cables and thermal insulation must be regularly checked during operation in order to make sure that there is no mechanical damage.

Insulation resistance measurements must be conducted in regular intervals determined in advance. We recommend checking the antifreeze control system every year before the start of the winter season. If the system is used for maintaining a process temperature, we recommend conducting its inspection at least twice a year. If the system fails to pass the test, find the possible cause or ask the GENERI company for consulting on the problem.

REPAIRS AND MAINTENANCE OF PIPING

- Reliably disconnect the heating circuit from power supply
- Protect the heating cable against mechanical and thermal damage during work
- When the work has been completed, check the heating cable installation and restore the thermal insulation
- Check the correct functioning of electric protection elements

Possible faults and their removal are described in detail in Table 3.

Fault:	Probable cause:	Method of repair:
Circuit breaker tripping	The switching temperature is lower than specified in the design.	Gradually connect the power supply to the individual circuits. Recalculate the design for a lower switching temperature. Preheat the piping by another heating source to the switching temperature as specified.
	An electric fault in the heating system.	Check all connections and termination of the heating cable.

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	Too long circuit.	Divide the circuit or design its new protection according to the parameters stated in the catalogue sheets of heating cables.
	A faulty protection element.	Replace the protection element.
Current protection tripping	An electric fault in the heating system.	Check all connections and termination of the heating cable.
	Contaminated terminal box, coupling or termination.	Dry out, reseal or reinstall. Conduct a check of insulation resistance.
	Too high leakage currents.	Modify the project.
	A faulty current protection.	Replace the current protection.
Heating cable not heating	The control thermostat contacts mismatched.	Reconnect the thermostat contacts.
	Loss of supply voltage.	Restore the power input.
	Too high transition resistance in the terminal box, coupling.	Find and remove the fault by tightening or repair.
Low temperature of piping	Damp thermal insulation.	Remove the insulation, replace it by dry insulation with correct parameters and ensure its sealing against the ingress of water.
	Design fault.	Consult with the designer. Modify the project according to recommendations by GENERI.
	An incorrectly set control element.	Repair or restore the correct setting.
	The heating cable exposed to a higher than permitted temperature.	Replace the cable.

Table 3

FAULT LOCALIZATION

In order to find a fault on a heating cable, it is possible to use the following, so-called ratio methods, depending on the fault type. All the methods described below can only be used in the case of a fault at a single place. If the heating cable is short-circuited or interrupted at several points, the fault position cannot be exactly determined.

Localization of a short-circuit between the main conductors:

The ratio method utilizes the resistance measurement between the main conductors at both ends of a heating cable. Measure the resistance between the conductors at one (Measurement A) and the other end (Measurement B) of the heating cable.

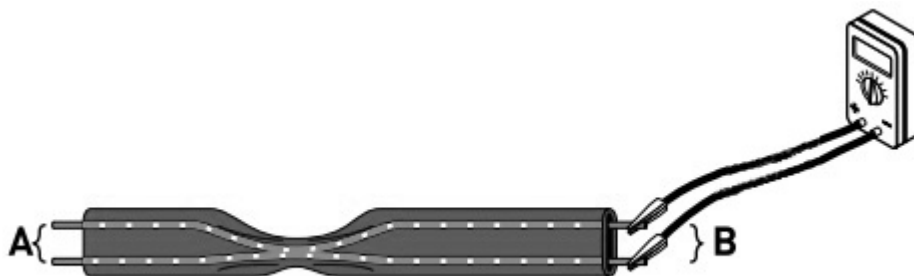


Figure 13

An approximate position of the fault is then given by the ratio of the resistance values measured at both ends according to the following equation:

$$D = \frac{A}{A + B} \times 100$$

Example: $A=0.8 \text{ Ohm}$
 $B=1.2 \text{ Ohm}$
 Heating cable length: 80 m

$$D = \frac{0,8}{0,8 + 1,2} \times 100 = 40\%$$

$$d = 80 \times 0,4 = 32m$$

The fault is located approximately 32 m from the A end.

Localization of a grounding fault

Measure the resistance between both main conductors and the sheathing at one (Measurement A) and the other end (Measurement B) of the heating cable.



Figure 14

An approximate position of the fault is then given by the ratio of the resistance values measured at both ends according to the same equation as in the previous case:

$$D = \frac{A}{A + B} \times 100$$

Example: $A=0.6 \text{ Ohm}$
 $B=0.9 \text{ Ohm}$
 Heating cable length: 50 m

$$D = \frac{0,6}{0,6 + 0,9} \times 100 = 40\%$$

$$d = 50 \times 0,4 = 20m$$

The fault is located approximately 20 m from the A end.

INSTALLATION MANUAL FOR HEATING CABLES

Localization of an interrupted cable

This method utilizes the resistance of the heating matrix measured at both ends of a heating cable to determine the place of a fault. It can involve a situation when a heating cable is interrupted without the occurrence of a short-circuit between the main conductors or between conductors and sheathing. Another hint can be a certain cold part of piping by the non-powered end of a heating cable.



Figure 15

Measure the resistance between the conductors at one (Measurement A) and the other end (Measurement B) of the heating cable. An approximate position of the fault is then given by the ratio of the resistance values measured at both ends according to the following equation:

$$D = \frac{\frac{1}{A}}{\frac{1}{A} + \frac{1}{B}} \times 100$$

Example: A=100 Ohm
 B=50 Ohm
 Heating cable length: 60 m

$$D = \frac{\frac{1}{100}}{\frac{1}{100} + \frac{1}{50}} \times 100 = 33,3\%$$

$$d = 60 \times 0,33 = 19,8m$$

The heating cable interruption is located approximately 19.8 m from the A end.

Annex 1: Report of installation of trace heating

Location system:	System:	Reference number:	Heating number:
Junction box number:	Location:	Zone classification:	Temperature class:
Heating manufacturer:	Type of heating:	Circuit :	Design voltage:
Megaohmmeter manufacturer /type:		Residual current trip setting:	Accuracy/a full range:
ADHESIVE HEATING TESTS		Date	Responsible person
<p>The integrity test for self-regulating accompanying heaters is only used to verify short circuits or circuit breaks. The minimum acceptable value of the insulation resistance must be 20MΩ, with the exception of MI for auxiliary heating where the minimum is 5MΩ. Minimum acceptable test voltage of 500 V. For MI, DC 1000V is recommended, and for DC 2500V polymer heating cables.</p>			
Insulation resistance testing(bypass controller if necessary)			
Installed accompanying heating (permission to start the auxiliary heating installation)			
Heating system installed on piping, tank, equipment:			
Heating system installed on valves, supports and other cooling parts:			
Installation in accordance with manufacturer's instructions:			
Thermal protection installation completed			
Entire test:			
Insulation resistance test:			
THE SYSTEM HAS BEEN CHECKED			
Labels, labels and identification completed (viz IEC 60079-30-1)			
Heating system effectively grounded:			
Temperature controller installed and set point verified:			
Junction boxes are all certified and closed:			
Thermal insulation sealed against weather:			
Drawings, documentation of actual execution:			
Performed by:		Company:	Date:
Participation by:		Company:	Date:
Accepted by:		Company:	Date:
Approved by:		Company:	Date:

Examinations and measurements on the installed heating cables

Sheet no.: from:

Job no. : Appendix handover protocol no.: Job:

Inspection by : Name : Signature :	Description of control (*= to protective braid)	Satisfactory condition	Example		
			date	measured	result
	1. insulation checking-conductor* - before installing thermal insulation	ringout, min. 10 M Ω	1.2.2012	> 50	OK
	1. insulation checking-contuctor* - before installing thermal insulation	min. 10 M Ω	2.2.2012	5	N
	2.insulation checking-conductor* - after installing thermal insulation	min. 10 M Ω	3.2.2012	> 50	OK
	3. function control (tempering) - by touch	warm - temp. difference min 5 °C	4.2.2012	8 / 15	OK
	4. installation of warning labels - strenght and distance	cca 3 m	5.2.2012	2 - 3,5	OK

contr.	branch :					branch :					branch :				
	customer					customer					customer				
	date	measured	result	name	signature	date	measured	result	name	signature	date	measured	result	name	signature
1.															
2.															
3.															
4.															

contr.	branch :					branch :					Measuring devices :				
	customer					customer					type serial number				
	date	measured	result	name	signature	date	measured	result	name	signature					
1.															
2.															
3.															
4.															

Notes:

The actually installed length of the heating cable is included in the installation log.
 A record of the control and / or setting of the thermostat value is given in the mounting log.
 The power control record (if included) is part of the revision.
 Checks carried out in accordance with ČSN EN 60079-14 ed. 4

Project: