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1. Introduction

The present BARTEC manual for installation + maintenance is to provide you with important information on electrical trace heatings for pipes.

It exclusively applies to the use of

- BARTEC-EKL (flexible single-core heating cables) as well as
- BARTEC-EMK (single-core mineral-insulated heating cables).

The content of this manual is particularly directed towards persons who are entrusted with the planning, erection, operation and maintenance of electrical trace heatings.

This manual applies to the following BARTEC products

- BARTEC EKL heating cables type: 27-582 .-5512-
- BARTEC EKL-light heating cables type: 27-582 .-5514-
- BARTEC EKL EX heating cables type: 27-582 .-5518-
- BARTEC EKL- Standard connection kits type: 27-5673- . 1 . .
- BARTEC EKL- Ex connection kits type: 27-5671- . 2 . .
- BARTEC EMK heating cables type: 27-383 .-20 . ./
- Pre-assembled EMK heating circuits Ex /Standard
Pre-assembled EMK heating loops Ex / Standard type: 27-361 .-: . . .
- Installation accessories

➔ The BARTEC warranty only applies if all provisions and recommendations of the manual and the product-accompanying installation and mounting instructions are strictly adhered to. This particularly applies to the above-mentioned instructions.

2. Important Installation and Maintenance Instructions

Observance of the following instructions is imperative when installing and maintaining BARTEC-EKL and BARTEC-EMK heating cables and their respective installation systems. Non-observance of these instructions may imply serious hazards for both personnel and system components.

For the installation and maintenance of electrical trace heatings, the respective national regulations, such as DIN VDE 0100 and DIN VDE 0105, (DIN)EN 50110 (1+2), as well as the respectively valid safety regulations, such as BGV A2, must be complied with.

- For industrial applications, DIN EN 60519 Part 1 and Part 2 as well as DIN VDE 0253 must be taken into account. For hazardous areas, the respectively applicable provisions must be adhered to.
 - For the Federal Republic of Germany:
EN 60 079-14, DIN VDE 0100, DIN VDE 0105, ElexV, RL 94/9/EG, RL 1999/92/EG
 - For Europe:
EN 50 014, EN 50 019, EN 60 079-14, RL 94/9/EG, RL 1999/92/EG
- Improper installation of the trace heating and the adjacent system components or heating cable damage may bear the risk of short circuits and fire during operation.
- When using an EKL or EMK heating cable in hazardous areas, a temperature monitor as well as a temperature limiter must always be applied.
- Protect both ends of the single-core heating cable against environmental impact.
- Junctions or contact points of the single-core heating cables are impermissible as the limit temperature and the max. perm. operating temperature of the heating cable would be exceeded.
- To ensure for a proper installation of BARTEC single-core heating cables, we recommend the use of BARTEC connection systems. Such systems have been specifically developed for BARTEC heating cables and have been tested and approved by test institutes.



3. Selection of the Heating Cable and Configuration

Prior to any installation of electrical trace heatings, the installer must check whether the trace heating has been properly configured. Particularly, the following aspects must be verified:

- Is an accurate configuration documentation and operation manual available?
- Does the selected heating cable meet the respective requirements?
This particularly refers to:
 - calculated heat losses
 - temperature class specified in the type examination certificates
 - max. permissible operating temperature
 - max. permissible ambient temperature
- Does the used pipe length exceed or underrun the calculated length?
- Has a connection system been selected which complies with the requirements?
- Does further material, which belongs to the trace heating or the adjacent installation, meet the
 - electrical
 - mechanical
 - thermal
 - chemical requirements?
- Has electrical equipment been selected for installation in hazardous areas for which an Ex type examination certificate or a conformity certificate is available?

If a respective configuration documentation is not provided for, we recommend a verification of the above-mentioned points on the basis of the BARTEC product documentation.

Should any questions arise during the examination of configuration documents, we recommend you to contact the BARTEC technical department. Thanks to their comprehensive system know-how and a DP-supported configuration, our expert team will provide you with assistance. For the address of our technical department, please refer to Chapter 12.

4. Storage

Incoming goods

- Compare the delivery note with the supplied goods.
- Examine the supplied heating cables and accessory components for possible transport damage.

Storage

- Store heating cables and connection components at a clean and dry location.
- During storage, particularly contact with chemicals and petrochemical products must be effectively avoided.
- It must be ensured that the heating cables are protected against mechanical damage during storage.
- The storage temperature must not underrun -40°C or exceed $+60^{\circ}\text{C}$.
- Even if heating cables and connection components are only shortly stored in damp rooms or at a construction site, the ends must be effectively protected against humidity (e.g. by installing an end termination).



5. Installation

5.1 Installation preparations

5.1.1 Scheduling

- The installation of the electrical trace heating must be temporally coordinated with other installation works. This particularly refers to works carried out at the piping system, the electrical installation and heat insulation.
- All installation works at the piping system must have been completed.
- Pressure tests as well as material tests of the piping system should have been terminated prior to installing the electrical trace heating.

5.1.2 Inspections prior to installation

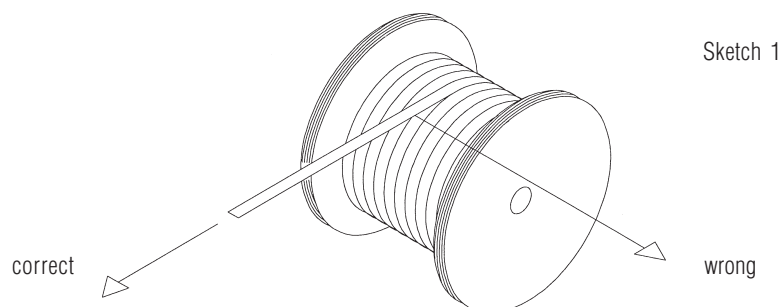
- Measure the insulation resistance at the heating cable shortly before starting the installation works.
- Check on the basis of the insulation resistance measuring whether the supplied heating cable length corresponds to the configuration specifications.
- Check whether all material required for the installation of the electrical trace heating is available at the construction site and free of damage.
- Above all, check whether the identification of the heating cable and the components complies with the configuration documents (material list) and type examination certificates.
- Check on the basis of the product-accompanying installation instructions whether all required tools are completely available.
- Plan the routing of the heating cable by inspecting the piping system to be heated.
- Within this context, pay attention to sharp edges and uneven surfaces which may damage the heating cable and remove them.
- Varnished and painted pipes and surfaces must be completely dry before starting installation works. Only after approx. 3 weeks, the drying and gas emission process is completed.

5.2 Installation of the heating cable

5.2.1 Handling of the heating cable

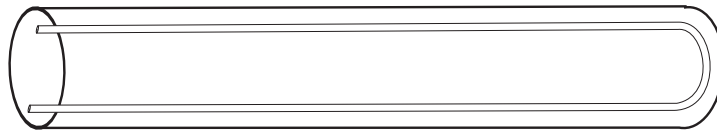
To unroll the heating cable, use a stable fixture for the heating cable reel.

- Evenly wind the heating cable off the reel (sketch 1). Avoid extensive pulling as well as bending and crimping of the heating cable.
- When rolling the heating cable off the reel, observe that the cable does not run over corners or sharp edges.
- Do not step on the heating cable! Do not use the heating conductor as stepping loop! Do not drive over the heating cable with a vehicle and keep other people from driving over the cable.



5.2.2 Routing of the heating cable

- Always route the heating cable in a stretched way along the pipe to reduce expensive installation time, avoid installation faults caused by complicated spiral routing and avert heating cable damage during heat insulation works. In addition to this, the heating cable can be easily localized afterwards if it was stretched for routing.

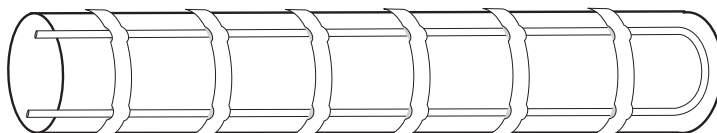


Sketch 2

- Only spiral-route the heating cable if this is expressly required by configuration.
- To ensure a sound heat transmission, the heating cable must be fitted planely over its entire length. If required, the spacings between the fitting points must be reduced.
- When routing the heating cable (1st cable), observe that the heating cable can be re-routed at pipe fixtures and other accessories without any junctions.
- Observe bypass and branch lines when routing.
- When installing EMK heating cables, make sure that the connecting sleeves are taken out of the insulation with pipe surface temperatures > 400 °C or maintained temperatures > 200 °C.

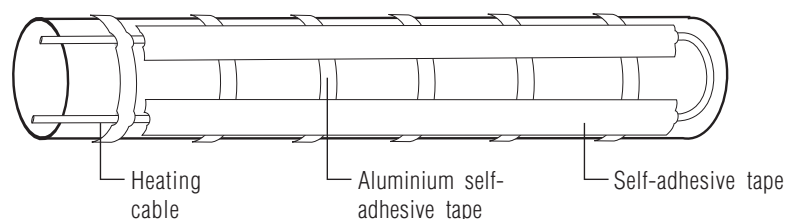
5.2.3 Fixation

- Fix the heating cable at least every 200 mm by means of a temperature-resistant self-adhesive tape or plastic cable ties. EMK mineral-insulated heating cables are to be fixed using stainless-steel fixing straps or cable ties (Sketch 3).



Sketch 3

- When selecting proper fixation means, please observe the following instructions:
 - Preferably fix the heating cable by means of BARTEC self-adhesive tapes/cable ties (refer to the selection chart "Fixing material").
 - When using cable ties, ensure a sufficient temperature resistance and resistance against chemical influences.
 - Do not use any metal fixtures for flexible single-core heating cables.
 - Only use aluminium self-adhesive tape if this is required by the configuration. The use of aluminium self-adhesive tapes improves heat transmission. Such tapes prevent insulation material from intruding between the heating cable and the piping wall.



Sketch 4

- For the heating of plastic pipes, aluminium self-adhesive tape or aluminium foil is to be provided for under or under and over the heating cable for a better heat transmission and distribution.



Routing at controls and instruments, flanges and pumps

- When routing the heating cable, always observe the minimally permissible bending radius! (5 x external diameter for EKL and EMK)

Example tank:

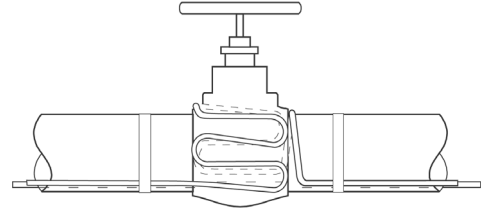
AD heating cable= 3 mm

Cable spacing = Factor bending radius x external diameter heating cable

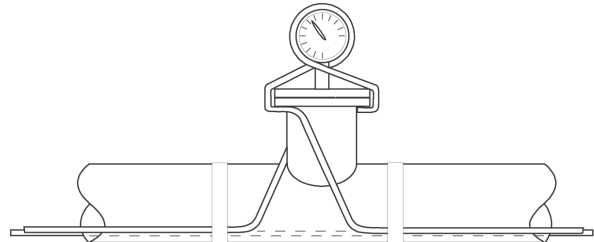
Cable spacing = 5 x 6 mm = 30 mm

- Always route heating cables at controls and instruments, valves, etc. in a way which ensures that they are freely accessible and replaceable in case of maintenance and servicing works and that heating circuits do not need to be cut. The use of a sufficiently large heating cable loop is the easiest way to achieve this.
- As a result of the increased heat losses at controls and instruments, valves, flanges, etc., a longer heating cable is required. These additional requirements are listed in the configuration.
- For typical routing methods, please refer to the following sketches.

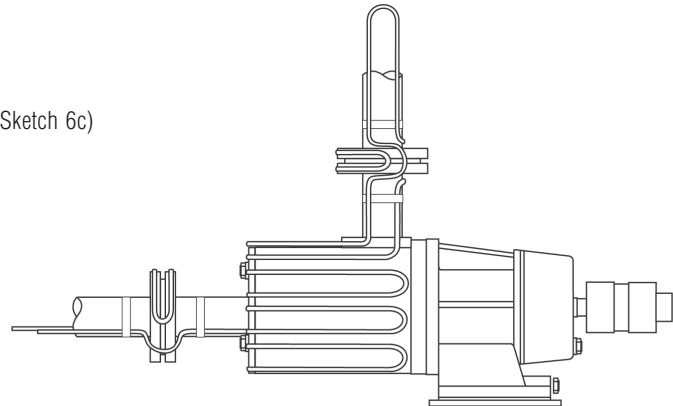
Routing at valves (Sketch 6a)



Routing at pumps (Sketch 6b)

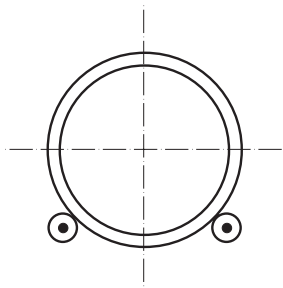


Routing at monometers (Sketch 6c)



Routing at supports (Sketch 6d)





Sketch 5

Stretched routing

- With double laying on the pipe, route the heating cable approx. in the "5.30 pm" and "7.30 pm" position.
 - With horizontal pipes, do not route the heating cable at the deepest point.
 - Do not route the heating cable at horizontal pipes on the upper pipe half unless this is required by the configuration. This protects the heating cable against mechanical damage, e.g. if installation personnel walks on the pipe.
- Furthermore, a routing at the upper pipe half is not recommendable for reasons of heat distribution and only reasonable with certain applications.

Fixing material selection table				
Self-adhesive tape/for heat. cable type ¹	Max. temperature	Width	Roll length	➔ Order No.
Aluminium self-adhesive tape/EKL	150°C	50 mm	55 m	02-5500-0014
Glass-fibre self-adhesive tape/EKL	180°C	12 mm	50 m	02-5500-0035
Accessories	Material	Width/Length	P	
S/S fixing strap EMK	Stainless steel	3/8" 3/4"	30 m 30 m	03-6510-0203 03-6510-0204
S/S clips fixing strap	Stainless steel	3/8" 3/4"	100 items 100 items	03-6515-0201 03-6515-0202
Nylon cable ties for EKL	105°C	200 mm	1,000 items	03-6500-0015
EKL spacing strip	Stainless steel	10 mm	30 m	03-6510-0200
EMK spacing strip	Stainless steel	12.8 mm	20 m	03-6510-0201
S/S cable ties for EMK	Stainless steel Stainless steel Stainless steel	201 mm 362 mm 679 mm	100 items 100 items 100 items	03-6510-0207 03-6510-0208 03-6510-0209
	up to DIN 40 up to DIN 80 up to DIN 150 up to DIN 300			

¹ The specification of the heating cable types refers to their max. possible operating temperatures. With lower maintained temperatures, self-adhesive tapes with a respectively lower temperature resistance may be used.

² With steam-rinsed pipes, use self-adhesive tape 02-5500-0035!

³ With plastic pipes, it is recommendable to wrap the piping with aluminium foil before installing it to protect the pipes and to achieve a better heat distribution.



5.3 Installation of accessories

- ONLY use BARTEC original accessories to comply with existing technical regulations and approvals.
- Please observe that the use of BARTEC original accessories constitutes a condition for possible warranty claims.
- Carefully observe the installation instructions and technical notes on the package inserts of the respective accessories. This is imperative for a fault-free installation.

5.3.1 BARTEC system accessories

Beside the heating cable, the following system accessories are usually required for the complete installation of a heating circuit:

- Heating cable connection system
- Cold leads
- Fixing accessories for the heating cable
- Heat-insulation ducts
- Warning labels “electrically heated”

Further system accessories may additionally be required:

- Heating cable connection
- Terminal box/connection box
- Mounting bracket and mounting plate for terminal or connection box
- BARTEC control units

5.3.2 Further installation instructions

- Prior to installing the power supply lines, install the heating cable connections.
- Install terminal boxes in a freely accessible way.
- When positioning the terminal boxes, make sure that the box entries with cable and heating cable screw connections do not point upwards.
- When installing connections, ensure that existing cable paths can be further used.
- During installation, keep the terminal boxes closed as long as possible to provide protection against dirt and humidity.
- Check for a proper establishment of the termination system and the correct functioning of the heating circuit by measuring the insulation and the loop resistance. (Chapter 9).

After the installation of boxes, check:

- whether suitable and approved screw connections and filler plugs have been used and whether they have been properly installed.
- for a tight fit of screw connections and filler plugs.
- for a tight fit of the box at the mounting bracket.
- Ensure whether the requirements stipulated in the type examination certificates have been met.



5.4 Acceptance and inspection

➤ **Caution** Prior to fitting the heat insulation, the installed heating circuits must be inspected.

Inspection process

- Make sure that the heating cable has been properly routed. Observe particularly that
 - the heating cable fits tightly with the pipe or the tank
 - the heating cable does not show any contact points or junctions
 - the length of the additional heating cable routed at flanges, valves, pumps, controls and instruments is sufficient
 - the heating cable does not show any damage and has not been routed under pipe clamps.
- Check for a proper installation of terminals, connections and terminal boxes as well as temperature controllers and sensors (visual check).
- Check for a proper installation of the limiter sensor (mandatory for heating circuits in hazardous areas), as well as for the limiter setting.
- Enter the position of the heating cables as well as that of terminals and connections into the piping documentations.
- Measure the insulation resistance in all heating circuits before installing the heat insulations (Chapter 10).
- The correct installation and functioning of the electrical trace heater must be confirmed by means of an acceptance certificate (refer to the following sample form).

Acceptance Certificate

BARTEC

Electrical trace heatings	<input type="checkbox"/>	Sheet		
Tank heatings	<input type="checkbox"/>	Heating circuit		
Customer		Date		
		Comm. No.		
		Project system		
		BARTEC Order No.		
Serial No.				
Heating circuit No.				
Pipe/tank No.				
Building				
Product				
Heating cable				
Type				
Installation number				
Heating cable length		_____ m	_____ m	_____ m
Voltage		_____ V	_____ V	_____ V
Current	Switch-on	_____ A	_____ A	_____ A
	Operation	_____ A	_____ A	_____ A
Capacity		_____ W/m	_____ W/m	_____ W/m
Resistance	Cold	_____ Ω	_____ Ω	_____ Ω
	Hot	_____ Ω	_____ Ω	_____ Ω
Insulation resistance- Setpoint: ≥ 5 MΩ with 1000 V measured voltage		> _____ MΩ	> _____ MΩ	> _____ MΩ
Temperature setting		Function check	Function check	Function check
		yes no	yes no	yes no
Controller		____ °C <input type="checkbox"/> <input type="checkbox"/>	____ °C <input type="checkbox"/> <input type="checkbox"/>	____ °C <input type="checkbox"/> <input type="checkbox"/>
Limiter		____ °C <input type="checkbox"/> <input type="checkbox"/>	____ °C <input type="checkbox"/> <input type="checkbox"/>	____ °C <input type="checkbox"/> <input type="checkbox"/>
Low temperature		____ °C <input type="checkbox"/> <input type="checkbox"/>	____ °C <input type="checkbox"/> <input type="checkbox"/>	____ °C <input type="checkbox"/> <input type="checkbox"/>
Ex-version		Ex <input type="checkbox"/> <input type="checkbox"/>	Ex <input type="checkbox"/> <input type="checkbox"/>	Ex <input type="checkbox"/> <input type="checkbox"/>
Temperature class		T _____	T _____	T _____
Comments:				
Above entries verified:				
_____		_____		_____
City/date		Installer		Customer



6. Temperature Control

Selection of a temperature controller

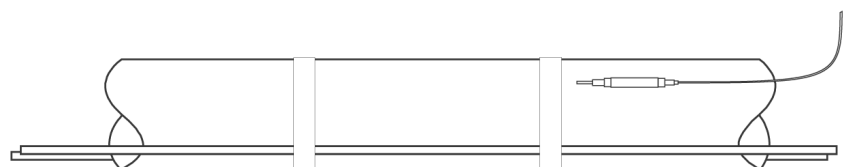
- For operations with single-core heating cable systems, a temperature controller is always required.
- When selecting a suitable temperature controller, particularly the following technical data must comply with the requirements of the respective application:
 - Operating voltage
 - Rated current
 - Temperature control range
 - Max. permissible temperature/max. perm. sensor temperature
 - IP protection
 - Explosion protection, if required
 - Type examination certificate
- For reasons of an economical power utilization, the use of a controller with surface sensor is in all cases recommendable.
- Prior to installation, verify whether the applied temperature controller complies with the technical requirements and the configuration.

Room temperature controller

- Install a room temperature controller always at the coolest spot of the environment (e.g. north side).
- Observe the installation instructions of the respective room temperature controller.

Temperature controller with sensing line

- With trace heatings for pipes, the temperature sensor should not be positioned directly at the heating cable, but at a safe distance (*Sketch 7*).
- When fixing the temperature sensor, a sound heat transmission between the sensor and the pipe must be ensured (e.g. by using an aluminium self-adhesive tape or heat transfer compound).
- Usually, the temperature sensor is fixed at a distance of at least 2 m from controls and instruments, flanges, pumps and supports to avoid false measurements.
- Observe the installation instructions of the respective temperature controller.
- If the position of the temperature controller should not be defined by configuration, please contact the technical department of BARTEC (Chapter 13), where you will get expert advice.



Sketch 7

Further installation instructions

- During installation, keep the casing of temperature controllers closed as long as possible to prevent dirt and humidity from intruding.
- Ensure for a proper fixing of the casing cover and a close sealing.
- Use suitable screw connections and filler plugs in accordance with the technical requirements and type examination certificates and check for their impermeability.



7. Temperature Limiter

For all single-core heating cable systems (EKL or EMK), a temperature limiter must be used in hazardous areas. A limiter permanently switches off the heating circuit upon exceedance of the limit temperature. The temperature limiter must be installed at the hottest spot.

Maximum surface temperature	Temperature class
450°C	T1
300°C	T2
200°C	T3
135°C	T4
100°C	T5
85°C	T6

The temperature limiter's task is to avoid an exceedance of the limit temperature in the tracer heating system, e.g. in case of controller failures or overvoltage, by switching off the heating. Within this context, the selection and installation of the temperature sensor plays a particularly important role. As regards the measuring accuracy, the selected sensor mass should be as low as possible.

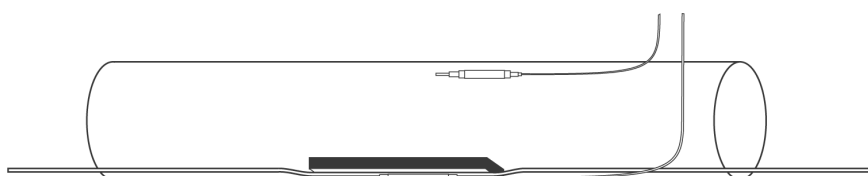
As a matter of fact, the hottest spot in the system is supposedly at the heating cable itself – usually at locations where a sound thermal connection of the heating cable to the surface to be heated is hardly possible, e.g. at valves or flanges.

Artificial hot spot

An artificial hot spot is created by fitting a heat insulation between the heating cable and the surface to be heated, at which the sensor for the temperature limiter is installed with direct contact to the heating cable (Sketch 8).

- When installing the temperature limiter, observe that the sensor is positioned at the hottest system spot. Use aluminium to fix the sensor and the heating cable to each other. To ensure that the temperature at the artificial hot spot is definitely higher than the heating cable temperature at spots with minor thermal connection, this hot spot must be dimensioned with approx. double sensor length.
- As a result of the unavoidable heat dissipation of the sensor itself, the deviation from the sensor mass depends on the heating cable mass (proportion of diameters) as well as on the specific heating capacity (W/m) and must be considered when setting the limiter temperature.
- Each EKL/EMK heating circuit in hazardous areas must be equipped with a limiter.
- When using an adjustable temperature limiter, the switch-off point must be set at up to T3 min. 5K and T2 and T1 min. 10K [refer to EN 50019:28] below the maximum surface temperature of the temperature class.

Example: For T3, limiter setting 195 °C.



Sketch 8



8. Heat Insulation

Important instruction

Prior to fitting the heat insulation, verify whether an acceptance inspection of the installation has been carried out and documented.

Installation of the heat insulation

The reliable functioning and efficiency of an electrical trace heating essentially depends on a proper and professional heat insulation installation.

The following factors must be particularly observed:

- Check for the compliance of the heat insulation (type, insulation thickness) with the configuration. A heat insulation deviating from the configuration must, in no case, be installed as otherwise a correct functioning of the trace heating can no longer be guaranteed.
- Install the heat insulation immediately after the installation of the trace heating to minimize the risk of heating cable damage.
- Only use dry insulation material. Humidity reduces the efficiency of insulation material and thus impairs the function of the trace heating.
- When installing the heat insulation, always take care not to damage the heating cable.
- Only use BARTEC heat insulation ducts for the ducting of heating and connection cables.
- Seal the heat insulation at all welds of the steel jacket and entries (valve entries, suspenders). The entire insulation must be reliably water-proof.
- After installation of the heat insulation, measure the insulation resistance at all heating circuits once more to ensure that the heating cable has not been damaged during the installation.
- Face caps must generally be provided with a mechanical protection to prevent the heating cable from damage.

Marking

- Mark the outer sheath of the heat insulation with “electrically heated” warning labels in clearances of maximally 3 meters in order to draw the attention of maintenance personnel to the electrical trace heating.



9. Power Supply and Electrical Protection Devices

Rated voltage

- BARTEC heating cables are available for various rated voltages. Respective information is available in BARTEC technical literature and from the technical department of BARTEC.
- Operate the respective heating cable only with the rated voltage provided for. The rated voltage is stated on the computer print-out of the heating cable layout.

Overcurrent protection device

- For overcurrent protection, please only use circuit-breakers which comply with the configuration and the technical BARTEC documents. Deviations therefrom may result in false tripping of the circuit-breaker and impairment of the efficiency of the overcurrent protection.
- If other protection units than those specified in the configuration or the technical BARTEC documents are to be used, please contact the technical department of BARTEC (Chapter 13).

Residual current operated circuit-breaker

- Principally, the use of a residual current operated circuit-breaker with 30 mA is recommended.
- To ensure for the efficiency of this protection measure, a heating cable with protective braiding is to be used. This protective braiding must be incorporated into the protection measures. This particularly applies to all trace heatings connected to non-conducting pipes (plastic pipes, coated pipes) and surfaces.

Caution

- When implementing the electrical protection measures, the respectively applicable national technical regulations must be adhered to.

In the Federal Republic of Germany:
VDE regulations, particularly DIN VDE 0100 as well as DIN VDE 0721, Part 1 and 2/A3
as well as VDE 0254



10. Inspection and Commissioning

Inspections

Continuing inspections of the trace heating during installation and operation serve the prevention of additional costs accruing from a belated detection of installation and mounting faults. As the installation costs for the trace heating and the heat insulation exceed the costs for the heating cable by far, the following inspection procedures should be consistently followed.

The insulation resistance is to be measured at the following points of time:

- a) **Pre-inspection**
Shortly before commencing installation of the heating cable at the construction site
- b) **Acceptance inspection**
After the heating circuit has been completely installed or prior to applying the heat insulation
- c) **Final inspection**
Immediately after the works at the heat insulation have been completed
- d) **Commissioning inspection**
Prior to switching on the system

Measuring of the insulation resistance

- This inspection procedure serves the detection of heating cable damage and possible installation faults of terminals and connections.
- An insulation test device with a minimum test voltage of 500 V DC and a maximum test voltage of 2000 V DC is to be used. The insulation resistance should be at least 50 MΩ per heating circuit, irrespective of the length.
- Measuring:
 - The measuring is to be carried out between the heating conductor and the protective braiding.
 - A further measuring is to be carried out between the protective braiding and the earthed piping

Acceptance and documentation

- Upon completion of the installation works (prior to applying the heat insulation), each heating circuit, if possible in the presence of the client, must be accepted. In accordance with the enclosed sample report, this acceptance inspection must be documented. (=Acceptance inspection)
- All further inspections must also be documented in the form of an inspection report.
- After the heat insulation has been completely installed, a final inspection of the individual heating circuits is recommendable.
- Usually, such inspection lies in the area of responsibility of the client or the final customer. (= Final inspection)

Commissioning

- Each trace heating may only be commissioned if
 - the acceptance certificates are available for each heating circuit and the fault-free condition of the trace heating has been confirmed.
 - the heat insulation has been completely installed and is in a dry state.
 - it is ensured that the heating circuit is operated in compliance with the data specified by BARTEC.

Note

Additional heating energy which is required for heating empty or already filled pipings has usually not been accounted for by the configuration. With system cold starts, you should therefore grant a sufficient period of time for the piping to achieve the desired temperature.



Note

In accordance with Section 8 ElexV (German regulations for electrical systems operated in hazardous areas), electrical equipment may only be operated, if

- it is subject to an EC type examination certificate issued by the German physical-technical federal authority (PTB), the mining test facility (DMT) or other test facilities listed in the 76/117/EEC guideline.
- the manufacturer marked them with label

Section 12 of the ElexV stipulates that the operator must arrange for an inspection of the electrical systems for their proper condition, which must be carried out prior to commissioning by an electrician or under the control or supervision of an electrician. (= Commissioning inspection)

11. Operation and Maintenance

Operation

- During the operation of the electrical trace heating, it must be ensured that all system components are operated in compliance with the operating data specified by BARTEC. This particularly applies to the observance of maximum temperatures. Operation within the range of these operating data forms a condition for possible future warranty claims.

System documentation

- For each system, a complete documentation ranging from configuration, to installation and commissioning to periodical maintenance works of a trace heating, should be kept.
- Such documentation should include:
 - Configuration documents
 - Heat loss calculation
 - Selection of the heating cable
 - Piping plans with heating circuit allocation
 - Circuit diagrams
 - Current piping plans
 - Acceptance reports
 - Reports on servicing works and interventions with the piping system, the trace heater and the heat insulation
 - Inspection reports
 - Operating manual

Maintenance

To allow for the best possible safety and reliability of a trace heating system, BARTEC recommends the implementation of a maintenance program which provides for visual, functional and electrical checks within specified time intervals.

Important maintenance instructions are listed in the following sections.



Visual and functional check

- Carefully check the heat insulation for possible damage, lacking sealings, cracks, outer sheath damage, lacking heat insulation ducts for heating cables and other cables, intruded water or chemicals.

If the heat insulation is subject to damage, the heating cable must be checked for possible impairments.

- ➔ Damaged heating cables must be replaced by new ones.
- ➔ Wear parts (e.g. sealings, locking plates, etc.) must be replaced.
- Check the terminal boxes, connection boxes and casings of temperature controllers for corrosion damage and possible mechanical impairments. Make sure that all casing covers are correctly locked.
- Check the temperature controller's connecting cables and capillary tube systems for damage and mechanically protected routing.
- Temperature controllers must be checked for their correct functioning.
- Temperature limiters must also be checked for their correct functioning.

Electrical inspection

- The measuring of the insulation resistance should be considered as an inherent part of the regular maintenance works.

Inspection intervals

- With anti-freeze systems, inspections should be carried out annually before the heating period.
- With systems serving the maintenance of process temperatures, inspections should be carried out in regular intervals, however, at least twice a year.

Personnel training

- The regular maintenance works should be carried out by trained and experienced maintenance personnel.
- You are recommended to support maintenance personnel with the implementation of new developments in the fields of application technology and maintenance by training measures.

BARTEC service

- Apart from establishing complete heating circuits, BARTEC also offers its experienced service personnel for accruing maintenance works.

Servicing works at the heat insulation and pipings

- Observe that the system is to be activated prior to each servicing procedure.
- Ensure not to damage the trace heating system during servicing works at the piping system or the heat insulation.
- Make sure that, upon completion of servicing works, the heating circuits, including heat insulation, are properly and professionally installed in accordance with the configuration.
- Upon completion of servicing works, carry out a visual, functional and electrical check at the trace heating and document such checks.

Note

For the operation and thus the maintenance of explosion-proof equipment and systems, DIN VDE 0105, Part 1 "General provisions" and Part 10 "Additional provisions for hazardous areas" are applicable.

Electrical systems in hazardous areas are categorized as systems requiring monitoring (in accordance with Section 2 of the German equipment safety law dated October 23, 1992).

The operator must ensure that electrical systems are inspected prior to the first commissioning and, thereafter, in regular intervals, at least, however, every 3 years.

The inspection which is subject to the obligation to provide supporting documents must be carried out by an electrician or under the control or supervision of an electrician.



12. Proceeding in Fault Cases

Damage in the heating circuit

- For servicing the heating circuit, only use original BARTEC components! (e.g. connections, terminals, sealings, etc.)

Instructions for the rectification of faults

- If faults occur in the trace heating system, we recommend troubleshooting in accordance with the following instructions and, if applicable, rectification of the fault.
- If the rectification measure in accordance with the following instructions is not successful, please immediately contact the technical department of BARTEC.

Note

For hazardous areas, the following provisions are applicable

- Servicing and modification works at electrical systems, during which an explosive atmosphere can be ignited, may only be carried out with the approval of the plant manager or a respectively authorized person.
- The most important safety measure is to create and ensure for a voltage-free condition prior to commencing works. (DIN VDE 0105, Part 1, Section 7)
- An authorization for the execution of hot works is required and, when working with hot surfaces/flames, respective protection measures must be taken.



12.1 Circuit-breaker trips

Possible cause	Rectification
1. Underdimensioned circuit-breaker	Check the current load, the overcurrent protection fuse and the max. current carrying capacity of the electrical supply line
2. Faulty RCCB	Replace the RCCB
3. Short-circuit/ground fault at - terminal - connection(s) - connection lines - heating cable due to damage	Localise and repair faulty terminal or connection or localise and replace the faulty heating cable

12.2 Residual current operated circuit-breaker (RCCB) trips

Possible cause	Rectification
1. Underdimensioned circuit-breaker 2. Faulty RCCB 3. Short-circuit/ground fault at - terminal - connection(s) - connection lines - heating cable due to damage	Check the current load, the overcurrent protection fuse and the max. current carrying capacity of the electrical supply line
5. Excessive humidity in terminal or connection(s) due to improper and unprofessional installation	Localise damp spot(s), replace the terminal block and dismount affected parts. First, check and repair casings outside and then casings underneath the insulation.
6. Heating cable or connection line damage	Localise the impaired spot and install a new heating cable or connection line



12.3 No or insufficient heating capacity

Possible cause	Rectification
1. No or insufficient line voltage	Control the line voltage at the heating circuit infeed and rectify existing faults
2. Heating circuit length is longer than specified in the configuration a) Connections have not been established b) The heating cable has been interrupted	Check heating circuit allocation, routing and length, re-calculate required heating capacity a) Establish connections and re-check the heating capacity b) Localise and remove the interruption, then re-check the heating capacity
3. High transmission resistance due to an improperly installed terminal, connection	Re-install the respective terminal, connection, etc. and ensure for a correct clamping and crimping
4. Temperature controller has been incorrectly connected or set or wrong sensor position	Correct the wiring or position the sensor properly
5. Exceedance of the max. permissible piping temperature	Check the piping temperature
6. Heating cable has been subjected to excessive humidity (e.g. faulty connection or heating cable damage)	Replace faulty parts
7. Heating cable has been subjected to excessive temperatures	Replace the heating cable
8. Temperature limiter has tripped	Check and, if required, replace the heating circuit

10.4 Heating capacity seems to be correct, the pipe temperature, however, does not reach the desired temperature

Possible cause	Rectification
1. Damp heat insulation	Replace the damp heat insulation by a dry one and ensure for a correct sealing
2. Insufficient fit of the heating cable routing with flanges, valves and controls and instruments	Use an additional heating cable by means of connections while not exceeding the max. permissible heating circuit length
3. Incorrect setting of the temperature controller	Correct the controller setting
4. Insufficient thermal dimensioning	Check the dimensioning in co-operation with the technical department of BARTEC and observe the recommendations of the BARTEC planning department
5. The connection line cross-section underruns the permissible value (excessive voltage drop)	Use a connection line with a permissible cross-section
6. Wrong sensor position	Position the sensor correctly

BARTEC GmbH Delivery Conditions

I. General Provisions

1. The scope of supplies or services (hereinafter referred to as: supplies) shall be governed by the mutual written agreements. However, general conditions of the orderer shall only be valid if the supplier or service provider (hereinafter referred to as: supplier) has expressly approved of such conditions in writing.
2. The supplier reserves unlimited proprietary and copyrighted exploitation rights with regard to any and all cost estimates, drawings and further documents (hereinafter referred to as: documents). The documents may only be disclosed to third parties upon an advance approval by the supplier and shall be immediately returned to the supplier if the order is not placed in his favour. Sentences 1 and 2 are analogously applicable to the orderer's documents; such documents, however, may be disclosed to third parties which the supplier has permissibly assigned with the delivery of supplies.
3. The orderer shall have a non-exclusive utilization right on standard software which shall comprise utilization based on the specified performance characteristics in unmodified form on the specified devices. The orderer shall be entitled to create one backup copy without any express agreement.
4. Partial deliveries shall be permissible if they are reasonably acceptable by the orderer.

II. Prices and Conditions of Payment

1. The prices are calculated ex works, excluding packaging, plus the respectively applicable legal value-added tax.
2. Should the supplier be assigned with erection or mounting works and should no agreements to the contrary have been concluded, the orderer shall, in addition to the specified compensation, bear any and all required additional costs such as travel costs, costs for tool and personal baggage transportation and daily allowance costs.
3. All payments shall be settled free point of payment specified by the supplier.
4. The orderer shall only be entitled to offset claims that are uncontested or legally acknowledged.

III. Reservation of Title

1. The supplied goods (reserved goods) shall remain in the ownership of the supplier until any and all claims against the orderer due to him on the basis of the business relationship are settled. Should the value of all security interests which the supplier is entitled to exceed the amount of all secured claims by more than 20 %, the supplier shall release a respective share of the security interests upon request by the orderer.
2. During the existence of reservation of title, the orderer shall refrain from any pledging or transfers by way of security. Furthermore, the orderer may only resell the respective reserved goods to resellers in the ordinary course of business under the condition that the reseller receives payment by his customers or provides for a reservation which ensures that the ownership shall only pass to the customers upon settlement of the respective customers' payment obligations.
3. The orderer shall immediately inform the supplier on any and all seizures, confiscations or further dispositions or interferences by third parties.
4. In cases of neglect of duty on part of the orderer, particularly with regard to delays in payment, the supplier shall, after unsuccessful expiry of a reasonable period of grace for subsequent performance granted to the orderer, be entitled to rescission and revocation; the legal provisions regarding the dispensability of a period of grace shall remain unaffected. The orderer shall be obliged to surrender of possession.

IV. Delivery Periods; Defaults

1. The compliance with delivery periods shall be subject to the timely receipt of any and all documents, required approvals and releases, particularly with regard to plans, to be furnished by the supplier as well as the compliance with specified payment conditions and further obligations by the supplier. Should these prerequisites not be fulfilled in time, the periods shall be extended accordingly; this shall not apply to cases of default caused by the supplier.
2. Should any non-compliance with set periods arise from cases of force majeure, e.g. mobilisations, wars, riots or similar events, e.g. strikes, lockouts, the periods shall be extended accordingly.
3. Should the supplier be in default, the orderer may – if he can establish probable cause of any incurred damage resulting thereof – claim for a compensation for each completed week of delay amounting to 0.5 % of the price of the part of the supplies which could not be admitted to appropriate operation due to the default. However, the total compensation claim shall not exceed 5 % of this price.
4. Any and all claims for damages brought forward by the orderer on the ground of delivery defaults as well as any and all claims for damages in lieu of performance which exceed the limits specified under No. 3 shall be excluded for all cases of delivery defaults, even after expiry of a period of grace possibly granted to the supplier. This shall not apply to cases of claims for damages brought forward on the grounds of intent, gross negligence or on the grounds of death, bodily injury or injuries to health which are subject to compulsory liability. Within the scope of the legal provisions, the orderer may only withdraw from the contract in cases of delivery defaults caused by the supplier. The above-specified regulations shall not effect any changes regarding the burden of proof for the disadvantage of the orderer.
5. Upon request by the supplier, the orderer shall, within a reasonable period of time, be obliged to declare whether he will withdraw from the contract due to any delivery defaults or whether he insists on the performance of the delivery.
6. Should the dispatch or delivery of the goods be delayed by more than one month after notification on the readiness for dispatch on behalf of the orderer, the orderer may be charged with storage expenditures amounting to 0.5 % of the prices of the goods subject to delivery for each month or part thereof. The total claim for such storage expenditures shall, however, not exceed 5 % of this price. The parties are free to provide proof for higher or lower storage costs.

V. Passing of Risks

1. Also with freight-paid goods, the risks shall pass to the orderer as follows:
 - a) With deliveries excluding erection or mounting works, the risks shall pass upon the goods' forwarding for dispatch or their collection. Upon request by the orderer, the deliveries shall be insured against the usual transportation risks by the supplier at the orderer's costs.
 - b) With deliveries including erection or mounting works, the risks shall pass on the date of the goods' integration into the orderer's operations or, if agreed upon, after a faultless test run.
2. Should the dispatch, the delivery, the erection or mounting works' start or implementation, the integration into the orderer's operations or the test run be delayed due to reasons caused by the orderer or should the orderer cause a default of acceptance on the basis of other reasons, the risks shall pass to the orderer.

VI. Erection and Mounting

Should no agreements to the contrary exist, the following provisions shall apply to all erection and mounting works:

1. The order shall bear the costs and provide for the following precautions in due time:
 - a) Any and all earth, construction and further non-sectoral supplementary works, including all required specialist and auxiliary personnel. Construction material and tools.
 - b) Any and all objects and materials required for mounting and commissioning, such as scaffoldings, hoisting gear and further appliances, combustibles and lubricants.
 - c) Energy and water at the utilization location, including connections, heating and illumination.
 - d) Sufficiently large, suitable, dry and lockable rooms at the mounting site for the storage of machine parts, equipment, materials, tools, etc.; suitable working and common rooms for the mounting personnel, including appropriate sanitary facilities. Furthermore, the orderer shall, for the protection of the supplier's possessions and the mounting personnel, take all measures on the construction site which he would take for the protection of his own possessions.
 - e) Protective clothing and protective appliances which may be required due to special conditions at the mounting site.
2. Prior to commencement of the mounting works, the orderer shall furnish all required information on the location of concealed current, gas and water lines or similar systems as well as the required static information unrequested.
3. Prior to erection or mounting, all materials and objects required for the commencement of the works shall be provided at the erection and mounting location and all preparatory works shall, prior to the erection or mounting process, be brought to a state of completion which allows for the erection or mounting process to be implemented in accordance with the specifications without any interruptions. Any and all delivery routes as well as the erection and mounting site must be paved and cleared.
4. Should the erection, mounting or commissioning process be delayed due to reasons not caused by the supplier, the orderer shall, in reasonable scope, bear the costs for waiting times and additionally required journeys of the supplier or the mounting personnel.
5. The orderer shall weekly confirm the duration of the mounting personnel's working time to the supplier and shall immediately inform him on the completion of the erection, mounting or commissioning process.
6. Should the supplier request the delivery's acceptance after completion of the above-specified processes, the orderer shall carry out such acceptance within a time period of two weeks. Should he fail to do so, acceptance shall be considered as granted. Acceptance shall also be considered as granted if the supplied delivery – possibly after completion of a specified test phase – is admitted to operation.

VII. Acceptance

The orderer may not refuse the acceptance of supplies on grounds of immaterial defects.

VIII. Material Defects

The supplier shall be liable for material defects as follows:

1. All parts or supplies which, within the limitation period, show material defects, the cause of which already existed at the time of passing of risks, shall, at the discretion of the supplier, be repaired, delivered or provided anew free of costs.
2. All claims on the grounds of material defects shall be subject to a limitation period of 12 months. This shall not apply to cases which are subjected to longer legal periods in accordance with Sections 4438, Clause 1, No. 2 (buildings and materials and objects for buildings), 479, Clause 1 (right of recourse) and 634a, Clause 1, No. 2 (defects or deficiencies of construction) of the BGB (German civil code). Furthermore, this shall not apply to cases involving death, bodily injury or injuries to health as well as cases of gross negligent breaches of duty on part of the supplier and cases of fraudulent concealment of defects. The legal provisions regarding the suspension, interruption or re-commencement of the limitation period shall remain unaffected.
3. The orderer shall immediately complain any and all material defects to the supplier in writing.
4. In cases of notifications of defects, the orderer shall be entitled to withhold payments in a scope which is appropriate in relation to the complained material defects. The orderer shall only be entitled to withhold payments if he has issued a notification of defect which is undoubtedly justified. In cases of unjustified notifications of defects, the supplier shall be entitled to claim reimbursement of the incurred expenditures from the orderer.
5. Initially, the supplier shall be granted a reasonable period of time for rectification of the material defects.
6. Should such rectification be unsuccessful, the orderer shall – without prejudice of possible claims for damages in accordance with Section XI. – be entitled to withdraw from the contract or reduce the respective compensation.
7. Claims on the grounds of material defects shall not be enforceable in cases of insignificant deviations from the specified quality, insignificant impairment of usability, natural wear or cases of damage which, after the passing of risks, arise out of faulty or negligent handling, excessive strain, unsuitable operating equipment, defective construction works or unsuitable construction grounds as well as in cases of defects caused by special external influences which have not been deemed as assumed under this contract and in cases of reproducible software errors. Should any improper modifications or repair works be carried out by the orderer or third parties, no claims on the grounds of material defects shall be enforceable for such modifications or repair works as well as for any consequences resulting thereof.
8. Any claims of the orderer regarding any and all required expenditures, particularly with regard to transportation, travel, labour and material costs, shall be excluded if such expenditures are increased due to a subsequent relocation of the delivered object to a location different from the orderer's facilities, unless such relocation complies with the delivered object's intentional use.
9. Recourse claims brought forward by the orderer against the supplier in accordance with Section 478 BGB (recourse by the entrepreneur) shall only be enforceable if the orderer has not concluded any agreements with his purchasers which exceed the statutory claims for defects. Furthermore, No. 8 shall be applicable accordingly to the scope of recourse claims by the orderer against the supplier in accordance with Section 478 BGB.
10. Furthermore, any and all cases of claims for damages shall be subject to Section XI. (Further Claims for Damages). Any further claims or claims other than those specified in Section VIII. by the orderer against the supplier and the supplier's vicarious agents brought forward on the grounds of material defects shall be excluded.

IX. Industrial Property Rights and Copyrights; Defects of Title

1. Should no agreements to the contrary exist, the supplier shall be obliged to perform the delivery free of any industrial property rights and copyrights held by third parties (hereinafter referred to as: property rights) in the country of delivery exclusively. Should any third party bring forward any justified claims against the orderer on the grounds of property rights infringement arising out of supplies delivered by the supplier which are used in accordance with the contractual provisions, the supplier shall be held liable to the orderer within the time periods specified in Section VIII., No.2 as follows:
 - a) The supplier shall, at his own discretion and costs, either acquire a utilization right for the respective supplies, change them in a way which ensures that no property rights are infringed or replace them. Should the supplier not be able to implement such measures under reasonable conditions, the orderer shall be entitled to the statutory withdrawal or reduction rights.
 - b) The supplier's liability regarding claims for damages shall be governed by Section XI.
 - c) The above-specified obligations of the supplier shall only be binding if the orderer immediately informs the supplier on any and all claims brought forward by third parties in writing, refuses to acknowledge infringement and the supplier is granted responsibility for any and all defence measures and settlement negotiations. Should the orderer stop the utilisation of the supplies on the grounds of limitation of damage or other important reasons, he shall be obliged to inform the affected third party that such utilisation stop shall not be construed as an acknowledgment of any property rights infringement.
2. Any claims of the orderer in cases of property rights caused on his part shall be excluded.
3. Any claims of the orderer are further excluded if property rights infringement is caused by specific orderer specifications, by applications not foreseeable by the supplier, by modifications of the supplies by the orderer or by application of the supplies in conjunction with products not delivered by the supplier.
4. In any and all cases of property rights infringements, the claims enforceable by the orderer as specified in No. 1 a) shall furthermore be respectively subjected to the provisions contained in Section VIII. No. 4, 5 and 9.
5. Any and all further cases of defects of title shall be respectively subjected to the provisions contained in Section VIII.
6. Any further claims or claims other than those specified in Section IX. by the orderer against the supplier and the supplier's vicarious agents brought forward on the grounds of defects of title shall be excluded.

X. Impossibility; Contractual Adaptation

1. In cases of impossibility of delivery, the orderer shall be entitled to claim damages, unless the supplier cannot be held responsible for the delivery's impossibility. However, the orderer's claim for damages shall be limited to 10 % of the value of the part of the delivery which could not be admitted to proper operation due to such impossibility. This shall not apply to cases of claims for damages brought forward on the grounds of intent, gross negligence or on the grounds of death, bodily injury or injuries to health which are subject to compulsory liability. The above-specified regulations shall not effect any changes regarding the burden of proof for the disadvantage of the orderer. The orderer's right to withdraw from the contract shall remain unaffected.
2. Should any unforeseeable events in accordance with Section IV., No. 2 considerably change the supplies' economic importance or contents or considerably affect the supplier's operations, the contract shall be respectively adapted in consideration of loyalty and good faith. Should this not be justifiable from an economical point of view, the supplier shall be entitled to withdraw from the contract. Should he intend to exploit this withdrawal right, he shall immediately inform the orderer upon recognition of the events' effects, even if an extension of the delivery period was initially agreed upon with the orderer.

XI. Further Claims for Damages

1. Any and all claims for damages and compensation brought forward by the orderer (hereinafter referred to as: claims for damages) for whatever legal reasons, particularly claims on the grounds of breach of duty under the obligation relationship and on the grounds of unlawful acts, shall be excluded.
2. This shall not apply to cases of compulsory liability, e.g. in accordance with product liability laws, in cases of intent, gross negligence, death, bodily injury or injuries to health or in cases of breach of essential contractual obligations. Claims for damages brought forward on the grounds of breach of essential contractual obligations shall, however, be limited to contractually typical, foreseeable cases of damage, unless such damage arises out of intent or gross negligence or compulsory liability is applicable in cases of death, bodily injury or injuries to health. The above-specified regulations shall not effect any changes regarding the burden of proof for the disadvantage of the orderer.
3. Should the orderer be entitled to claims for damages in accordance with Section XI., such claims shall be subject to the limitation period applicable to claims for material defects in accordance with Section VIII., No. 2. Claims for damages brought forward in accordance with product liability laws shall be subjected to the statutory limitation regulations.

XII. Place of Jurisdiction and Applicable Law

1. The sole place of jurisdiction for any and all disputes indirectly or directly arising in connection with the contractual relationship shall be the supplier's corporate domicile, given the orderer is a merchant. However, the supplier shall also be entitled to file actions at the orderer's corporate domicile.
2. Any and all legal relationships arising in connection with this contract shall be subjected to German material right, excluding the United Nations convention on the international sale of goods (CISG).

XIII. Contractual Bindingness

Even if individual provisions of this contract should be legally unenforceable, the remaining contractual provisions shall remain binding. This shall not apply if adherence to the contract presents an unreasonable burden to one contractual party.