

Electrical apparatus for explosive gas atmospheres — Electrical resistance trace heating —

Part 2: Application guide for design, installation and maintenance

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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**Electrical apparatus for explosive gas atmospheres –
Electrical resistance trace heating
Part 2: Application guide for design,
installation and maintenance
(IEC 62086-2:2001)**

Matériel électrique pour atmosphères
explosives gazeuses –
Traçage par résistance électrique
Partie 2: Guide d'application
pour la conception, l'installation
et la maintenance
(CEI 62086-2:2001)

Elektrische Betriebsmittel für
gasexplosionsgefährdete Bereiche –
Elektrische Widerstands-Begleitheizungen
Teil 2: Anwendungsleitfaden
für Entwurf, Installation und
Instandhaltung
(IEC 62086-2:2001)

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of the International Standard IEC 62086-2:2001, prepared by IEC TC 31, Electrical apparatus for explosive atmospheres, was submitted to the CENELEC Unique Acceptance Procedure and was approved by CENELEC as EN 62086-2 on 2005-02-01 without any modification.

The following dates were fixed:

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Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 62086-2:2001 was approved by CENELEC as a European Standard without any modification.

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ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES – ELECTRICAL RESISTANCE TRACE HEATING –

Part 2: Application guide for design, installation and maintenance

1 Scope

This part of IEC 62086 provides guidance for the application of electrical resistance trace-heating systems in areas where explosive gas atmospheres may be present.

It provides recommendations for the design, installation and maintenance of trace-heating equipment and associated control and monitoring equipment.

This part supplements the requirements specified in IEC 62086-1.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 62086. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 62086 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60079-0:1998, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements*

IEC 60079-10:1995, *Electrical apparatus for explosive gas atmospheres – Part 10: Classification of hazardous areas*

IEC 60079-14:1996, *Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in hazardous areas (other than mines)*

IEC 60079-17:1996, *Electrical apparatus for explosive gas atmospheres – Part 17: Inspection and maintenance of electrical installations in hazardous areas (other than mines)*

IEC 62086-1, *Electrical apparatus for explosive gas atmospheres – Electrical resistance trace heating – Part 1: General and testing requirements* ¹⁾

3 Definitions

For the purposes of this part of IEC 62086, the definitions in IEC 62086-1 apply.

¹⁾ To be published.

4 Application considerations

4.1 General

This standard supplements the requirements of IEC 60079-14 and IEC 60079-17.

Where trace-heating systems are to be installed in explosive gas atmospheres, full details of the hazardous area classification(s) (IEC 60079-10) should be specified. The specification should state the zone of risk (1 or 2), gas group (IIA, IIB or IIC) and temperature classification in accordance with IEC 60079-0. Where special considerations apply or where site conditions may be especially onerous, these conditions should be detailed in the trace-heating specification.

Where trace-heating systems are to be installed on mobile equipment or interchangeable skid units, the specification for these trace-heating systems should be designed to accommodate the worst conditions in which the trace-heating system may be used.

Where any parts of the trace-heating system are likely to be exposed to ultraviolet radiation, those parts should be suitable for use in such conditions.

4.2 Corrosive areas

All components of electric trace-heating systems should be examined to verify that they are compatible with any corrosive materials that may be encountered during the lifetime of the system. Trace-heating systems operating in corrosive environments may have a higher potential for failure than in non-corrosive environments. Deterioration of the thermal insulation system is made worse by corrosion of the weather barrier and the possibility of pipeline and vessel leaks soaking the thermal insulation. Particular attention should be given to the materials of piping systems, as well as the electric trace-heating systems, as related to the effective earth-leakage/ground-fault return path. The use of non-metallic or hybrid piping systems may further complicate the earth-leakage/ground-fault return path and special consideration should be given to these piping systems. Earth-leakage/ground-fault return paths that are established at the time of installation may become degraded due to corrosion during the operation of the plant.

4.3 Installation considerations

For convenience, various process types, according to the degree of application criticality and process temperature accuracy required, may be specified (see table 1). However, it should be recognized that each specific application may involve a combination of considerations.

Table 1 – Process types

Application criticality	Process temperature accuracy required		
	Above a minimum point type I	Within a moderate band type II	Within a narrow band type III
Critical (C-) ^a	C – I	C – II	C – III
Non-critical (NC-) ^b	NC – I	NC – II	NC – III
^a Critical applications			
^b Non-critical applications			

When the trace heating is critical to the process, consideration should be given to circuit monitoring (heating circuits should be monitored for correct operation and alarms provided to indicate damage or fault) and to back up (redundant) heating systems. Spare or back-up trace heating controls may be specified to be automatically activated in the event of a fault being indicated by the monitoring/alarm system. This is sometimes known as “redundance”. Back-up trace heating allows maintenance and repairs to be performed without a process shutdown.

4.4 Process temperature accuracy

4.4.1 Type I

A type I process is one for which the temperature should be maintained above a minimum point. Ambient sensing control may be acceptable. Large blocks of power may be controlled by means of a single control device and an electrical distribution panel board. Heat input may be provided unnecessarily at times and wide temperature excursions should be tolerable. Energy efficiency may be improved through the use of dead-leg control techniques (see 6.13).

4.4.2 Type II

A type II process is one for which the temperature should be maintained within a moderate band. Pipeline sensing mechanical thermostats may be typical.

4.4.3 Type III

A type III process is one for which the temperature should be controlled within a narrow band. Pipe-sensing controllers using thermocouple or resistance-temperature detector (RTD) units facilitate field (work site) calibration and provide maximum flexibility in the selection of temperature alarm and monitoring functions. Heat input capability may be provided to heat up or raise the fluid temperature, or both, within a specified range and time interval. Type III considerations require strict adherence to flow patterns and thermal insulation systems.

5 Thermal insulation

5.1 General

The selection, installation and maintenance of thermal insulation should be considered a key component in the performance of an electrical trace-heating system. The thermal insulation system is normally designed to prevent the majority of heat loss with the trace-heating system compensating for the remainder. Therefore, problems with thermal insulation will have a direct impact on the overall system performance.

The primary function of thermal insulation is to reduce the rate of heat transfer from a surface that is operating at a temperature other than ambient. This reduction of energy loss may

- reduce operating expenses;
- improve system performance;
- increase system output capability.

Prior to any heat loss analysis for an electrically traced pipeline, vessel or other mechanical equipment, a review of the selection of the insulation system is recommended. The principal areas for consideration are as follows:

- selection of an insulation material;
- selection of a weather barrier (cladding);
- selection of the economic insulation thickness;
- selection of the proper insulation size.

5.2 Selection of insulating material

The following are important aspects to be considered when selecting an insulation material:

- thermal characteristics;
- mechanical properties;
- chemical compatibility;
- moisture resistance;
- personnel safety characteristics;
- fire resistance;
- smoke, toxicity;
- cost.

Insulation materials commonly available include:

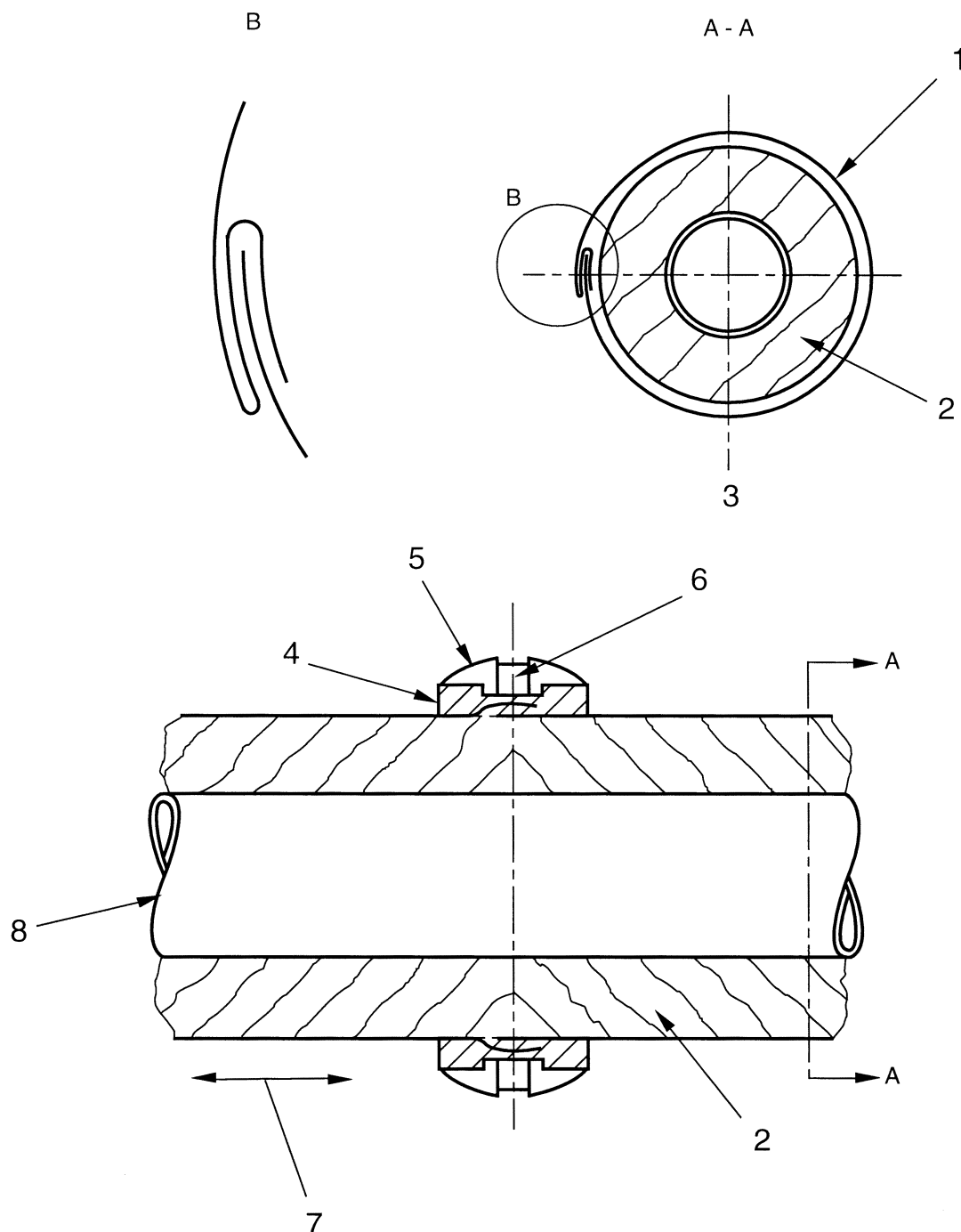
- expanded silica;
- mineral fibre;
- cellular glass;
- urethane;
- fibreglass;
- calcium silicate;
- isocyanurate;
- perlite silicate.

For soft insulants (mineral fibre, fibre-glass, etc.), actual pipe size insulation may be used in many cases by banding the insulation tightly. Care should be taken to prevent the heater from being buried within the insulation, which may cause damage to the heater or may restrict proper heat transfer. As an alternative, the next largest pipe size insulation that can easily enclose pipe and electric trace heater is also acceptable. Rigid insulation (calcium silicate, expanded silica, cellular glass, etc.), may be pipe-size insulation if board sections are cut to fit the longitudinal joint. This type of installation technique is commonly referred to as an extended leg installation. Alternatively, the next largest insulation size may be selected to accommodate the trace heater. In all cases, the insulation size and thickness should be clearly specified.

5.3 Selection of weather barrier (cladding)

Proper operation of an electrically trace heated system depends upon the insulation being dry. Electric tracing normally has insufficient heat output to dry wet thermal insulation. Some insulation materials, even though removed from the piping and force dried, never regain their initial characteristics after once being wet.

Straight piping may be weather-protected with metal jacketing, polymeric, or a mastic system. When metal jacketing is used, it should be smooth with formed, modified "S" longitudinal joints. The circumferential end joints should be sealed with closure bands and supplied with sealant on the outer edge or where they overlap (see figure 1).



IEC 156/01

Key

- 1 – Metal jacket
- 2 – Insulation
- 3 – Metal jacket insulated pipe
- 4 – Mastic sealer

- 5 – Closure band
- 6 – Insulated strap
- 7 – Movement
- 8 – Pipe

Figure 1 – Thermal insulation – Weather-barrier installation

Jacketing that is overlapped or otherwise closed without sealant is not effective as a barrier to moisture. A single, unsealed joint can allow a considerable amount of water to leak into the insulation during a rainstorm.

The type of weather barrier used should, as a minimum, be based on a consideration of the following:

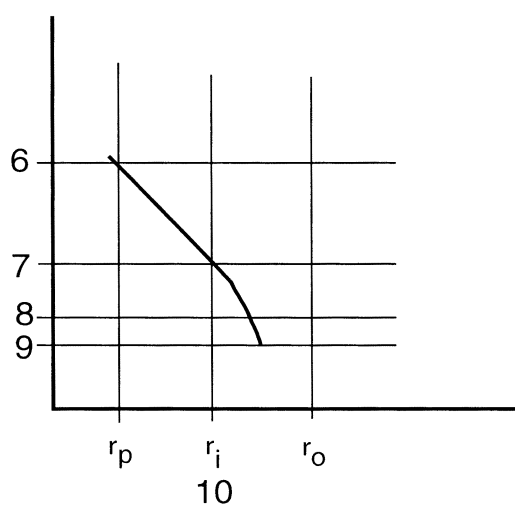
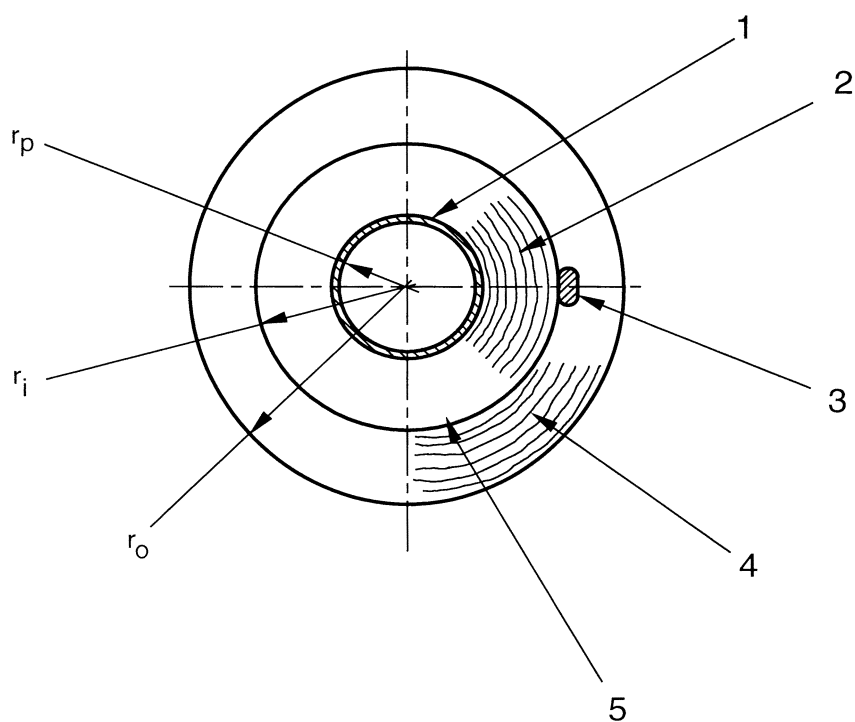
- effectiveness in excluding moisture;
- corrosive nature of chemicals in the area;
- fire protection requirements;
- durability to mechanical abuse;
- cost.

5.4 Selection of economical thickness

At a minimum, an economic consideration of the insulation will weigh the initial costs of the materials and installation against the energy saved over the life of the insulation. It should be noted that the actual insulation thicknesses do not always correspond exactly to the nominal insulation thickness. When choosing the insulation size, considerations should be made as to whether or not the actual pipe-size insulation is suitable for accommodating both pipe and trace heater.

5.5 Double insulation

The double insulation technique may be employed when the pipe temperature exceeds the maximum allowable temperature of the trace heater. Prevention of the freezing of condensate in high-temperature steam lines when these lines are not in use is a typical application. It consists of locating the trace heater between two layers of insulation surrounding the pipe. The essence of the double-insulation technique is to determine the correct combination of inner and outer insulation type and thickness that will result in an acceptable interface temperature for the trace heater. This relationship is illustrated in figure 2. Note that maximum ambient temperature conditions should be considered in this determination.



IEC 157/01

Key

- | | |
|----------------------------|--|
| 1 – Pipe | 6 – Maximum temperature pipe |
| 2 – Inner insulation layer | 7 – Interface temperature |
| 3 – Heat tracer | 8 – Outer insulation surface temperature |
| 4 – Outer insulation layer | 9 – Ambient temperature |
| 5 – Metal foil (aluminium) | 10 – Radius |

Figure 2 – Typical temperature profile

6 System design

6.1 Introduction

When designing trace-heating systems for use in explosive gas atmospheres, additional constraints are imposed due to the requirements and classification of the area under consideration. The design of any trace-heating system should conform to all IEC requirements for the use of electrical equipment in these areas and with the requirements of this standard.

Each process imposes unique demands on the designer in order to achieve the desired temperature and maintain it within the specified conditions. Trace-heating systems necessarily interface with other specified items of equipment such as thermal insulation and the electrical supply available to power the system. The final system will be an integration of all these component parts so the values of these interface items have to be known and controlled in order to design systems that will perform as required. Local ambient temperature data, both maxima and minima, have to be known and incorporated into the design.

Consideration should be given as to the maintenance of the systems and process equipment, to energy efficiency, and to testing the installed systems for operational satisfaction and safety.

6.2 Purpose of, and major requirement for, trace heating

Trace heaters should be selected and installed so as to provide sufficient power for

- a) compensation of heat loss when maintaining a specified temperature of a workpiece (no heat exchange is assumed with the workpiece or its contents); see calculation method in 6.3; and/or
- b) raising the temperature of a workpiece, and its content when specified, with a specified value to be established within a specified period (see calculation method in 6.4);
- c) a combination of a) and b).

It should be observed that heat losses established in accordance with 6.3 and 6.4 should be multiplied by a safety factor determined on the basis of 6.5. The excess of installed power over the power as required, and the way in which trace heaters are applied, installed and operated shall not be the cause, not even after evaluation of worst-case conditions, of any unacceptable risk in an explosive gas atmosphere.

6.3 Heat loss calculations

To determine heat loss for a given set of conditions, a complete insulation specification is required, including details of the thermal conductivity of the insulation at several mean temperatures, the type of weather barrier specified, insulation size and thickness, desired workpiece maintenance temperature, and the minimum ambient temperature and wind conditions.

Given these parameters, the heat loss may be determined by calculation. For example, the heat loss for pipes and tubes may be evaluated using the following equation:

$$q = \frac{(T_p - T_a)}{\frac{1}{\pi D_1 h_i} + \frac{\ln\left(\frac{D_2}{D_1}\right)}{2\pi K_1} + \frac{\ln\left(\frac{D_3}{D_2}\right)}{2\pi K_2} + \frac{1}{\pi D_3 h_{co}} + \frac{1}{\pi D_3 h_o}} \quad (1)$$