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Interested committees:

Title: Draft BS EN IEC 60079-30-2 ED 2 Explosive atmospheres. Part 30-2: Electrical resistance trace heating - Application guide for design, installation and maintenance.

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



31/1614/CD

COMMITTEE DRAFT (CD)

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CLOSING DATE FOR COMMENTS:

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SUPERSEDES DOCUMENTS:

31/1611/RR

IEC TC 31 : EQUIPMENT FOR EXPLOSIVE ATMOSPHERES

SECRETARIAT:

United Kingdom

SECRETARY:

Mr Mick Maghar

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☐ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

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TITLE:

Explosive atmospheres - Part 30-2: Electrical resistance trace heating - Application guide for design, installation and maintenance

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –

**Part 30-2: Electrical resistance trace heating –
Application guide for design, installation and maintenance**

FOREWORD

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International Standard IEC/IEEE 60079-30-2 has been prepared by IEC technical committee 31: Equipment for explosive atmospheres, in cooperation with the Petroleum & Chemical Industry Committee of the IEEE Industrial Applications Society under the IEC/IEEE Dual Logo Agreement.

NOTE A list of IEEE participants can be found at the following URL:
http://standards.ieee.org/downloads/60079/60079-30-2-2015/60079-30-2-2015_wg-participants.pdf.

This second edition of IEC/IEEE 60079-30-2 cancels and replaces the first edition of IEC/IEEE 60079-30-2 published in 2015 and constitutes a technical revision.

This edition includes the following significant changes, apart from a general review and updating of the first edition of IEC/IEEE 60079-30-2, with respect to the previous edition:

- the relocation of

The significance of changes between IEC/IEEE 60079-30-2, Edition 1.0 (2015) and IEC/IEEE 60079-30-2, Edition 2.0 (20) is as listed below:

		Type		
Changes	Clause	Minor and editorial changes	Extension	Major technical changes

NOTE The technical changes referred to include the significance of technical changes in the revised IEC Standard, but they do not form an exhaustive list of all modifications from the previous version.

Explanations:**A) Definitions****Minor and editorial changes**

clarification

decrease of technical requirements

minor technical change

editorial corrections

These are changes which modify requirements in an editorial or a minor technical way. They include changes of the wording to clarify technical requirements without any technical change, or a reduction in level of existing requirement.

Extension addition of technical options

These are changes which add new or modify existing technical requirements, in a way that new options are given, but without increasing requirements for equipment that was fully compliant with the previous standard. Therefore, these will not have to be considered for products in conformity with the preceding edition.

Major technical changes addition of technical requirements

increase of technical requirements

These are changes to technical requirements (addition, increase of the level or removal) made in a way that a product in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition. These changes have to be considered for products in conformity with the preceding edition. For these changes additional information is provided in clause B) below.

NOTE These changes represent current technological knowledge. However, these changes should not normally have an influence on equipment already placed on the market.

B) Information about the background of 'Major Technical Changes'**C1 – The requirements**

The text of this standard is based on the following IEC documents:

FDIS	Report on voting

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

International standards are drafted in accordance with the ISO/IEC Directives, Part 2.

This standard is intended to be used in conjunction with IEC/IEEE 60079-30-1:20, *Explosive atmospheres – Part 30-1: Electrical resistance trace heating – General and testing requirements*.

268 A list of all parts of IEC 60079 series, under the general title *Explosive atmospheres*, can be
269 found on the IEC website.

270 The IEC Technical Committee and IEEE Technical Committee have decided that the contents
271 of this publication will remain unchanged until the stability date indicated on the IEC web site
272 under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the
273 publication will be

- 274 • reconfirmed,
- 275 • withdrawn,
- 276 • replaced by a revised edition, or
- 277 • amended.

278

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EXPLOSIVE ATMOSPHERES –

Part 30-2: Electrical resistance trace heating – Application guide for design, installation and maintenance

1 Scope

This part of IEC 60079 provides guidance for the application of electrical resistance trace heating systems in areas where explosive atmospheres can be present, with the exclusion of those classified as requiring EPL Ga/Da (traditional relationship to Zone 0 and Zone 20 respectively). This standard also provides guidance for explosive atmospheres incorporating the Division method of area classification that may be applied by some users of this standard.

NOTE Information on the Division method is given in NFPA 70 and CSA C22.1.

It provides recommendations for the design, installation, maintenance and repair of trace heating systems including associated control and monitoring equipment. It does not cover devices that operate by induction heating, skin effect heating or direct pipeline heating, nor those intended for stress relieving.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-426, *International Electrotechnical Vocabulary – Part 426: Equipment for explosive atmospheres*

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-15, *Explosive atmospheres – Part 15: Equipment protection by type of protection “n”*

IEC/IEEE 60079-30-1, *Explosive atmospheres – Part 30-1: Electrical resistance trace heating – General and testing requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-426, IEC 60079-0 and IEC/IEEE 60079-30-1 apply.

4 Application considerations

4.1 General

This part of IEC 60079 supplements the requirements specified in IEC 60079-14, IEC 60079-17 and IEC/IEEE 60079-30-1.

For trace heating systems that are to be installed in locations where EPLs Gb, Gc, Db and Dc are required, and/or to cover the requirements in Annex D of IEC/IEEE 60079-30-1, full details

of the area classifications shall be specified. Where special considerations apply or where site conditions can be especially onerous, these conditions shall be detailed in the trace heating specification.

The specification for heating systems to be installed on mobile equipment or skid units (e.g. relocatable structures) should accommodate the adverse conditions in which the trace heating system can be used.

Where any parts of the trace heating system are likely to be exposed, those parts should be suitable for the environment.

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 can be encountered during the lifetime of the system. Trace heating systems operating in corrosive environments 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 moisture leaks soaking the thermal insulation.

4.3 Process temperature accuracy

4.3.1 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 temperature controller and an electrical distribution panel board. Heat input can be provided unnecessarily at times and wide temperature excursions should be tolerable. Energy efficiency can be improved through the use of dead-leg control or ambient proportional control techniques (see 6.14).

4.3.2 Type II

A Type II process is one for which the temperature should be maintained within a moderate band. Control by mechanical thermostats is typical.

4.3.3 Type III

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

4.4 Installation considerations

If failure of any part of the trace heating system can result in a safety or process problem, then the trace heating system can be considered to be a critical component of the total process. The temperature control and circuit monitoring requirements of an application may be defined according to the temperature control types described in 4.3.

When trace heating is critical to the process, circuit monitoring for correct operation, malfunction alarms, and back-up trace heaters should be considered. Spare or back-up controllers can be specified to be automatically activated in the event of a fault being indicated by the monitoring/alarm system. Back-up trace heaters can allow maintenance or repairs to be performed without a process shutdown and can be used to enhance reliability.

5 Thermal insulation

5.1 General

The selection, installation and maintenance of thermal insulation is a key component in the performance of an electrical trace heating system. The thermal insulation system is normally designed to limit heat loss with the trace heating system compensating for the remainder. Therefore, problems with thermal insulation 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 can:

- 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 with consideration for optimum trace heater design;
- selection of the proper insulation size.

Information about the equivalent thickness of insulating cements is given in Annex H.

5.2 Selection of insulating material

The following are important aspects to be considered when selecting an insulation material. These factors should be considered and the selection optimised according to the operator's criteria:

- temperature rating;
- thermal conductivity, λ , of the insulation;
- mechanical properties;
- chemical compatibility and corrosion resistance;
- moisture resistance;
- health risks during installation;
- fire resistance;
- toxicological properties when exposed to fire;
- costs.

Insulation materials commonly available include:

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

- polyisocyanurate;
- perlite silicate.

For soft insulants (mineral fibre, fibreglass, etc.), actual pipe size insulation may be used in many cases by banding the insulation tightly. Care should be taken to prevent the trace heater from being buried within the insulation, which can cause damage to the trace heater or 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.

Insulation for valves, flanges, pumps, instruments, and other irregularly shaped equipment may be constructed for the particular configuration. This can be fabricated from block, insulation segments or flexible removable covers.

Non-insulated or partially insulated pipe supports or equipment require additional heat input to compensate for the higher heat loss. Insulating cements or fibrous materials should be used to fill cracks and joints. Where insulating cements are used for total insulation of an irregular surface, a proportionally thicker layer of insulating cement may be applied to achieve the desired insulating capability.

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 can 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).

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, therefore specifications for elastomeric water sealing of cladding should be suitable for long term exposure to the environmental conditions.

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 to provide optimum trace heating design

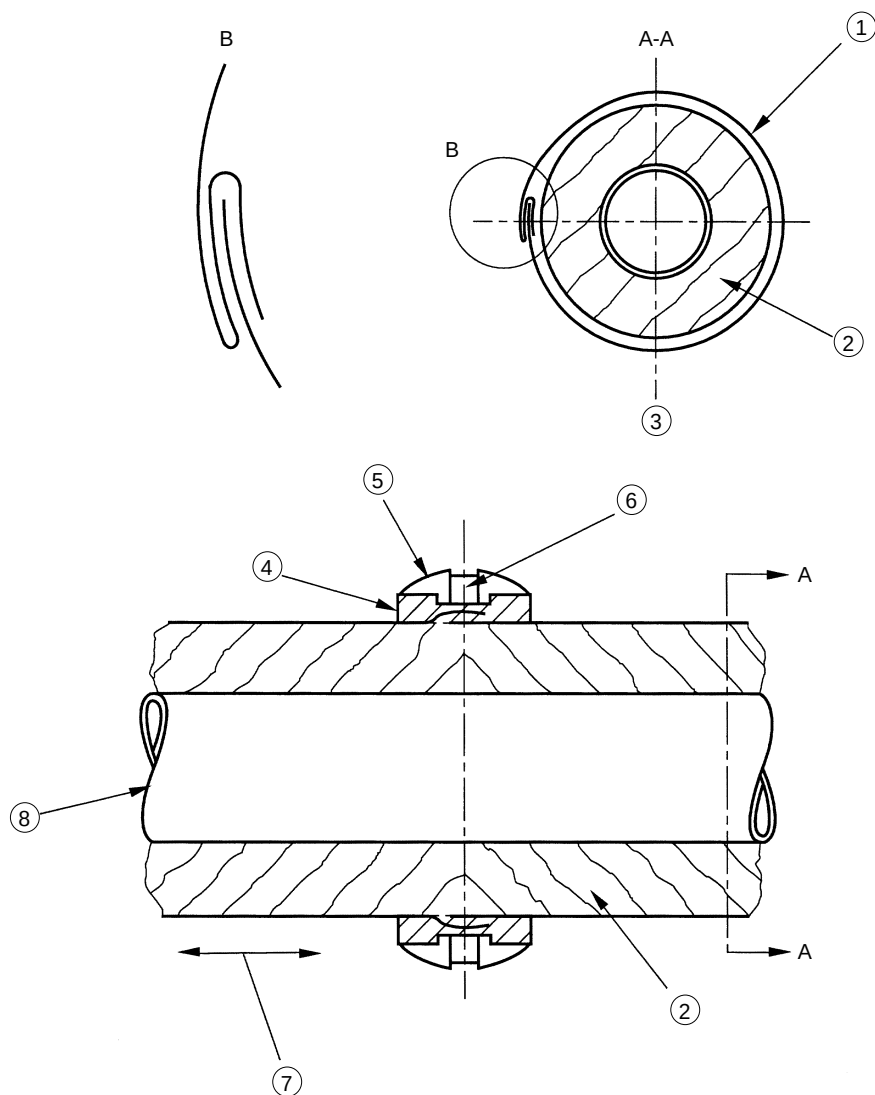
At a minimum, an economic consideration of the insulation weighs the initial costs of the materials and installation against the energy saved over the life of the insulation. It should be noted that the actual insulation thicknesses do not always correspond exactly to the nominal insulation thickness. 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.

The insulation thickness selected for economic consideration of non-traced portions of a system does not necessarily provide for an optimum or acceptable trace heating system design and installation. Consideration of the electric trace heating design should be made in conjunction with the selection of insulation. Selection of an optimum insulation thickness for electric traced lines can do the following:

- reduce the power output level necessary for each trace heater;
- increase the length of trace heater circuits;
- decrease the number of circuits required;
- decrease the total power required for electric trace heater systems.

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 results 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. Consideration should be given to joint installation and alignment of the inner insulation to account for thermal expansion of the piping.

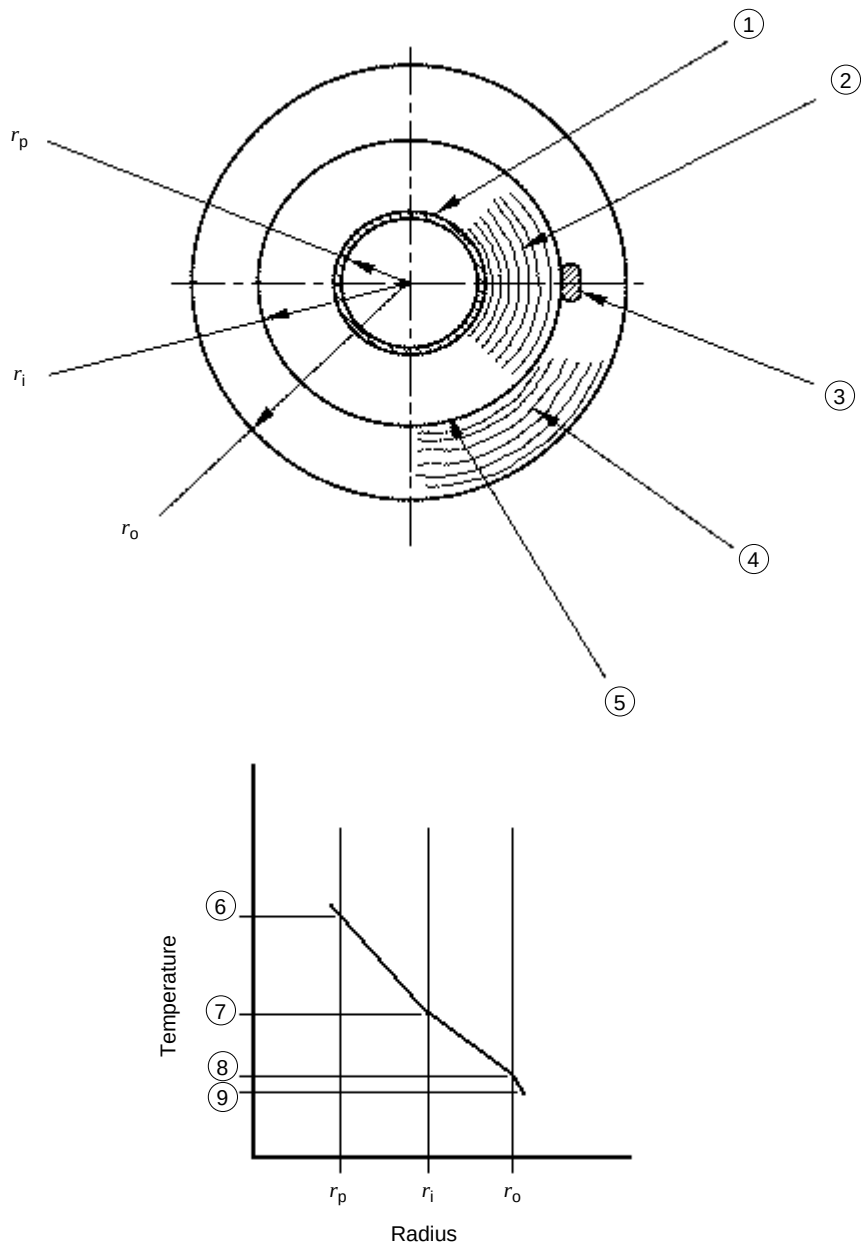


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Key

- | | |
|-------------------------------|-------------------|
| 1 metal jacket | 5 closure band |
| 2 insulation | 6 insulated strap |
| 3 metal jacket insulated pipe | 7 movement |
| 4 mastic sealer | 8 pipe |

Figure 1 – Thermal insulation – Weather-barrier installation



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Key

- | | |
|--------------------------|--|
| 1 pipe | 6 maximum temperature pipe |
| 2 inner insulation layer | 7 interface temperature |
| 3 trace heater | 8 outer insulation surface temperature |
| 4 outer insulation layer | 9 ambient temperature |
| 5 metal foil (aluminium) | |

Figure 2 – Typical temperature profile

6 System design

6.1 General

Each trace heating application imposes unique demands on the designer 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 is 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 perform as required.

The design of any trace heating system should conform to all IEC/IEEE requirements for the use of electrical equipment and with the requirements of this standard. 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.

Considerations that affect the efficiency of trace heating design are insulation thickness and supply voltage. Insulation type selection is generally made based on temperature and environmental conditions. The insulation thickness selected for traced lines should be made in conjunction with the trace heater selection, to provide an optimum trace heating design. See 5.4 for additional discussion of this topic. Selection of the supply voltage to be applied to trace heating circuits can greatly influence the overall power supply and economics of the system.

System design should include a review of the distances between pipes and between pipes and parts of the structure in order to permit installation of the thermal insulation.

When designing trace heating systems for use in explosive atmospheres, additional constraints are imposed due to the requirements and classification of the area under consideration.

The details of each circuit design should be recorded on a form such as the example indicated in Table A.1 and retained.

Information about design for heat loss calculations and examples is provided in Annex E for pipes and in Annex F for vessels.

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 at the specified minimum ambient temperature; see calculation method in IEC/IEEE 60079-30-1; or
- b) raising the temperature of a workpiece, and its contents when specified, within a specified time period; see calculation method in 6.6; or
- c) a combination of a) and b).

The trace heater selection shall consider the determination of the maximum possible sheath temperature under adverse conditions as specified in IEC/IEEE 60079-30-1. The methods employed include the product classification method, stabilized design, and controlled design.

The sheath temperature can be reduced, for example, through adjustments to the system parameters, by the use of multiple tracers to reduce the power produced per unit length, or by the selection of the temperature control system.

The manufacturer of the trace heating provides the required design calculations and methods. The end user is constrained to the design calculations and methods specified by the manufacturer.

6.3 Training

Persons involved in the design of electric trace heating systems should be suitably trained in all techniques required.

6.4 Selection of trace heater

6.4.1 General

For a particular application, there are some basic design characteristics that should be reviewed to determine the choice of trace heater(s). These are as follows.

- a) The maximum withstand temperature of the trace heaters should be greater than the maximum possible workpiece temperature (which can be greater than the normal maintain temperature).
- b) Trace heaters should be suitable for operation in the environmental conditions specified, for example, a corrosive atmosphere or a minimum ambient temperature.
- c) Trace heaters should be verified as certified for use in the particular explosive atmosphere.

For any application, there is a maximum allowable power output at which a trace heater can be used without damaging either the workpiece or its contents. This is particularly critical in certain cases, such as with lined pipes, vessels containing caustic soda or with heat sensitive materials. The maximum allowable power output shall be recorded in the system documentation. Multiple tracing or spiralling of a single trace heater can be required.

6.4.2 Site-fabricated trace heaters

Site-fabricated trace heaters are permissible provided:

- installation personnel are trained in the special techniques required;
- trace heaters are certified for site-fabrication;
- the installation instructions supplied by the manufacturer cover site-fabrication;
- trace heater(s) pass the field (site work) tests specified in 8.5.5;
- trace heater(s) is/are marked in accordance with IEC/IEEE 60079-30-1.

Trace heater(s) not excluded by the above considerations are technically suitable for the application, but it is still necessary to determine the maximum allowable power output of each. This is a function of the construction, the maximum withstand temperature, the maximum operating temperature and maximum permissible temperature of the workpiece and thermal insulation.

For each particular trace heater and application, the maximum allowable power output shall be determined from the manufacturer's data that is based on tests specified in IEC/IEEE 60079-30-1. The value used should be chosen so that the maximum withstand temperature is not exceeded. The limiting value of maximum allowable power output for each trace heater is either the value chosen from the manufacturer's data or that specified for the process, whichever is the lower. However, the power output may be further limited by the use of multiple tracing.

The designer can then select the type, length or size and loading of the trace heater. The actual installed load should be not less than the design loading and the actual power output not greater than that obtained above. The type of trace heater and the values of installed load and power output should be recorded in the system documentation.

6.4.3 Specific types of trace heating

The series and parallel types of trace heating are generally defined by their electrical characteristics.

Series trace heaters typically use the electrical conductor as the heating element, so the voltage supply and circuit length become critical parameters in the design of each circuit. Series trace heaters with polymeric insulation are particularly suited for installations with long circuit lengths. Series trace heaters with mineral insulation (MI) and metallic sheaths are particularly suited for very high process temperature maintenance. Parallel trace heaters typically consist of two parallel conductors with a separate polymeric or metallic heating element that draws voltage from the conductors. These are characteristically used for freeze protection, and for process temperature maintenance of complex piping installations. The constant wattage type typically has a spirally wound metallic heating element.

The PTC type typically consists of a polymeric heating element extruded between the conductors. The power-limiting type typically falls between the previous types, with higher output at higher operating temperatures than the PTC type, and with lower operating temperatures than the constant wattage type.

6.5 Maximum temperature determination

6.5.1 General

It is important that the maximum sheath temperatures of trace heaters are determined accurately for all applications in explosive atmospheres. It is imperative that the circuit designer follows all guidelines, specifications, and design methodology provided by the manufacturer in accordance with IEC/IEEE 60079-30-1. Some examples of why it is important to determine the maximum sheath temperature of the trace heater are:

- applications such as non-metallic piping where the maximum temperature of the trace heater can approach the maximum withstand temperature of the workpiece, the thermal insulation, or other components of the system;
- applications that have no control or ambient sensing control, and that have potentially high tracer sheath temperatures at equilibrium;
- critical applications where a high degree of process temperature accuracy is required;
- applications in explosive atmospheres where it is assumed that the controlling thermostat is not functioning, such that the tracer sheath temperature cannot exceed the ignition temperature or T-rating of the gas, vapour, or combustible dust expected in that location.

It is important that the circuit designer understands that there are three possible measures for protecting the tracing system from exceeding the high-limit temperature – the PTC characteristic of the trace heater, the use of a temperature controller or high temperature limiter, and by stabilized design calculations. The methods and limitations for the evaluation of maximum temperature are provided in IEC/IEEE 60079-30-1.

When multiple trace heaters (especially on installations with multiple flow conditions) are grouped together under a single temperature controller and/or high temperature limiter, each design condition should be analysed as a stabilized design.

6.5.2 PTC characteristic

Trace heaters that significantly reduce power with an increase in temperature, i.e. positive temperature coefficient trace heaters, may be assigned temperature classes by testing (as given in IEC/IEEE 60079-30-1). In many applications further temperature limiting control measures are not necessary, provided that the temperature class of the trace heater is lower in temperature than that specified for the application. Nevertheless the limiter and stabilized design measures may be applied to operate the system in a narrower band of process temperatures.

6.5.3 Stabilized design

Stabilized design is based on the principle of determining the maximum workpiece and trace heater sheath temperatures under adverse conditions. This is a calculation of the Equilibrium

conditions that occur when the heat input equals the system heat loss. The adverse conditions include:

- a) maximum ambient temperature, typically assumed to be 40 °C unless otherwise specified;
- b) no wind (still air);
- c) use of a conservative or minimum value for the thermal conductivity of the thermal insulation;
- d) no temperature control by design or to simulate a failed temperature controller;
- e) the trace heater is operated at its stated operating voltage plus 10 %;
- f) the trace heater is assumed to be operating at the upper limit of the manufacturing tolerance, or at the minimum specific resistance for series trace heaters.

Specific requirements for stabilized designs are found in IEC/IEEE 60079-30-1. Testing for stabilized design is also defined in IEC/IEEE 60079-30-1. Typically the maximum sheath temperature of the trace heater is calculated from formulae derived from the evaluation of empirical data and by the theoretical approach described in the Annex of IEC/IEEE 60079-30-1 for the trace heater product design verification methodology. Alternatively, design programs that calculate the maximum sheath temperature on the basis of these adverse parameters may be used.

6.5.4 Controlled design

A temperature controller and/or high temperature limiter shall prevent the trace heater from exceeding the high-limit temperature by typically sensing:

- a) the temperature of the workpiece or other application components;
- b) the temperature on the sheath of the trace heater;
- c) parameters other than temperature, such as current.

The temperature limiter/control system opens the circuit if a malfunction occurs in the sensor or the temperature controller or high temperature limiter. Specific requirements for controlled designs are found in IEC/IEEE 60079-30-1.

A control and monitoring system should be used which meets the application requirements of this standard that is appropriate to the application considerations. Refer to Clause 7.

6.6 Heat up and cool down considerations

In certain plant operations, it can be necessary to specify that the trace heating system is capable of raising the temperature of a static product within a certain time period, or that it can be necessary to consider cool down times. Heat up and cool down considerations are given in Annex G.

6.7 Design information

6.7.1 Design information documentation

To help ensure a workable trace heating design, the design function should be furnished with up-to-date process and piping information and should be updated with any specification and drawing revisions that pertain to the trace heating system. Any or all of the following can be applicable:

- a) Process parameters:
 - Area classification documentation including applicable ignition temperatures
 - System flow diagram
 - Equipment detail drawings (pumps, valves, strainers, etc.)

Process procedures that would cause elevated pipe temperatures, that is, steam out or exothermic reactions

b) Piping parameters:

- 1) Equipment layout drawings (plans, sections, etc.)
- 2) Pipe drawings (plans, isometrics, line lists, etc.)
- 3) Piping specifications
- 4) It is recommended to maintain adequate distances between the pipes and between pipes and parts of the structure in order to permit installation of the thermal insulation.

c) Thermal insulation requirements and data:

- 1) Thermal design parameters
- 2) Thermal insulation specifications
- 3) Thermal insulation schedules
- 4) Bills of material

d) Electrical parameters:

- 1) Electrical drawings (one lines, elementaries, etc.)
- 2) Electrical equipment specifications
- 3) Equipment details
- 4) Equipment installation and instruction manuals
- 5) Bills of material

6.7.2 Isometric or trace heater configuration line lists and load charts

Each trace heater circuit design should include the following information:

a) Design data:

- 1) Area classification, including the lowest ignition temperature for each area if applicable
- 2) Piping designation or line number
- 3) Pipe size, rating and material
- 4) Thermal insulation type, nominal size, thickness, and *k*-factor
- 5) Trace heater designation and/or circuit number
- 6) Temperature to be maintained
- 7) Maximum process temperature
- 8) Minimum ambient temperature
- 9) Maximum exposure temperature (when applicable)
- 10) Maximum sheath temperature (when required)
- 11) Heat loss at desired maintenance temperature per unit length of pipe
- 12) Heat up parameters (when required)
- 13) Watts per unit length of trace heater at desired maintenance temperature
- 14) Watts, total
- 15) Circuit current, start-up and steady state
- 16) Bills of material

b) Installation drawings:

- 1) Isometric equipment installation drawings
- 2) Piping location with line numbers
- 3) Location of power connections, end seals, and temperature sensors as applicable

- 4) Length of piping
- 5) Trace ratio of trace heater per length of pipe
- 6) Length of trace heaters
- 7) Extra length of trace heater applied to valves, pipe supports, and other heat sinks
- 8) Operating voltage
- 9) Power distribution panel number or designation, the alarm and control equipment designation, and set points

6.8 Power system

The power system for an electric trace heating system consists of the power source, distribution transformers, and the heat tracer distribution system. Refer to IEC 60364-1 for specific information.

Since the power source is a key factor in the overall design of an electric trace heating system, it is recommended that voltage levels and physical location be determined in the early stages of the design.

The kilovoltampere (kVA) ratings of the distribution transformers should be based on the maximum design operating load, plus consideration for circuit startup and selected spare capacity. Maximum design operating load and startup loads should be based on minimum startup temperature. To optimize transformer size, consider startup of the fewest possible circuits at a time. A power system can require several distribution transformers, depending on the magnitude and physical distribution of the trace heating loads. The distribution transformer secondary should be an earthed system.

The physical location of the distribution system should be considered in relation to the piping system when developing the distribution system. Whenever practical, locate the panels in unclassified and noncorrosive areas. The selection of the distribution panel enclosure is based on the environment and area classifications. All enclosures should have the specific system identification clearly marked on the outside, and the circuit directories should be easily accessible. The branch circuit wiring of each trace heating circuit requires an over-current protective device. Selection of branch circuit protective device ratings should be based on heater start-up currents and their duration at the minimum temperature the trace heater can experience until design operating conditions are reached.

The recommended number of trace heaters or segments should not exceed five on a single protective device.

6.9 Earthing requirements

Earthing requirements include the following:

- a) The electrically conductive covering of the trace heater is connected to the earthing system.
- b) In applications where the primary earth path is dependent on the electrically conductive covering, the chemical resistance of the material should be considered if exposure to corrosive vapours or liquids can occur.
- c) Stainless steel type braids and sheaths typically have high resistance and might not provide effective earth paths. Consideration should be given to alternative earthing means or supplemental earthing protection.