

INTERNATIONAL STANDARD



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



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2015 IEC, Geneva, Switzerland

Copyright © 2015 IEEE

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing being secured. Requests for permission to reproduce should be addressed to either IEC at the address below or IEC's member National Committee in the country of the requester or from IEEE.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue
New York, NY 10016-5997
United States of America
stds.ipr@ieee.org
www.ieee.org

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About the IEEE

IEEE is the world's largest professional association dedicated to advancing technological innovation and excellence for the benefit of humanity. IEEE and its members inspire a global community through its highly cited publications, conferences, technology standards, and professional and educational activities.

About IEC/IEEE publications

The technical content of IEC/IEEE publications is kept under constant review by the IEC and IEEE. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 60 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

INTERNATIONAL STANDARD



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.260.20

ISBN 978-2-8322-2736-7

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	6
1 Scope	10
2 Normative references	10
3 Terms and definitions	10
4 Application considerations	10
4.1 General	10
4.2 Corrosive areas	11
4.3 Process temperature accuracy	11
4.3.1 Type I	11
4.3.2 Type II	11
4.3.3 Type III	11
4.4 Installation considerations	11
5 Thermal insulation	12
5.1 General	12
5.2 Selection of insulating material	12
5.3 Selection of weather barrier (cladding)	13
5.4 Selection of economical thickness to provide optimum trace heating design	13
5.5 Double insulation	14
6 System design	17
6.1 General	17
6.2 Purpose of, and major requirement for, trace heating	17
6.3 Training	18
6.4 Selection of trace heater	18
6.4.1 General	18
6.4.2 Site-fabricated trace heaters	18
6.4.3 Specific types of trace heating	19
6.5 Maximum temperature determination	19
6.5.1 General	19
6.5.2 PTC characteristic	19
6.5.3 Stabilized design	20
6.5.4 Controlled design	20
6.6 Heat up and cool down considerations	20
6.7 Design information	20
6.7.1 Design information documentation	20
6.7.2 Isometric or trace heater configuration line lists and load charts	21
6.8 Power system	22
6.9 Earthing requirements	22
6.10 Earth-fault protection of equipment	23
6.11 Start-up at minimum ambient temperatures	23
6.12 Long trace heater runs	23
6.13 Flow pattern analysis	23
6.14 Dead-leg control technique	25
6.15 Chimney effect	25
6.16 Safety shower and eyewash station design requirements	26

7	Control and monitoring	26
7.1	General.....	26
7.2	Mechanical controllers	27
7.3	Electronic controllers	27
7.4	Application suitability	27
7.5	Location of controllers.....	27
7.6	Location of sensors.....	28
7.7	Alarm considerations	28
7.7.1	General	28
7.7.2	Trace heating circuit alarm	28
7.7.3	Temperature alarms	29
7.7.4	Other alarms.....	29
7.7.5	Integrated control	29
8	Recommendations for installation	29
8.1	General.....	29
8.2	Preparatory work	30
8.2.1	General	30
8.2.2	Scheduling and coordination.....	30
8.2.3	Confirmation of equipment.....	30
8.2.4	Receiving materials	30
8.2.5	Warehousing and handling	30
8.2.6	Personnel aspects	30
8.3	Installation of trace heating circuits.....	30
8.3.1	Coordination and equipment verification	30
8.3.2	Pre-installation testing and design verification	31
8.3.3	Visual examination	31
8.3.4	Insulation resistance test	31
8.3.5	Component substitution	31
8.3.6	Location of power supply	31
8.3.7	Installation of trace heaters	32
8.3.8	Connections and terminations.....	34
8.4	Installation of control and monitoring equipment	36
8.4.1	General	36
8.4.2	Verification of equipment suitability.....	36
8.4.3	Temperature controller and monitoring devices.....	36
8.4.4	Sensor considerations	36
8.4.5	Controller operation, calibration, and access	40
8.4.6	Necessary modifications	40
8.5	Installation of thermal insulation system (see also Clause 5).....	40
8.5.1	General	40
8.5.2	Preparatory work	40
8.5.3	Installation of the thermal insulation materials	40
8.5.4	Cladding	41
8.5.5	Field (site work) circuit insulation resistance test	41
8.5.6	Visual inspection	41
8.5.7	Documentation	42
8.6	Installation of distribution wiring and coordination with branch circuits	42
8.6.1	General	42
8.6.2	Earth-fault protective device	42

8.6.3	Circuit protective device	42
8.6.4	Tagging/Identification	42
8.7	Commissioning	42
8.7.1	Pre-commissioning check	42
8.7.2	Functional check and final documentation.....	43
9	Maintenance	44
9.1	General.....	44
9.2	Fault location	44
9.3	Fault rectification	44
10	Repairs.....	45
10.1	General.....	45
10.2	Practicability of repair to electric trace heaters.....	45
10.2.1	Mechanical damage.....	45
10.2.2	Damage due to corrosion.....	45
10.2.3	Damage due to overheating.....	45
10.3	Repair techniques for electrical trace heaters	45
10.3.1	General	45
10.3.2	In-line splice	46
10.3.3	Connection via junction box	46
10.4	Earthing.....	46
10.5	Testing	46
Annex A (informative)	Example of design data record	47
Annex B (informative)	Checklist for installation requirements	48
Annex C (informative)	Example of trace heater commissioning record	50
Annex D (informative)	Example of maintenance schedule and log record.....	52
Annex E (informative)	Pipe heat loss considerations – Heat loss formula and example calculations.....	54
Annex F (informative)	Vessel heat loss considerations.....	60
F.1	General.....	60
F.2	Insulation heat loss (Q_{ins}).....	60
F.3	Slab surface areas (Q_{slab}).....	61
F.4	Support heat loss (Q_{supt})	61
F.5	Manhole heat loss ($Q_{manhole}$).....	62
F.6	Convection coefficient formulae	62
F.6.1	General	62
F.6.2	Free convection, nonfluid surface, any orientation (h_i, h_{co}, h_o)	62
F.6.3	Forced convection, any orientation (h_o)	63
F.6.4	Radiation component, all coefficients (h_f, h_i, h_{co}, h_o).....	63
Annex G (informative)	Heat up and cool down considerations	65
G.1	Heat up.....	65
G.2	Cool down.....	66
Annex H (informative)	Method to determine equivalent thicknesses of insulating cements.....	68
Bibliography	69
Figure 1 – Thermal insulation – Weather-barrier installation.....		15
Figure 2 – Typical temperature profile.....		16

Figure 3 – Flow pattern analysis example	24
Figure 4 – Bypass example	25
Figure 5 – Typical installation of control sensor and sensor for temperature limiting control	38
Figure 6 – Limiting device sensor on sheath of trace heater	38
Figure 7 – Limiting device sensor as artificial hot spot	39
Figure E.1 – Assumed temperature gradients	55
Table 1 – Pre-installation checks	32
Table A.1 – Example of design data record	47
Table B.1 – Example of pre-commissioning check and trace heater installation record	48
Table C.1 – Example of trace heater commissioning record	50
Table D.1 – Example of maintenance schedule and log record	52

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –

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

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation.

IEEE Standards documents are developed within IEEE Societies and Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of IEEE and serve without compensation. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information contained in its standards. Use of IEEE Standards documents is wholly voluntary. IEEE documents are made available for use subject to important notices and legal disclaimers (see <http://standards.ieee.org/IPR/disclaimers.html> for more information).

IEC collaborates closely with IEEE in accordance with conditions determined by agreement between the two organizations. This Dual Logo International Standard was jointly developed by the IEC and IEEE under the terms of that agreement.

- 2) The formal decisions of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees. The formal decisions of IEEE on technical matters, once consensus within IEEE Societies and Standards Coordinating Committees has been reached, is determined by a balanced ballot of materially interested parties who indicate interest in reviewing the proposed standard. Final approval of the IEEE standards document is given by the IEEE Standards Association (IEEE-SA) Standards Board.
- 3) IEC/IEEE Publications have the form of recommendations for international use and are accepted by IEC National Committees/IEEE Societies in that sense. While all reasonable efforts are made to ensure that the technical content of IEC/IEEE Publications is accurate, IEC or IEEE cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications (including IEC/IEEE Publications) transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC/IEEE Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC and IEEE do not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC and IEEE are not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or IEEE or their directors, employees, servants or agents including individual experts and members of technical committees and IEC National Committees, or volunteers of IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board, for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC/IEEE Publication or any other IEC or IEEE Publications.
- 8) Attention is drawn to the normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that implementation of this IEC/IEEE Publication may require use of material covered by patent rights. By publication of this standard, no position is taken with respect to the existence or validity of any patent rights in connection therewith. IEC or IEEE shall not be held responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patent Claims or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

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 first edition of IEC/IEEE 60079-30-2 cancels and replaces the first edition of IEC 60079-30-2 published in 2007 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 60079-30-2, harmonization with IEEE Std 515, with respect to the previous edition:

- the relocation of trace heater product design methodology and requirements to IEC/IEEE 60079-30-1;
- the relocation and/or duplication of information on installation, maintenance, and repair to the MTs under SC31J for their addition into IEC 60079-14, IEC 60079-17, and IEC 60079-19;
- the inclusion of more detailed information on safety showers and eyewash units;
- the introduction of Annexes from IEEE Std 515.

The significance of changes between IEC 60079-30-2, Edition 1.0 (2007) and IEC/IEEE 60079-30-2, Edition 1.0 (2014) is as listed below:

Changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Addition of clarification for the exclusion of areas coverage classifications of EPLs Ga and Da	1	X		
Addition of requirements for the Division method of area classification that may be applied by some users	1			C1
Relocation of heat loss design requirements to IEC/IEEE 60079-30-1	6.3	X		
Addition of safety shower and eyewash station design requirements	6.16			C2
Addition of Annex for an example of a design data record	Annex A	X		
Addition of Annex for a checklist of installation requirements	Annex B	X		
Addition of Annex for an example of a trace heater commissioning record	Annex C	X		
Addition of Annex for an example of a maintenance schedule and log record	Annex D	X		
Addition of Annex for pipe heat loss considerations	Annex E	X		
Addition of Annex for vessel heat loss considerations	Annex F	X		
Addition of Annex for heat up and cool down considerations	Annex G	X		
Addition of Annex for a method to determine the equivalent thickness of insulating cements	Annex H	X		

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 for the Division method of area classification are applicable only for users of this standard intending qualification for these areas.

C2 – The design requirements for safety showers and eyewash units have been included for harmonization and for added safety.

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

FDIS	Report on voting
31/1190/FDIS	31/1199/RVD

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 60079-30-1:2014, *Explosive atmospheres – Part 30-1: Electrical resistance trace heating – General and testing requirements*.

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 may 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.

Where trace heating systems are to be installed in explosive atmospheres, full details of the area classifications shall be specified. The specification shall state, as applicable, the