



**IEEE**

**IEC/IEEE 60079-30-1**

Edition 1.0 2015-09

# **INTERNATIONAL STANDARD**



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



**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](mailto:info@iec.ch)  
[www.iec.ch](http://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](mailto:stds.ipr@ieee.org)  
[www.ieee.org](http://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](http://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](http://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](http://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](http://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](http://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](http://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](mailto:csc@iec.ch).



**IEEE**

**IEC/IEEE 60079-30-1**

Edition 1.0 2015-09

# **INTERNATIONAL STANDARD**



**Explosive atmospheres –**

**Part 30-1: Electrical resistance trace heating – General and testing requirements**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 29.260.20

ISBN 978-2-8322-2758-9

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

## CONTENTS

FOREWORD.....	5
INTRODUCTION.....	10
1 Scope.....	11
2 Normative references .....	15
3 Terms and definitions .....	16
4 General requirements .....	22
4.1 General.....	22
4.2 Mechanical strength.....	22
4.3 Terminations and connections.....	23
4.4 Circuit protection requirements for branch circuits.....	23
4.5 Temperature requirements.....	23
4.5.1 General .....	23
4.5.2 Stabilized design .....	24
4.5.3 Controlled design.....	24
5 Testing.....	26
5.1 Type tests.....	26
5.1.1 General .....	26
5.1.2 Dielectric test .....	26
5.1.3 Electrical insulation resistance test.....	27
5.1.4 Flammability test .....	27
5.1.5 Impact tests.....	29
5.1.6 Deformation test .....	32
5.1.7 Cold bend test.....	32
5.1.8 Water resistance test .....	33
5.1.9 Integral component resistance to water test.....	33
5.1.10 Verification of rated output.....	34
5.1.11 Thermal stability of electrical insulating material .....	36
5.1.12 Thermal performance test.....	36
5.1.13 Determination of maximum sheath temperature .....	38
5.1.14 Verification of start-up current .....	46
5.1.15 Verification of the electrical resistance of electrically conductive covering .....	46
5.1.16 Outdoor exposure test .....	47
5.2 Routine tests.....	47
5.2.1 Dielectric test .....	47
5.2.2 Verification of rated output.....	47
6 Marking .....	47
6.1 Product markings for trace heaters .....	47
6.2 Markings for field assembled components.....	48
7 Documentation requirements .....	48
7.1 General.....	48
7.2 Circuit design documentation .....	48
7.3 Trace heating system documentation .....	49
7.3.1 General .....	49

7.3.2	For trace heating systems according to the product classification method .....	49
7.3.3	For trace heating systems according to stabilized design method .....	49
7.3.4	For trace heating systems according to controlled design method.....	49
7.4	Instructions for installation of trace heating system .....	50
7.5	Instructions for commissioning .....	50
7.6	Instructions for maintenance / repair or modification .....	50
Annex A (informative) Type test matrix for EPLs Gb/Gc/Db/Dc (Refer to IEC 60079-14 for the relationship of EPLs to Zones) .....		52
Annex B (informative) Checklist for installation .....		53
Annex C (normative) Trace heater product design verification methodology .....		54
C.1	General.....	54
C.2	Design methodology and selection of trace heaters .....	54
C.3	Stabilized design calculations .....	54
C.4	Trace heater performance and equilibrium conditions .....	55
C.5	Heat loss calculations .....	57
C.6	Heat loss design safety factor .....	58
C.7	Maximum temperature determination .....	58
C.7.1	Theoretical pipe and sheath temperature calculations – metallic applications .....	58
C.7.2	Theoretical vessel and sheath temperature calculations – Metallic applications .....	59
C.7.3	Sheath temperature – metallic application utilizing a temperature limiter control sensing the trace heater sheath or an artificial hot spot .....	60
C.7.4	Theoretical sheath temperature calculations – Non-metallic applications .....	60
C.7.5	Sheath temperature – non-metallic applications utilizing a temperature limiter control sensing the trace heater sheath or an artificial hot spot .....	62
Annex D (normative) Requirements for Division 1 and Division 2 trace heating systems .....		63
D.1	Application .....	63
D.2	General.....	63
D.3	Terminations and connections.....	63
D.4	Control and temperature requirements .....	63
D.4.1	General .....	63
D.4.2	Stabilized design .....	63
D.4.3	Controlled design.....	64
D.4.4	Requirements for protective device in Divisions 1 and 2 .....	64
D.5	Type tests .....	64
D.5.1	Division 1 trace heating equipment .....	64
D.5.2	Division 2 equipment .....	65
D.6	Marking.....	65
D.7	Instructions – Installation requirements .....	65
Annex E (normative) Type test matrix for Division 1 and 2 explosive atmospheres .....		67
Bibliography.....		69
Figure 1 – Flammability test.....		28
Figure 2 – Example of room temperature impact test .....		30
Figure 3 – Example of minimum temperature impact test .....		31
Figure 4 – Cold bend test.....		33

Figure 5 – Integral components resistance to water test.....	34
Figure 6 – Verification of rated output .....	35
Figure 7 – Maximum sheath temperature using product classification approach .....	39
Figure 8 – Verification of sheath temperatures using pipe sculpture .....	41
Figure 9 – Verification of sheath temperature, plate test .....	44
Figure 10 – Verification of sheath temperature – plate test with serpentine sample .....	44
Figure 11 – Plate test with two samples crossed over .....	45
Figure 12 – Plate test with a single sample crossed over .....	46
Figure C.1 – Equilibrium conditions for workpiece maintenance .....	55
Figure C.2 – Equilibrium conditions for upper limit evaluation .....	56
Table 1 – Application or exclusion of specific clauses of IEC 60079-0.....	11
Table 2 – Sheath temperature design conditions based on equipment protection levels – Stabilized design approach .....	24
Table 3 – Sheath temperature design conditions based on equipment protection levels EPLs – Controlled design approach .....	25
Table 4 – Test voltages for the dielectric test.....	26
Table A.1 – Determination of test samples.....	52
Table B.1 – Trace heater installation record – Example .....	53
Table D.1 – Division trace heating systems.....	63
Table D.2 – Sheath temperature design conditions – Stabilized design approach .....	64
Table D.3 – Sheath temperature design conditions – With temperature control device .....	64
Table E.1 – Applicable trace heater and trace heater pads and panels tests by installation location .....	67
Table E.2 – Applicable tests for integral components with trace heaters and trace heater pads and panels.....	68

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### EXPLOSIVE ATMOSPHERES –

#### Part 30-1: Electrical resistance trace heating – General and testing requirements

#### 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 IEC 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 members 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 60079-30-1 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.

This publication is published as an IEC/IEEE Dual Logo standard.

NOTE A list of IEEE participants can be found at the following URL:  
[http://standards.ieee.org/downloads/60079/60079-30-1-2015/60079-30-1-2015\\_wg-participants.pdf](http://standards.ieee.org/downloads/60079/60079-30-1-2015/60079-30-1-2015_wg-participants.pdf).

This first edition of IEC/IEEE 60079-30-1 cancels and replaces the first edition of IEC 60079-30-1 published in 2007 and constitutes a technical revision.

This edition includes the following significant changes, apart from the general revision and updating of the first edition of IEC 60079-30-1 and harmonization with IEEE Std 519 with respect to the previous edition:

- the inclusion of a minimum temperature impact test;
- the addition of a mechanical procedure in the thermal stability test;
- the inclusion of a thermal performance test to replace the thermal safety requirements;
- the inclusion of a second procedure utilizing a plate fixture for sheath temperature determination;
- the inclusion of an ultraviolet and condensation test;
- the revision and significant expansion of documentation requirements;
- the addition of Annexes covering requirements for Divisions 1 and 2;
- the addition of a table covering the applicability of requirements from IEC 60079-0;
- the addition of an Annex covering trace heater product design verification methodology (formerly located in IEC 60079-30-2);
- the further harmonization of this edition with several national standards.

The significance of changes between IEC 60079-30-1, Edition 1.0 (2007) and IEC/IEEE 60079-30-1, Edition 1.0 (2015) is as listed below:

Change	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Addition of clarification for the exclusion 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		X	
Addition of table specifying the application or exclusion of specific clauses of IEC 60079-0 Edition 6	1	X		
For controlled designs, a clarification for the need for verification by testing and the addition of a table for the specific requirements	4.5.2	X		
For controlled designs, a clarification for the need for verification by testing and the addition of a table for the specific requirements	4.5.3	X		
For controlled designs, clarifications and additions on the separate requirements for Gb/Db and Gc/Dc	4.5.3		X	
The requirements for calibration of the flammability test fixture are replaced with equivalent requirements for the energy levels of the test gases	5.1.4	X		
Addition of a minimum temperature impact test	5.1.5			C1

Changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
For thermal stability, the addition of a bending requirement on a mandrel	5.1.11			C1
The replacement of the thermal safety procedure with a thermal performance procedure	5.1.12			C2
The addition of a second procedure utilizing a plate fixture for the systems method for maximum sheath temperature determination	5.1.13.2			C3
Addition of outdoor exposure test	5.1.16			C4
Requirement changed for the marking of the minimum installation temperature	6.1			C5
Addition of new markings requirements for field assembled components	6.2			C5
Additions and changes to the documentation requirements	7			C5
Addition of Annex	Annex A	X		
Addition of Annex	Annex B	X		
Addition of Annex specifying trace heating design verification methodology, moved from IEC 60079-30-2	Annex C			C6
Addition of Annex for the Division method of area classification that may be applied by some users	Annex D		X	
Addition of Annex for the Division method of area classification that may be applied by some users	Annex E		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 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 additional mechanical testing have been included for harmonization and for added safety.

C2 – The requirements for thermal performance have been included to recognize the necessity for thermal stability of products in explosive atmospheres.

C3 – A second procedure utilizing a plate fixture has been included for sheath temperature determination, which may be used in lieu of the sheath temperature verification part of 5.1.13.4.2.

C4 – An outdoor exposure test has been added to cover products that may be exposed to sunlight and moisture in the intended application.

C5 – Additional marking and documentation requirements have been added to provide additional information to the end user.

C6 – The trace heating design verification methodology has been added to align with the evaluation requirements for the stabilized design and the controlled design methods of maximum sheath temperature determination.

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

FDIS	Report on voting
31/1191/FDIS	31/1201/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 rules given in the ISO/IEC Directives, Part 2.

This standard is intended to be used in conjunction with IEC/IEEE 60079-30-2:2015, *Explosive atmospheres – Part 30-2: Electrical resistance trace heating – Application guide for design, installation and maintenance*.

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

The IEC Technical Committee and IEEE Technical Committee have decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.**

## INTRODUCTION

IEC/IEEE 60079-30-1 is intended to provide a comprehensive overview of the essential requirements and testing appropriate to electric surface heating equipment used in explosive atmospheres. The requirements of this part of IEC 60079 are considered to be the minimum requirements for equipment protection levels Gb, Gc, Db, and Dc in explosive atmospheres for gases, dusts, and fibres/flyings. While some of this work already exists in national standards or international standards, this standard has collated much of this existing work and considerably added to it. This standard also contains the minimum requirements for users applying the Division method of area classification.

## EXPLOSIVE ATMOSPHERES –

### Part 30-1: Electrical resistance trace heating – General and testing requirements

#### 1 Scope

This part of IEC 60079 specifies general and testing requirements for electrical resistance trace heaters for application in explosive atmospheres with the exclusion of those for EPL Ga and Da. This standard covers trace heaters that comprise either factory or field (work-site) assembled units, and which may be series trace heaters, parallel trace heaters, trace heater pads, or trace heater panels that have been assembled and/or terminated in accordance with the manufacturer's instructions.

This standard also includes requirements for termination assemblies and control methods used with trace heating systems. The explosive atmospheres referred to in this standard are those defined in IEC 60079-10-1 and IEC 60079-10-2.

Annexes D and E outline the application of this standard for those users applying the Division method of area classification.

This standard supplements and modifies the general requirements of IEC 60079-0, except as indicated in Table 1. Where a requirement of this standard conflicts with a requirement of IEC 60079-0, the requirement of this standard takes precedence.

**Table 1 – Application or exclusion of specific clauses of IEC 60079-0**

IEC 60079-0		Electrical resistance trace heaters and integral components		Terminations as separate components
Ed. 6.0 (2011) (informative)	Clause / Subclause title (normative)	Group I and Group II	Group III	
1	Scope	Applies	Applies	Applies
2	Normative references	Applies	Applies	Applies
3	Terms and definitions	Applies, except ambient temperature, see 3.1	Applies, except ambient temperature, see 3.1	Applies, except ambient temperature, see 3.1
4	Equipment grouping	Applies	Applies	Applies
4.1	Group I	Applies	Excluded	Applies
4.2	Group II	Applies, always IIC	Excluded	Applies
4.3	Group III	Excluded	Applies, outside of thermal insulation only, always IIIC	Applies, outside of thermal insulation only
4.4	Equipment for a particular explosive atmosphere	Excluded	Excluded	Applies
5.1	Environmental influences	Applies	Applies	Applies
5.1.1	Ambient temperature	Replaced by 6.1e)	Replaced by 6.1e)	Applies, see 3.1
5.1.2	External source of heating or cooling	Applies	Applies	Applies
5.2	Service temperature	Modified	Modified	Applies