

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Explosive atmospheres –
Part 25: Intrinsically safe electrical systems**

**Atmosphères explosives –
Partie 25: Systèmes électriques de sécurité intrinsèque**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2010 IEC, Geneva, Switzerland

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 from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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 IEC publications

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

- Catalogue of IEC publications: www.iec.ch/searchpub

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

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

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch

Tel.: +41 22 919 02 11

Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,...). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:

Email: csc@iec.ch

Tél.: +41 22 919 02 11

Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Explosive atmospheres –
Part 25: Intrinsically safe electrical systems**

**Atmosphères explosives –
Partie 25: Systèmes électriques de sécurité intrinsèque**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

XC

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Terms, definitions and abbreviations	7
3.1 Terms and definitions	7
3.2 Abbreviations	8
4 Descriptive system document	8
5 Grouping and classification.....	9
6 Levels of protection	9
6.1 General.....	9
6.2 Level of protection “ia”.....	9
6.3 Level of protection “ib”.....	9
6.4 Level of protection “ic”.....	9
7 Ambient temperature rating	10
8 Interconnecting wiring / cables used in an intrinsically safe electrical system	10
9 Requirements of cables and multi-core cables.....	10
9.1 General.....	10
9.2 Multi-core cables	10
9.3 Electrical parameters of cables.....	11
9.4 Conducting screens.....	11
9.5 Types of multi-core cables.....	11
9.5.1 General	11
9.5.2 Type A cable	11
9.5.3 Type B cable	11
9.5.4 Type C cable	11
10 Termination of intrinsically safe circuits	11
11 Earthing and bonding of intrinsically safe systems.....	12
12 Protection against lightning and other electrical surges	12
13 Assessment of an intrinsically safe system	13
13.1 General.....	13
13.2 Simple apparatus	14
13.3 Analysis of inductive circuits.....	15
13.4 Faults in multi-core cables.....	15
13.4.1 Type of multi-core cables.....	15
13.4.2 Type A cable	15
13.4.3 Type B cable	15
13.4.4 Type C cable	16
13.5 Type verifications and type tests	16
14 Marking	16
15 Predefined systems	16
Annex A (informative) Assessment of a simple intrinsically safe system.....	17
Annex B (normative) Assessment of circuits with more than one source of power	20
Annex C (informative) Interconnection of non-linear and linear intrinsically safe circuits	23
Annex D (normative) Verification of inductive parameters	59

Annex E (informative) A possible format for descriptive systems drawings and installation drawings	61
Annex F (informative) Surge protection of an intrinsically safe circuit.....	64
Annex G (normative) Testing of cable electrical parameters.....	67
Annex H (informative) Use of simple apparatus in systems	69
Annex I (normative) FISCO systems	71
Bibliography.....	74
Figure 1 – Systems analysis	14
Figure 2 – Typical system using simple apparatus	15
Figure B.1 – Sources of power connected in series.....	21
Figure B.2 – Sources of power connected in parallel.....	22
Figure B.3 – Sources of power not deliberately connected	22
Figure C.1 – Equivalent circuit and output characteristic of resistive circuits	24
Figure C.2 – Current and/or voltage addition for interconnections	26
Figure C.3 – Output characteristic and equivalent circuit of a source with trapezoidal characteristic	29
Figure C.4 – Example of an interconnection.....	33
Figure C.5 – Sum characteristics for the circuit as given in Figure C.4.....	35
Figure C.6 – Current and/or voltage addition for the example given in Figure C.4	36
Figure C.7 – Limit curve diagram for universal source characteristic – Group IIC.....	47
Figure C.8 – Limit curve diagram for universal source characteristic – Group IIB	57
Figure C.9 – Copy pattern for universal source diagrams.....	58
Figure D.1 – Typical inductive circuit	60
Figure E.1 – Typical block diagram for IS system descriptive system document.....	62
Figure E.2 – Typical installation drawing for IS system	63
Figure F.1 – Surge protection requirements of an instrument loop	66
Figure I.1 – Typical system	73
Table A.1 – Simple system analysis.....	19
Table C.1 – Parameters necessary to describe the output characteristic.....	28
Table C.2 – Assignment of diagrams to equipment groups and inductances.....	31

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –**Part 25: Intrinsically safe electrical systems**

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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements 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.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC 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 transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is 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 its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees 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 Publication or any other IEC 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 some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60079-25 has been prepared by subcommittee 31G: Intrinsically safe apparatus, of IEC technical committee 31: Equipment for explosive atmospheres.

This second edition cancels and replaces the first edition published in 2003 and constitutes a thorough technical revision.

The significant changes with respect to the previous edition are listed below:

- extension of the scope from Group II to Groups I, II and III;
- introduction of level of protection "ic";
- addition of requirements for cables and multi-core cables;
- reference to IEC 60079-11 regarding the termination of intrinsically safe circuits
- requirements for the assessment of an expanded and clarified intrinsically safe system regarding level of protection "ic", simple apparatus and faults in multi-core cables;

- introduction of predefined systems and merging of the system requirements for FISCO from IEC 60079-27;
- addition of requirements for simple intrinsically safe systems containing both lumped inductance and lumped capacitance;
- addition of a method for testing the electrical parameters of cables;
- additional information for the use of simple apparatus in systems.

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

FDIS	Report on voting
31G/202/FDIS	31G/203/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.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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.

EXPLOSIVE ATMOSPHERES –

Part 25: Intrinsically safe electrical systems

1 Scope

This part of IEC 60079 contains the specific requirements for construction and assessment of intrinsically safe electrical systems, type of protection “i”, intended for use, as a whole or in part, in locations in which the use of Group I, II or III apparatus is required.

NOTE 1 This standard is intended for use by the designer of the system who may be a manufacturer, a specialist consultant or a member of the end-user's staff.

This standard supplements and modifies the general requirements of IEC 60079-0 and the intrinsic safety standard IEC 60079-11. Where a requirement of this standard conflicts with a requirement of IEC 60079-0 or IEC 60079-11, the requirement of this standard takes precedence.

This standard supplements IEC 60079-11, the requirements of which apply to electrical apparatus used in intrinsically safe electrical systems.

The installation requirements of Group II or Group III systems designed in accordance with this standard are specified in IEC 60079-14.

NOTE 2 Group I installation requirements are presently not provided in IEC 60079-14.

2 Normative references

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

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

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

IEC 60079-11:2006, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”*

IEC 60079-14:2007, *Explosive atmospheres – Part 14: Electrical installations design, selection and erection*

IEC 60079-15, *Electrical apparatus for explosive gas atmospheres – Part 15: Construction, test and marking of type of protection “n” electrical apparatus*

IEC 60079-27:2008, *Explosive atmospheres – Part 27: Fieldbus intrinsically safe concept (FISCO)*

IEC 61158-2, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61241-0, *Electrical apparatus for use in the presence of combustible dust – Part 0: General requirements*

IEC 61241-11, *Electrical apparatus for use in the presence of combustible dust – Part 11: Protection by intrinsic safety 'iD'*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions, specific to intrinsically safe electrical systems, apply. They supplement the terms and definitions which are given in IEC 60079-0 and IEC 60079-11.

3.1.1

intrinsically safe electrical system

assembly of interconnected items of electrical apparatus, described in a descriptive system document, in which the circuits or parts of circuits, intended to be used in an explosive atmosphere, are intrinsically safe circuits

3.1.2

certified intrinsically safe electrical system

intrinsically safe electrical system conforming to 3.1.1 for which a certificate has been issued confirming that the electrical system complies with IEC 60079-25

3.1.3

uncertified intrinsically safe electrical system

intrinsically safe electrical system conforming to 3.1.1 for which the knowledge of the electrical parameters of the items of certified intrinsically safe electrical apparatus, certified associated apparatus, simple apparatus and the knowledge of the electrical and physical parameters of the interconnecting wiring permit the unambiguous deduction that intrinsic safety is preserved

3.1.4

descriptive system document

document in which the items of electrical apparatus, their electrical parameters and those of the interconnecting wiring are specified

3.1.5

system designer

person who is responsible for the descriptive system document, has the necessary competence to fulfil the task and who is empowered to enter into the commitments on behalf of his employer

3.1.6

maximum cable capacitance

C_c

maximum capacitance of the interconnecting cable that can be connected into an intrinsically safe circuit without invalidating intrinsic safety

3.1.7

maximum cable inductance

L_c

maximum inductance of the interconnecting cable that can be connected into an intrinsically safe circuit without invalidating intrinsic safety