IEC 60079-11

Edition 6.0 2011-07
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Explosive atmospheres –
Part 11: Equipment protection by intrinsic safety "i"

Atmosphères explosives –
Partie 11: Protection de l'équipement par sécurité intrinsèque «i»

IEC 60079-11:2011 RLV (en-fr)

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2011 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 Varembé
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 It also gives information on projects, withdrawn and replaced publications.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

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

IEC 60079-11

Edition 6.0 2011-07
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Explosive atmospheres –
Part 11: Equipment protection by intrinsic safety "i"

Atmosphères explosives –
Partie 11: Protection de l'équipement par sécurité intrinsèque «i»

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.260.20

ISBN 978-2-88912-520-3

® Registered trademark of the International Electrotechnical Commission
Marque déposée de la Commission Electrotechnique Internationale

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

IEC 60079-11

Edition 6.0 2011-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Explosive atmospheres –
Part 11: Equipment protection by intrinsic safety "i"

Atmosphères explosives –
Partie 11: Protection de l'équipement par sécurité intrinsèque «i»

IEC 60079-11:2011

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

SC 31G/IEC 60079-11 (2011), sixth edition/I-SH 01

EXPLOSIVE ATMOSPHERES –

Part 11: Equipment protection by intrinsic safety "i"

INTERPRETATION SHEET 1

This interpretation sheet has been prepared by subcommittee 31G: Equipment for explosive atmospheres – Equipment protection by intrinsic safety "i", of IEC technical committee 31.

The text of this interpretation sheet is based on the following documents:

ISH	Report on voting
31G/235/ISH	31G/238/RVISH

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

Following decision No 16 of the TC 31 meeting in Melbourne in 2011, the issuing of an Interpretation Sheet for IEC 60079-11:2011 (6th edition) was requested, in order to clarify the significance of the changes with respect to the 5th edition.

Question

What are the minor editorial, extensions, and major technical changes of the 6th edition with respect to the 5th edition?

Answer

The following table shows the significance of the changes.

The significance of the changes between IEC Standard, IEC 60079-11, Edition 5, 2006-07 and IEC 60079-11, Edition 6, 2011-06 are as listed below

October 2014 ICS 29.260.20

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

Significance of changes with respect to IEC 60079-11:2006

		Type		
Significant Changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
General: Changes to remove specific clause references to other IEC 60079 standards	General	x		
Scope: Expansion to include Group III	1		x	
Scope: Table 1 updated to include references to both IEC 60079-0 Edition 5 and Edition 6	1		x	
Normative references: Deletion of IEC 60079-27, and addition of IEC 61158-2 and IEC 62013-1	2	x		
Terms and definitions: Commonly used definitions moved to IEC 60079-0. Energy limitation definitions moved from IEC 60079-0.New definitions added	3	x		
Spark ignition compliance: Group III ignition requirements added	5.5		x	
Temperature for small components for Group I and Group II: Relocated to IEC 60079-0	5.6.2	x		
Intrinsically safe apparatus and component temperature for Group III	5.6.5		x	
Enclosures for Group I or Group II apparatus	6.1.2	x		
Apparatus complying with Annex F	6.1.2.3 c)	x		
Enclosures for Group III apparatus	6.1.3		x	
Requirements for connections and accessories for IS apparatus when located in the non-hazardous area	6.2.5			C1
Separation of conductive parts	6.3.2	x		
Encapsulation	6.6.1	x		
Encapsulation used for the exclusion of explosive atmospheres	6.6.2			C2
Primary and secondary cells and batteries	7.4.1		x	
Battery construction	7.4.2		x	
Level of Protection “ic”	8.1	x		
Filter capacitors	8.6.2		x	
Wiring, printed circuit board tracks, and connections	8.8 c)	x		
FISCO apparatus	9.2		x	
Handlights and caplights	9.3		x	
Circuits with both inductance and capacitance	10.1.5.2	x		
Electrolyte leakage test for cells and batteries	10.5.2	x		
Spark ignition and surface temperature of cells and batteries	10.5.3	x		
Determination of the acceptability of fuses requiring encapsulation	10.6.2		x	
Optical isolators tests	10.11		x	
Marking	12.1	x		
Encapsulation	Annex D			C2
Fieldbus intrinsically safe concept (FISCO) – Apparatus requirements	Annex G		x	
Ignition testing of semiconductor limiting power supply circuits	Annex H		x	

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

Explanation of the Types of Significant Changes:

A) Definitions

1. 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.

2. 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.

3. 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 – Requirements for external connections, other than battery charging connections, that are designed for use only when an explosive gas or dust atmosphere is not present, for example when in a non-hazardous area or when a gas-free permit is in force, have been added.

C2 – The requirements for encapsulation referenced in 6.6.2 and detailed in Annex D have been changed in terms of the thickness to the free surface and are extended related to moulding. Annex D is changed from informative to normative.

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

© IEC 2016

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60079-11
Edition 6.0 2011-06

EXPLOSIVE ATMOSPHERES –

Part 11: Equipment protection by intrinsic safety "i"

INTERPRETATION SHEET 2

This interpretation sheet has been prepared by subcommittee 31G: Intrinsically-safe apparatus, of IEC technical committee 31: Equipment for explosive atmospheres.

The text of this interpretation sheet is based on the following documents:

ISH	Report on voting
31G/252/ISH	31G/254/RVD

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

Interpretation of 6.2.5 – Requirements for connections and accessories for IS apparatus when located in the non-hazardous area

Question:

Does the first NOTE of 6.2.5 imply that equipment which may be connected to non-intrinsically safe connection facilities of intrinsically safe apparatus restricted to use in non-hazardous area need to be assessed applying IEC 60079-11, if the value of U_m is less than 250 V a.c.? Does this furthermore apply to equipment to be connected to non-intrinsically safe connection facilities of associated apparatus, if the value of U_m is less than 250 V a.c.?

Background:

The first NOTE of 6.2.5 requires in cases were U_m is specified less than 250 V a.c. that this should not be derived from unassessed equipment. This is sometimes read as if the requirements of IEC 60079-11 should be applied for voltage limitation to guarantee U_m.

Terminological entry 3.13.13 defines that U_m is the maximum voltage that can be applied to the non intrinsically safe connection facilities of associated apparatus without invalidating the

ICS 29.260.20

IEC 60079-11:2011-06/ISH2:2016-07(en-fr)

AVA Documents Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

type of protection. NOTE 1 of 3.13.13, as an example, explains that this may apply to connection facilities used for charging batteries.

In IEC 60079-11 there are no measures required for limiting the voltage of non I.S. circuits to the specified U_m value, except for the use of a single Zener diode protected by a fuse as an integral measure of an associated apparatus limiting the voltage which can appear at a transformer (8.3) or a coupler (8.9.2).

IEC 60079-14: 2013, 16.2.1 states:

Where U_m marked on the associated apparatus is less than 250 V it shall be installed in accordance with one of the following:

a) where U_m does not exceed 50 V a.c. or 120 V d.c., in an SELV or PELV system, or
b) via a safety isolating transformer complying with the requirements of IEC 61558-2-6, or technically equivalent standard, or
c) directly connected to apparatus complying with the IEC 60950 series, IEC 61010-1, or a technically equivalent standard, or
d) fed directly from cells or batteries.

Answer

No

IEC 60079-11 does not require measures to limit U_m where it is specified as 250 V a.c. which is guaranteed by the public power supply using standards other than IEC 60079-11. Similarly, IEC 60079-14 allows measures not compliant with IEC 60079-11 for limiting U_m to below 250 V a.c.

Therefore no assessment of the voltage supply according to IEC 60079-11 is necessary where U_m is specified less than 250 V a.c. provided that one of the measures allowed by IEC 60079-14:2013, 16.2.1 are applied.

NOTE This does not alter the requirement of the 3rd paragraph of 6.2.5 to assess, in accordance with IEC 60079-11, any protective circuitry located in the non-hazardous area accessory.

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

© IEC 2016

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60079-11
Edition 6.0 2011-06

EXPLOSIVE ATMOSPHERES –

Part 11: Equipment protection by intrinsic safety "i"

INTERPRETATION SHEET 3

This interpretation sheet has been prepared by subcommittee 31G: Intrinsically-safe apparatus, of IEC technical committee 31: Equipment for explosive atmospheres.

The text of this interpretation sheet is based on the following documents:

ISH	Report on voting
31G/253/ISH	31G/255/RVD

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

Question

Regarding IEC 60079-11:2011 Edition 6.0 (2011-06), some clauses specifically indicate whether or not the requirement is applicable or not applicable to level of protection “ic”. However, many other clauses include no indication one way or the other, resulting in potential inconsistencies when applied. In the interest of improving consistency, what are the requirements in IEC 60079-11:2011 Edition 6.0 (2011-06) that are applicable to level of protection “ic”?

Answer

In answering this question, the following considerations were taken:

1) Requirements in IEC 60079-11 Edition 6.0 (2011-06) indicating that the requirements are applicable to level of protection “ic” are considered “Applicable”;
2) Requirements in IEC 60079-11 Edition 6.0 (2011-06) indicating that the requirements are not applicable to level of protection “ic” are considered “Not applicable”;
3) Regarding requirements in IEC 60079-11 Edition 6.0 (2011-06) other than those referenced in 1) and 2) above:
   - determine if the intent of these requirements for levels of protection "ia" and "ib" is to address fault (abnormal) conditions; and

ICS 29.260.20

IEC 60079-11:2011-06/ISH3:2016-07(en-fr)

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

- if the intent is to address fault (abnormal) conditions, then the requirements are considered not applicable for level of protection "ic".

Based on the above considerations, the following informative table (similar in concept to Annex B of IEC 60079-0:2011 on Ex Components) provides guidance regarding which requirements in IEC 60079-11 Edition 6.0 (2011-06) are applicable to level of protection “ic”.

Additional background

As additional background details, the following seven key issues of principle were taken into account when developing the above answer:

1) Objective of the original transfer of type of protection “nL” to “ic”: The objective of the original transfer of type of protection “nL” to “ic” (as first included in IEC 60079-11 Fifth Edition) was not to substantially revise the applicable requirements, except where the maintenance team MT 60079-11 made specific reference to level of protection “ic” in a given clause. Examples of this include 7.1, which simplifies the rating requirements for level of protection “ic” protective components from “nL” requirements; and 6.2.1, which increases the separation distances for level of protection “ic” terminals (to align with IEC 60079-14) from “nL” requirements. This objective approach is consistent with how the transfer of other IEC 60079-15 types of protection have been handled, and are still being handled in other IEC 60079 series standards.
2) Common applications of a level of protection “ic” circuit that protects an arcing part: The following are common applications of a level of protection “ic” circuit that protects an arcing part:
   - The circuit does not exit the device.
   - The circuit exits one device and is interconnected via a wiring method to another device, with both devices and the interconnecting wiring method being part of a system.
   - The circuit exits a device via a receptacle, with entity parameters provided for field connection to the receptacle.
   - The circuit exits a device via a terminal block, with entity parameters provided for field connection to the terminal block.

   For all the above applications, the level of protection "ic" circuit does not begin until after the last protective component that establishes the necessary voltage and current limitation. For other circuitry in the device, another type of protection, such as “nA” or “ec”, is applied. It is also possible for an entire apparatus to be only ”Ex ic”.
3) Remarks in the draft I-SH: In the draft I-SH, the intent is for all Remarks to only be for issues specific to level of protection “ic”. The few exceptions to this are for Remarks highlighting requirements that, while applicable to all types of protection “i”, represent a significant change in requirements from type of protection “nL” to “ic”.
4) Transient effects on level of protection “ic” circuits: For level of protection “ic” circuits, the effects of transients are only addressed for diode safety barriers. This is because connection of such barriers is to unspecified equipment. For other level of protection “ic” circuit applications, no additional evaluation is required regarding the effects of transients based on the following considerations:
   - the presence of an explosive atmosphere is only under abnormal conditions; and
   - the circuit complies with the applicable safety requirements of the relevant industrial standards.
5) Separation distances for level of protection “ic” circuits: Separation distances are only applicable to the level of protection “ic” circuit and to the protective components that establish the level of protection “ic” circuit. Where separation distances are required, separations that do not comply with the values of Table 5 or Annex F are to be shorted as part of the evaluation, if the shorting may impair intrinsic safety.

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

6) Protective components for level of protection “ic” circuits: Voltage and current limiting protective components comply with the applicable requirements for components on which intrinsic safety depends (e.g. 7.1).

7) IEC/TC 31 MT 60079-15 support: The MT 60079-15 convener has been involved in the development of the content of this I-SH, and supports it based on the current IEC 60079-11 Edition 6.0 (2011-06) text.

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

The following informative table provides guidance regarding which requirements in IEC 60079-11 Edition 6.0 (2011-06) are applicable to level of protection “ic”.

Informative guide for level of protection “ic” evaluations

NOTE 1 In some cases, where a clause is indicated as “Applicable” to level of protection “ic”, it is applicable in its entirety. In other cases, the clause is only applicable in part. Remarks are provided to indicate which parts of a given clause are applicable to level of protection “ic”, along with indicating general explanatory content regarding the application of the clause to level of protection “ic”.

NOTE 2 Where a clause is indicated as being not applicable, in its entirety or in part, consideration is still given regarding the applicability of other IEC 60079-11 and IEC 60079-0 clauses, including the applicable safety requirements of the relevant industrial standards in accordance with IEC 60079-0.

Clause	Requirement	Applicability	Remark
1	Scope	Applicable	
2	Normative references	Applicable	
3	Terms and definitions	Applicable	For “ic” circuits, Ui, Ii, Pi are maximum values possible in normal operation. Uo, Io, Po are determined in normal operation, but with the most onerous rated load for each case attached. Reduction of maximum voltage from Um can be achieved with a transformer that complies with the applicable requirements of this standard. The same equipment designed for “ic”, and also designed for “ia” or “ib”, can have different parameters for connection to “ic” circuits versus connection to “ia” or “ib” circuits. Even though these are all the same “type of protection”, just with varying EPLs, the requirements under “Multiple types of protection” in IEC 60079-0 applies.
4	Grouping and classification of intrinsically safe apparatus and associated apparatus	Applicable	While “nL” was only a Gc type of protection, “ic” is for both Gc and Dc.
5	Levels of protection and ignition compliance requirements of electrical apparatus		
5.1	General	Applicable	Opening, shorting and earthing of an “ic” circuit at output terminals intended for field wiring are considered normal operating conditions.
5.2	Level of protection "ia"	Not applicable	Addresses safety factors and fault conditions for "ia".
5.3	Level of protection "ib"	Not applicable	Addresses safety factors and fault conditions for "ib".
5.4	Level of protection "ic"	Applicable	A safety factor of 1.0 with no fault condition is applicable for "ic".
5.5	Spark ignition compliance	Applicable	
5.6	Thermal ignition compliance		
5.6.1	General	Applicable	Temperature testing is to be under worst case normal operating conditions.
5.6.2	Temperature for small components for Group I and Group II	Applicable	
5.6.3	Wiring within intrinsically safe apparatus for Group I and Group II	Applicable	Requirement is addressed by testing according to 5.6.1, or addressed according to the applicable safety requirements of the relevant industrial standards.

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause	Requirement	Applicability	Remark
5.6.4	Tracks on printed circuit boards for Group I and Group II	Applicable	Requirement is addressed by testing according to 5.6.1, or addressed according to the applicable safety requirements of the relevant industrial standards.
5.6.5	Intrinsically safe apparatus and component temperature for Group III	Applicable	Temperature classification to be based on the temperature of the surface exposed to dust.
5.7	Simple apparatus	Applicable	
6	Apparatus construction		
6.1	Enclosures	Applicable	
6.2	Facilities for connection of external circuits		
6.2.1	Terminals	Applicable	NOTE As with “ia” and “ib”, due to IEC 60079-14 installation requirements, circuits that exit a piece of equipment via a terminal block, with entity parameters provided for field connection to the terminal block, maintain the following: – at least 50 mm separation distance between terminals for “ic” circuits and terminals for non-intrinsically safe circuits. – at least 6 mm separation distance between terminals for separate intrinsically safe circuits. – at least 3 mm separation distance between terminals for intrinsically safe circuits and earthed parts, if connection to earth has not been considered in the safety analysis. This separation distance requirement is different from previous Ex “nL” requirements.
6.2.2	Plugs and sockets	Applicable	
6.2.3	Determination of maximum external inductance to resistance ratio (L_o/R_o) for resistance limited power source	Applicable	
6.2.4	Permanently connected cable	Applicable	
6.2.5	Requirements for connections and accessories for IS apparatus when located in the non-hazardous area	Applicable	Applicable except regarding protective circuitry for functions such as charging in the non-hazardous area. As there is no application of faults, the ratings of components may be ensured without additional protection.
6.3	Separation distances		
6.3.1	General	Applicable	Applicable to “ic” circuit and protective components only. Where separation distances are less than required, they are to be shorted if the shorting may impair intrinsic safety. NOTE For example, an "ic" circuit is the circuit after the last protective component that establishes the necessary voltage and current limitation.

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause	Requirement	Applicability	Remark
6.3.2	Separation of conductive parts	Applicable	Applicable to "ic" circuit and protective components only. Any use of an interposing insulating partition or earthed metallic partition is only required to comply with the safety requirements of the relevant industrial standard.
6.3.2.1	Distances according to Table 5	Applicable	Regarding transformers, only applicable between external connections. Remaining construction features of transformers are only required to comply with the applicable safety requirements of the relevant industrial standards.
6.3.2.2	Distances according to Annex F	Applicable	Regarding transformers, only applicable between external connections. NOTE Remaining construction features of transformers are only required to comply with the applicable safety requirements of the relevant industrial standard. Through solid insulation of conductors are required to comply with Table 5.
6.3.3	Voltage between conductive parts	Applicable	For “ic”, the effects of transients are only addressed for diode safety barriers because connection is to unspecified equipment. For other “ic” applications, no additional evaluation is required regarding the effects of transients based on the following considerations: • The presence of an explosive atmosphere is not likely to occur in normal operation. • The circuit complies with the applicable safety requirements of the relevant industrial standards. Where separation of conductive parts is required, separations that do not comply with the values of Table 5 or Annex F may be shorted as part of the evaluation if it may impair intrinsic safety.
6.3.4	Clearance	Not Applicable	Any use of an interposing insulating partition or earthed metallic partition is only required to comply with the safety requirements of the relevant industrial standard. See 6.3.2.
6.3.5	Separation distances through casting compound	Applicable	
6.3.6	Separation distances through solid insulation	Applicable	
6.3.7	Composite separations	Applicable	Applicable, except regarding the 1/3 restriction for composite separations, as this restriction is based on fault considerations.
6.3.8	Creepage distance	Applicable	Applicable, except regarding the 1/3 restriction for composite separations, and the partition restrictions above 1,575 V. Any use of an interposing insulating partition or earthed metallic partition shall comply with the safety requirements of the relevant industrial standard. See 6.3.2.
6.3.9	Distance under coating	Applicable	

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause	Requirement	Applicability	Remark
6.3.10	Requirements for assembled printed circuit boards	Applicable	Applicable, except for consideration of the body of a component as being an uninsulated live part. For example, a component mounted over or adjacent to tracks as defined in c) is not considered as connected to the track.
6.3.11	Separation by earthed screens	Applicable	Where separation distances to the earthed screen do not comply with the required separation distances to earth, the screen is to be capable of carrying the maximum possible current to which it could be continuously subjected (such as a short to earth).
6.3.12	Internal wiring	Applicable	
6.3.13	Dielectric strength requirement	Applicable	Applicable, except for the additional dielectric strength testing in the 3rd paragraph. Regarding the 2nd paragraph, only applicable to insulation or insulating components. Additional dielectric testing is not required between level of protection "ic" and other circuits, or between separate level of protection "ic" circuits. This aligns with previous level of protection "nL" requirements. NOTE Dielectric test requirements of other applicable standards may still apply (such as the relevant industrial standards).
6.3.14	Relays	Applicable	Applicable only regarding requirement for relay to be used within its rating. NOTE Requirements for dielectric and separation distances are still addressed, along with applicable safety requirements of the relevant industrial standards.
6.4	Protection against polarity reversal	Applicable	
6.5	Earth conductors, connections and terminals	Applicable	Earthing requirements in the 1st paragraph are only applicable if earth is necessary for "ic" circuit. Requirements for earthing are suitably addressed by the applicable safety requirements of the relevant industrial standards. Requirements in 2nd paragraph only applicable to level of protection "ia" and level of protection "ib". A single connection is sufficient for level of protection 'ic'.
6.6	Encapsulation	Applicable	Applicable only if relying on encapsulation to exclude the atmosphere so as to reduce separation distances, or reduce the ignition capability of hot components. No short conditions are applied unless separation distances are less than required values so as to impair intrinsic safety (see Annex D).
7	Components on which intrinsic safety depends		
7.1	Rating of components	Applicable	For voltage and current, this clause simplifies the rating requirements for "ic" protective components from "nL" requirements. NOTE The concept of a component having a defined "failure mode such that protection is maintained" as an alternative to de-rating (as existed for "nL") does not exist for "ic".

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause	Requirement	Applicability	Remark
7.2	Connectors for internal connections, plug-in cards and components	Applicable	Applicable except for requirement regarding incorrect connection of internal plug-in connections in the 1st paragraph, and the open circuit failure of a connection requirement in the 2nd paragraph. While interchangeability is a concern for external connections due to field error, it is not considered an “ic” concern for internal connections. Production control and proper service expectations can address internal applications. Open circuit failure of a connection requirement is not applicable because faults are not considered for ‘ic’. Both are not considered a normal operations condition (see 6.5).
7.3	Fuses	Applicable	Where an “ic” circuit depends upon a fuse **and** where the fuse is directly connected to the mains **and** where the fuse is also directly connected to a circuit that is considered normally subject to overloading or shorting (such as output field wiring receptacles or terminals), the breaking capacity of such a fuse is based upon the prospective short circuit current of the mains supply. A diode safety barrier would be a common example of such an application involving output field wring terminals. The prospective short-circuit current of a 250 V mains supply is considered to not be greater than 1 500 A.”
7.4	Primary and secondary cells and batteries	Applicable	For both apparatus and associated apparatus, when such involves more than type of protection “ic” (such as ‘ic nA’ apparatus or ‘nA [ic]’ associated apparatus), connection of cells and batteries in parallel for ‘ic’ is only permitted in the ‘ic’ circuit provided that intrinsic safety is not impaired.
7.5	Semiconductors		
7.5.1	Transient effects	Applicable	For “ic”, the effects of transients are only addressed for diode safety barriers because connection is to unspecified equipment. For other “ic” applications, no additional evaluation is required regarding the effects of transients based on the following considerations: • The presence of an explosive atmosphere not likely to occur in normal operation. • The circuit complies with the applicable safety requirements of the relevant industrial standards. NOTE Semiconductors serving as protective components in "ic" circuits are required to comply with the applicable requirements elsewhere in this standard.

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause	Requirement	Applicability	Remark
7.5.2	Shunt voltage limiters	Applicable	For “ic”, the effects of transients are only addressed for diode safety barriers because connection is to unspecified equipment. For other “ic” applications, no additional evaluation is required regarding the effects of transients based on the following considerations: • The presence of an explosive atmosphere is not likely to occur in normal operation. • The circuit complies with the applicable safety requirements of the relevant industrial standards. For level of protection ‘ic’, a single semiconductor is sufficient.
7.5.3	Series current limiters	Applicable	For level of protection “ic” a single semiconductor is sufficient.
7.6	Failure of components, connections and separations	Applicable	Applicable except for "ia" and "ib" requirements in 2nd paragraph, and infallible connections requirements in 5th and 6th paragraphs.
7.7	Piezo-electric devices	Applicable	Applicable only if the piezo-circuit can be directly shorted (for example due to non-compliant spacings or sparking components) (see 10.7). NOTE The potential for the enclosure to be impacted is a normal operating condition, and therefore is applicable to "ic".
7.8	Electrochemical cells for the detection of gases	Applicable	
8	Infallible components, infallible assemblies of components and infallible connections on which intrinsic safety depends	Not applicable	According to 8.1, Clause 8, in its entirety, does not apply for "ic" circuits.
9	Supplementary requirements for specific apparatus		
9.1	Diode safety barriers	Applicable	For “ic”, the effects of transients are addressed for diode safety barriers because connection is to unspecified equipment. NOTE Earthing requirements are applicable to “ic” due to the earthing requirements of intrinsically safe circuits in IEC 60079-14.
9.2	FISCO apparatus	Applicable	
9.3	Handlights and caplights	Applicable	
10	Type verifications and type tests		
10.1	Spark ignition test	Applicable	A safety factor of 1.0 with no countable or non-countable fault conditions is applicable for "ic".
10.2	Temperature tests	Applicable	Applicable except for non-linear concerns in the last line of the 1st paragraph, which would require mandatory testing of components with non-linear aspects in the actual rated ambient. Such an approach to testing is not applicable for "ic" circuits, and is only to be an option.
10.3	Dielectric strength tests	Applicable	See 6.3.13.

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause	Requirement	Applicability	Remark
10.4	Determination of parameters of loosely specified components	Applicable	
10.5	Tests for cells and batteries	Applicable	Applicable except short circuit testing is only to be considered at points external to the cell or battery where the required separation distances are not met. Where temperature rise testing of the cells and batteries is required, only one sample need be subjected to the testing.
10.6	Mechanical tests		
10.6.1	Casting compound	Applicable	Force and impact testing is applicable to casting compounds that complete enclosures. As such, this is a normal operating conditions concern, and the testing is therefore applicable to "ic".
10.6.2	Determination of the acceptability of fuses requiring encapsulation	Applicable	While encapsulation of fuses for “ic” is not generally required, the concern regarding encapsulation flowing within the chamber of a fuse, and preventing the element to open, does reflect a normal operating conditions concern, and therefore is applicable to "ic" circuits (also see 7.3). NOTE One example of such a concern is for glass cartridge fuses.
10.6.3	Partitions	Not applicable	Any use of an interposing insulating partition or earthed metallic partition is only required to comply with the safety requirements of the relevant industrial standard.
10.7	Tests for intrinsically safe apparatus containing piezoelectric devices	Applicable	Applicable only if the piezo-circuit can be directly shorted (for example due to non-compliant spacings or sparking components)(see 7.7). NOTE The potential for the enclosure to be impacted is a normal operating condition, and therefore is applicable to "ic".
10.8	Type tests for diode safety barriers and safety shunts	Applicable	For level of protection “ic”, the effects of transients are to be addressed for diode safety barriers because connection is to unspecified equipment. (See 7.5.1)
10.9	Cable pull test	Applicable	
10.10	Transformer tests	Not applicable	This testing is required by 8.2.4, which is explicitly waived for "ic" circuits. NOTE Applicable safety requirements of the relevant industrial standards still apply.
10.11	Optical isolators tests	Not applicable	This testing is required by 8.9.2, which is explicitly waived for "ic" circuits. NOTE Applicable safety requirements of the relevant industrial standards still apply.
10.12	Current carrying capacity of infallible printed circuit board connections	Not applicable	This testing is required by 8.8, which is explicitly waived for "ic" circuits.
11	Routine verifications and tests		
11.1	Routine tests for diode safety barriers		
11.1.1	Completed barriers	Applicable	NOTE Removable links are not generally needed for level of protection “ic” safety barriers.

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause	Requirement	Applicability	Remark
11.1.2	Diodes for 2-diode "ia" barriers	Not applicable	This testing is applicable only to "ia" circuits.
11.2	Routine tests for infallible transformers	Not applicable	This testing is required by 8.2.5, which is explicitly waived for "ic" circuits.
12	Marking	Applicable	Where it is necessary to include marking from one of the other methods of protection listed in IEC 60079-0, the symbol “ic” shall occur first.
13	Documentation	Applicable	Where “ic” live maintenance procedures are specified by the manufacturer in the instructions provided, the effects of this live maintenance do not invalidate intrinsic safety under both normal operating conditions and under conditions that may reasonably be considered to occur during live maintenance.
Annex A (normative)	Assessment of intrinsically safe circuits	Applicable	
Annex B (normative)	Spark test apparatus for intrinsically safe circuits	Applicable	
Annex C (informative)	Measurement of creepage distances, clearances and separation distances through casting compound and through solid insulation		
Annex D (normative)	Encapsulation	Applicable	Applicable only if relying on encapsulation to exclude the atmosphere so as to reduce separation distances, or reduce the ignition capability of hot components. No fault conditions are applied unless separation distances are less than required values (see 6.6.2).
Annex E (informative)	Transient energy test		
Annex F (normative)	Alternative separation distances for assembled printed circuit boards and separation of components	Applicable	Regarding transformers, only applicable between external connections. NOTE Remaining construction features of transformers are required to only comply with the applicable safety requirements of the relevant industrial standard. Through solid insulation of conductors are required to comply with Table 5.
Annex G (normative)	Fieldbus intrinsically safe concept (FISCO) - Apparatus requirements	Applicable	
Annex H (informative)	Ignition testing of semiconductor limiting power supply circuits		

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

© IEC 2019

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60079-11
Edition 6.0 2011-06

EXPLOSIVE ATMOSPHERES –

Part 11: Equipment protection by intrinsic safety "i"

INTERPRETATION SHEET 4

This interpretation sheet has been prepared by subcommittee 31G: Intrinsically-safe apparatus, of IEC technical committee 31: Equipment for explosive atmospheres.

The text of this interpretation sheet is based on the following documents:

DISH	Report on voting
31G/293/DISH	31G/296/RVD

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

The wording in the intrinsic safety standard, IEC 60079-11 (2011), with respect to the enclosure requirements for intrinsically safe apparatus for Group III where the separation is accomplished by meeting the requirements for clearance or creepage distances of Table 5 or Annex F, according to Subclause 6.1.3a), is ambiguous. This observation may lead to different interpretation by different test laboratories.

This issue was discussed at the Busan, Republic of Korea meeting of the MT in October 2018. The MT agreed at that meeting that this interpretation should also be applied to IEC 60079-11:2011.

Because the title of Subclause 6.1.2.3 is “Apparatus complying with Annex F”, an interpretation has been made that the additional tests required by 6.1.2.3a) only apply when Annex F is used. The potential for compromising infallible creepage and clearance distances exists when Annex F is applied, but also exist when Table 5 is applied.

IEC 60079-11:2011-06/ISH4:2019-04(en-fr)

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

The wording of IEC 60079-11 is:

6.1.3 Enclosures for Group III apparatus

Where the intrinsic safety of intrinsically safe apparatus can be impaired by ingress of dust or by access to conducting parts, for example if the circuits contain infallible creepage distances, an enclosure is necessary by one of the following:

a) Where separation is accomplished by meeting the requirements for clearance or creepage distances of Table 5 or Annex F, the enclosure shall provide a degree of protection of at least IP5X, according to IEC 60529. For such enclosures the [*requirements of*] 6.1.2.3 a) shall additionally apply.

The text of the referenced clause is:

6.1.2.3 Apparatus complying with Annex F

Apparatus meeting the separation requirements of Tables F.1 or F.2 shall be provided with protection to achieve pollution degree 2. This can be achieved by one of the following:

a) an enclosure meeting the requirements of IP54 or greater according to the intended use and environmental conditions in accordance with IEC 60529. For such enclosures the clauses of IEC 60079-0 identified in Table 1 additionally apply.

Question

For Groups IIIA, IIIB, and IIIC, where Annex F is not applied and the creepage or clearance distances of Table 5, Column 2 or Column 5 are relied upon for intrinsic safety, do all the applicable enclosure requirements of IEC 60079-0 listed in Table 1, including thermal endurance and resistance to impact, apply?

Interpretation

Yes, for Groups IIIA, IIIB, IIIC, the “Tests of enclosures” requirements of IEC 60079-0 apply for intrinsically safe apparatus for which the creepage and clearance distances are assessed against either Table 5 or Annex F.

This does not apply where the separations are protected by means other than an enclosure, such as encapsulation or conformal coating as described in 6.1.3b) of IEC 60079-11.

NOTE These tests are specified in the following subclauses of IEC 60079-0:2011; 6.2, 6.5, 7.1.1, 7.1.2.1, 7.1.2.2, 7.1.2.3, 7.2, 7.3, 12, 16, 26.4.1, 26.4.1.1, 26.4.1.2, 26.4.1.2.1, 26.4.1.2.2, 26.4.2, 26.4.3, 26.4.4, 26.5.2, 26.7, 26.8, 26.9, 26.10, 26.16, as well as Annex C and Annex F.

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

© IEC 2019

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60079-11
Edition 6.0 2011-06

EXPLOSIVE ATMOSPHERES –

Part 11: Equipment protection by intrinsic safety "i"

INTERPRETATION SHEET 5

This interpretation sheet has been prepared by subcommittee 31G: Intrinsically-safe apparatus, of IEC technical committee 31: Equipment for explosive atmospheres.

The text of this interpretation sheet is based on the following documents:

DISH	Report on voting
31G/306/DISH	31G/308/RVDISH

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

BACKGROUND

As stated in the scope of Edition 6 of IEC 60079-11 (2011), the standard supplements and modifies the general requirements of IEC 60079-0. Subsequent to the publication of Edition 6 of IEC 60079-11, IEC 60079-0 was revised. The revised version of IEC 60079-0 (Edition 7:2017) now contains the 200 mm dust blanketing temperature test for Group III Da equipment (Subclause 5.3.2.3.1), relocated from IEC 60079-18 and IEC 60079-31.

QUESTIONS

1) Does the alternative approach of IEC 60079-11:2011 for equipment with components dissipating less power than given in Table 4 and with continuous short-circuit current less than 250 mA still apply when assessing according to IEC 60079-0:2017?
2) Is it necessary to conduct the 200 mm dust blanket temperature testing of Group III EPL Da intrinsically safe apparatus when applying IEC 60079-0:2017 in situations where the power limits of IEC 60079-11:2011 Table 4 are exceeded?

IEC 60079-11:2011-06/ISH5:2019-08(en)

ICS 29.260.20

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

ANSWER

1) Yes. The requirement of IEC 60079-0 is modified by the requirement of IEC 60079-11 and the requirements of IEC 60079-11 take precedence over IEC 60079-0.
2) Yes.

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

© IEC 2019

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60079-11
Edition 6.0 2011-06

EXPLOSIVE ATMOSPHERES –

Part 11: Equipment protection by intrinsic safety "i"

INTERPRETATION SHEET 6

This interpretation sheet has been prepared by subcommittee 31G: Intrinsically-safe apparatus, of IEC technical committee 31: Equipment for explosive atmospheres.

The text of this interpretation sheet is based on the following documents:

DISH	Report on voting
31G/311/DISH	31G/314/RVDISH

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

Background

The second and third paragraphs of IEC 60079-11:2011, Subclause 10.5.3 b) state the following:

The maximum surface temperature shall be determined as follows:

For "ia" and "ib" all current-limiting devices external to the cell or battery shall be short-circuited for the test. The test shall be carried out both with internal current-limiting devices in circuit and with the devices short-circuited using 10 cells in each case. The 10 samples having the internal current-limiting devices short-circuited shall be obtained from the cell/battery manufacturer together with any special instructions or precautions necessary for safe use and testing of the samples. If the internal current limiting devices protect against internal shorts then these devices need not be removed. However, such devices shall only be considered for Level of Protection "ib".

The intent of the cited paragraphs is to simulate an internal short inside a cell, by shorting the cell's external terminals for the purpose of thermal assessment.

29.260.20

IEC 60079-11:2011-06/ISH6:2019-12(en-fr)

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

It was found that two details have been misinterpreted in these paragraphs:

a) The subjects of the paragraphs are cells or batteries, while the intent is clearly to simulate internal shorts inside cells and not inside batteries in which case the shorts could be interpreted as being external to the cell(s) within a battery.

b) It is unclear what constitutes a current limiting device that protects against internal shorts.

A separator with shutdown function may be interpreted as a current limiting device that protects against internal shorts by its function, but since it is a constructional part of the cell that is not removable without invalidating the functionality of the basic cell, it is not a current limiting device for the purposes of implementing the standard. Conversely, a CID (Current interruption device), for example, is a switch that is triggered by increased pressure inside the cell, and the cell's functionality is not invalidated by the absence of the CID.

The reference to internal current limiting devices that protect against internal shorts in edition 6 was included to address unknown future cell technologies which could include such current limiting devices, however at this time no such current limiting devices are known.

Question

For either Level of Protection "ia" or "ib", what are the current limiting devices that are required to be disabled (or equivalent e.g. not fitted, short-circuited or removed) by IEC 60079-11:2011, Subclause 10.5.3 b), and what are the current limiting devices that need not be disabled?

Answer

All discrete protective devices that can be schematically represented as individual devices apart from the cell are to be disabled for the purposes of testing according to IEC 60079-11:2011, Subclause 10.5.3 b), regardless if they are located inside the cell or if they are external to the cell. This includes, but is not limited to resistors, fuses, resettable fuses (NTC, PTC, PPTC), CID (current interruption device), semiconductors, etc.

Features that provide essential cell functions, such as a separator with shutdown function or the ohmic resistance of the electrolyte, are not considered current limiting devices in the sense of this clause and need not be shorted or removed, and such cells can be considered for Level of Protection "ia".

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

CONTENTS

FOREWORD 7
1 Scope 9
2 Normative references 14
3 Terms and definitions 15
4 Grouping and classification of intrinsically safe apparatus and associated apparatus 20
5 Levels of protection and ignition compliance requirements of electrical apparatus 21
5.1 General 21
5.2 Level of protection "ia" 21
5.3 Level of protection "ib" 22
5.4 Level of protection "ic" 22
5.5 Spark ignition compliance 22
5.6 Thermal ignition compliance 22
5.6.1 General 22
5.6.2 Temperature for small components for Group I and Group II 23
5.6.3 Wiring within intrinsically safe apparatus for Group I and Group II 23
5.6.4 Tracks on printed circuit boards for Group I and Group II 24
5.6.5 Intrinsically safe apparatus and component temperature for Group III 25
5.7 Simple apparatus 26
6 Apparatus construction 27
6.1 Enclosures 27
6.1.1 General 27
6.1.2 Enclosures for Group I or Group II apparatus 27
6.1.3 Enclosures for Group III apparatus 28
6.2 Facilities for connection of external circuits 28
6.2.1 Terminals 28
6.2.2 Plugs and sockets 31
6.2.3 Determination of maximum external inductance to resistance ratio (L_o/R_o) for resistance limited power source 31
6.2.4 Permanently connected cable 32
6.2.5 Requirements for connections and accessories for IS apparatus when located in the non-hazardous area 32
6.3 Separation distances 33
6.3.1 General 33
6.3.2 Separation of conductive parts 33
6.3.3 Voltage between conductive parts 37
6.3.4 Clearance 37
6.3.5 Separation distances through casting compound 37
6.3.6 Separation distances through solid insulation 38
6.3.7 Composite separations 38
6.3.8 Creepage distance 38
6.3.9 Distance under coating 40
6.3.10 Requirements for assembled printed circuit boards 40
6.3.11 Separation by earthed screens 41
6.3.12 Internal wiring 42
6.3.13 Dielectric strength requirement 42
6.3.14 Relays 42
6.4 Protection against polarity reversal 43

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

6.5 Earth conductors, connections and terminals ... 43
6.6 Encapsulation ... 44
6.6.1 General ... 44
6.6.2 Encapsulation used for the exclusion of explosive atmospheres ... 45
7 Components on which intrinsic safety depends ... 45
7.1 Rating of components ... 45
7.2 Connectors for internal connections, plug-in cards and components ... 46
7.3 Fuses ... 46
7.4 Primary and secondary cells and batteries ... 47
7.4.1 General ... 47
7.4.2 Battery construction ... 48
7.4.3 Electrolyte leakage and ventilation ... 48
7.4.4 Cell voltages ... 49
7.4.5 Internal resistance of cell or battery ... 49
7.4.6 Batteries in equipment protected by other types of protection ... 49
7.4.7 Batteries used and replaced in explosive atmospheres ... 49
7.4.8 Batteries used but not replaced in explosive atmospheres ... 50
7.4.9 External contacts for charging batteries ... 50
7.5 Semiconductors ... 50
7.5.1 Transient effects ... 50
7.5.2 Shunt voltage limiters ... 50
7.5.3 Series current limiters ... 51
7.6 Failure of components, connections and separations ... 51
7.7 Piezo-electric devices ... 52
7.8 Electrochemical cells for the detection of gases ... 52
8 Infallible components, infallible assemblies of components and infallible connections on which intrinsic safety depends ... 53
8.1 Level of Protection “ic” ... 53
8.2 Mains transformers ... 53
8.2.1 General ... 53
8.2.2 Protective measures ... 53
8.2.3 Transformer construction ... 53
8.2.4 Transformer type tests ... 54
8.2.5 Routine test of mains transformers ... 54
8.3 Transformers other than mains transformers ... 54
8.4 Infallible windings ... 55
8.4.1 Damping windings ... 55
8.4.2 Inductors made by insulated conductors ... 55
8.5 Current-limiting resistors ... 56
8.6 Capacitors ... 56
8.6.1 Blocking capacitors ... 56
8.6.2 Filter capacitors ... 57
8.7 Shunt safety assemblies ... 57
8.7.1 General ... 57
8.7.2 Safety shunts ... 57
8.7.3 Shunt voltage limiters ... 58
8.8 Wiring, printed circuit board tracks, and connections ... 58
8.9 Galvanically separating components ... 59
8.9.1 General ... 59

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

8.9.2 Isolating components between intrinsically safe and non-intrinsically safe circuits ... 59
8.9.3 Isolating components between separate intrinsically safe circuits ... 59
9 Supplementary requirements for specific apparatus ... 60
9.1 Diode safety barriers ... 60
9.1.1 General ... 60
9.1.2 Construction ... 60
9.2 FISCO apparatus ... 60
9.3 Handlights and caplights ... 61
10 Type verifications and type tests ... 61
10.1 Spark ignition test ... 61
10.1.1 General ... 61
10.1.2 Spark test apparatus ... 61
10.1.3 Test gas mixtures and spark test apparatus calibration current ... 62
10.1.4 Tests with the spark test apparatus ... 63
10.1.5 Testing considerations ... 64
10.2 Temperature tests ... 65
10.3 Dielectric strength tests ... 66
10.4 Determination of parameters of loosely specified components ... 66
10.5 Tests for cells and batteries ... 66
10.5.1 General ... 66
10.5.2 Electrolyte leakage test for cells and batteries ... 66
10.5.3 Spark ignition and surface temperature of cells and batteries ... 67
10.5.4 Battery container pressure tests ... 68
10.6 Mechanical tests ... 68
10.6.1 Casting compound ... 68
10.6.2 Determination of the acceptability of fuses requiring encapsulation ... 68
10.6.3 Partitions ... 68
10.7 Tests for intrinsically safe apparatus containing piezoelectric devices ... 68
10.8 Type tests for diode safety barriers and safety shunts ... 69
10.9 Cable pull test ... 70
10.10 Transformer tests ... 70
10.11 Optical isolators tests ... 70
10.11.1 General ... 70
10.11.2 Thermal conditioning, dielectric and carbonisation test ... 70
10.11.3 Dielectric and short-circuit test ... 72
10.12 Current carrying capacity of infallible printed circuit board connections ... 72
11 Routine verifications and tests ... 73
11.1 Routine tests for diode safety barriers ... 73
11.1.1 Completed barriers ... 73
11.1.2 Diodes for 2-diode “ia” barriers ... 73
11.2 Routine tests for infallible transformers ... 73
12 Marking ... 74
12.1 General ... 74
12.2 Marking of connection facilities ... 74
12.3 Warning markings ... 75
12.4 Examples of marking ... 75
13 Documentation ... 77
Annex A (normative) Assessment of intrinsically safe circuits ... 78

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Annex B (normative) Spark test apparatus for intrinsically safe circuits 100
Annex C (informative) Measurement of creepage distances, clearances and separation distances through casting compound and through solid insulation 108
Annex D (normative) Encapsulation 111
Annex E (informative) Transient energy test 118
Annex F (normative) Alternative separation distances for assembled printed circuit boards and separation of components 121
Annex G (normative) Fieldbus intrinsically safe concept (FISCO) – Apparatus requirements 125
Annex H (informative) Ignition testing of semiconductor limiting power supply circuits 130
Bibliography 141

Figure 1 – Separation of intrinsically safe and non-intrinsically safe terminals 31
Figure 2 – Example of separation of conducting parts 36
Figure 3 – Determination of creepage distances 39
Figure 4 – Creepage distances and clearances on printed circuit boards 41
Figure 5 – Examples of independent and non-independent connecting elements 44
Figure A.1 – Resistive circuits 81
Figure A.2 – Group I capacitive circuits 82
Figure A.3 – Group II capacitive circuits 83
Figure A.4 – Inductive circuits of Group II 84
Figure A.5 – Group I inductive circuits 85
Figure A.6 – Group IIC inductive circuits 86
Figure A.7 – Simple inductive circuit 87
Figure A.8 – Simple capacitive circuit 87
Figure A.9 – Equivalent capacitance 99
Figure B.1 – Spark test apparatus for intrinsically safe circuits 104
Figure B.2 – Cadmium contact disc 105
Figure B.3 – Wire holder 105
Figure B.4 – Example of a practical design of spark test apparatus 106
Figure B.5 – Arrangement for fusing tungsten wires 107
Figure C.1 – Measurement of clearance 108
Figure C.2 – Measurement of composite distances 109
Figure C.3 – Measurement of creepage 110
Figure C.4 – Measurement of composite creepage 110
Figure D.1 – Examples of encapsulated assemblies conforming to 6.3.5 and 6.6 113
Figure D.2 – Applications of encapsulation using casting compound without an enclosure 115
Figure D.3 – Examples of assemblies using moulding conforming to 6.6 116
Figure E.1 – Example of test circuit 119
Figure E.2 – Example of output waveform 120
Figure G.1 – Typical system 129
Figure H.1 – Safety factor vs ignition probablity 140

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Table 1 – Applicability of specific clauses of IEC 60079-0 9
Table 2 – Temperature classification of copper wiring (in a maximum ambient temperature of 40 °C) 24
Table 3 – Temperature classification of tracks on printed circuit boards (in a maximum ambient temperature of 40 °C) 25
Table 4 – Maximum permitted power dissipation within a component immersed in dust 26
Table 5 – Clearances, creepage distances and separations 35
Table 6 – Minimum foil thickness or minimum wire diameter of the screen in relation to the rated current of the fuse 54
Table 7 – Compositions of explosive test mixtures adequate for 1,0 safety factor 62
Table 8 – Compositions of explosive test mixtures adequate for 1,5 safety factor 63
Table 10 – Routine test voltages for infallible transformers 73
Table 11 – Text of warning markings 75
Table A.1 – Permitted short-circuit current corresponding to the voltage and the Equipment Group 88
Table A.2 – Permitted capacitance corresponding to the voltage and the Equipment Group 93
Table A.3 – Permitted reduction of effective capacitance when protected by a series resistance 99
Table F.1 – Clearances, creepage distances and separations for Level of Protection ”ia” and “ib” when ingress protected, and special conditions of material and installation are fulfilled 123
Table F.2 – Clearances, creepage distances and separations for Level of Protection ”ic” when ingress is protected by an enclosure or by special conditions of installation 124
Table G.1 – Assessment of maximum output current for use with ‘ia’ and ‘ib’ FISCO rectangular supplies 126
Table G.2 – Assessment of maximum output current for use with ‘ic’ FISCO rectangular supplies 126
Table H.1 – Sequence of tests 133
Table H.2 – Safety factor provided by several explosive test mixtures that may be used for the tests in Table H.1 135
Table H.3 – Example of a Group I circuit with characteristics described by Curve II of Figure H.1 – This passes the test sequence of Table H.1 136
Table H.4 – Example of a Group I circuit with characteristics described by Curve III of Figure H.1 – This does not pass the test sequence of Table H.1 138

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –

Part 11: Equipment protection by intrinsic safety "i"

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 60079-11 has been prepared by subcommittee 31G: Intrinsically safe apparatus, of IEC technical committee 31: Equipment for explosive atmospheres.

This sixth edition cancels and replaces the fifth edition of IEC 60079-11 published in 2006, the first edition of IEC 61241-11 published in 2005, and the new Annex G replaces the apparatus requirements of the second edition of IEC 60079-27 published in 2008. This sixth edition constitutes a technical revision of these publications.

NOTE IEC 60079-25 cancels and replaces the remaining subject matter of IEC 60079-27.

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

- Inclusion of non-edition specific references to IEC 60079-0.
- The merging of the apparatus requirements for FISCO from IEC 60079-27.
- The merging of the requirements for combustible dust atmospheres from IEC 61241-11.

AVA Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

- Clarification of the requirements for accessories connected to intrinsically safe apparatus; such as chargers and data loggers.
- Addition of new test requirements for opto-isolators.
- Introduction of Annex H about ignition testing of semiconductor limiting power supply circuits.

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

FDIS	Report on voting
31G/207/FDIS	31G/213/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 standard supplements and modifies the general requirements of IEC 60079-0, except as indicated in Table 1 (see Scope).

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

A list of all parts of the 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.

The contents of the corrigendum of January 2012, the interpretation sheet 1 of October 2014, the interpretation sheet 2 and 3 of July 2016, the interpretation sheet 4 of April, the interpretation sheet 5 of August 2019 and interpretation sheet 6 of December 2019 have been included in this copy.

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.

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

EXPLOSIVE ATMOSPHERES –

Part 11: Equipment protection by intrinsic safety "i"

1 Scope

This part of IEC 60079 specifies the construction and testing of intrinsically safe apparatus intended for use in an explosive atmosphere and for associated apparatus, which is intended for connection to intrinsically safe circuits which enter such atmospheres.

This type of protection is applicable to electrical equipment in which the electrical circuits themselves are incapable of causing an explosion in the surrounding explosive atmospheres.

This standard is also applicable to electrical equipment or parts of electrical equipment located outside the explosive atmosphere or protected by another Type of Protection listed in IEC 60079-0, where the intrinsic safety of the electrical circuits in the explosive atmosphere may depend upon the design and construction of such electrical equipment or parts of such electrical equipment. The electrical circuits exposed to the explosive atmosphere are evaluated for use in such an atmosphere by applying this standard.

The requirements for intrinsically safe systems are provided in IEC 60079-25.

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 requirements of this standard shall take precedence.

If requirements in this standard are applicable to both intrinsically safe apparatus and associated apparatus the term “apparatus” is used throughout the standard.

This standard is for electrical equipment only; therefore the term “equipment” used in the standard always means “electrical equipment”.

If associated apparatus is placed in the explosive atmosphere, it shall be protected by an appropriate Type of Protection listed in IEC 60079-0, and then the requirements of that method of protection together with the relevant parts of IEC 60079-0 also apply to the associated apparatus.

Table 1 – Applicability of specific clauses of IEC 60079-0

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed. 5.0 (2007) (informative)	Ed. 6.0 (2011) (informative)	Clause / Subclause title (normative)	Group I and Group II	Group III	
1	1	Scope	Applies	Applies	Applies
2	2	Normative references	Applies	Applies	Applies
3	3	Terms and definitions	Applies	Applies	Applies
4	4	Equipment grouping	Applies	Applies	Applies
4.1	4.1	Group I	Applies	Excluded	Applies
4.2	4.2	Group II	Applies	Excluded	Applies

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed. 5.0 (2007) (informative)	**Ed. 6.0 (2011) (informative)**	**Clause / Subclause title (normative)**	**Group I and Group II**	**Group III**	
4.3	4.3	Group III	Excluded	Applies	Applies
4.4	4.4	Equipment for a particular explosive atmosphere	Applies	Applies	Applies
5.1	5.1	Environmental influences	Applies	Applies	Applies
5.1.1	5.1.1	Ambient temperature	Applies	Applies	Applies
5.1.2	5.1.2	External source of heating or cooling	Applies	Applies	Applies
5.2	5.2	Service temperature	Applies	Applies	Applies
5.3.1	5.3.1	Determination of maximum surface temperature	Applies	Applies	Excluded
5.3.2.1	5.3.2.1	Group I electrical equipment	Applies	Excluded	Excluded
5.3.2.2	5.3.2.2	Group II electrical equipment	Applies	Excluded	Excluded
5.3.2.3	5.3.2.3	Group III electrical equipment	Excluded	Applies	Excluded
5.3.3	5.3.3	Small component temperature for Group I or Group II electrical equipment	Applies	Excluded	Excluded
6.1	6.1	General	Applies	Applies	Applies
6.2	6.2	Mechanical strength of equipment	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
6.3	6.3	Opening times	Excluded	Excluded	Excluded
6.4	6.4	Circulating currents in enclosures (e.g. of large electrical machines)	Excluded	Excluded	Excluded
6.5	6.5	Gasket retention	Excluded except when 6.1.2.3a)is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
6.6	6.6	Electromagnetic and ultrasonic radiating equipment	Applies	Applies	Excluded
7.1.1	7.1.1	Applicability	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
7.1.2	7.1.2.1	Specification of materials	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
7.1.3	7.1.2.2	Plastic materials	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
7.1.4	7.1.2.3	Elastomers	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
7.2	7.2	Thermal endurance	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed. 5.0 (2007) (informative)	**Ed. 6.0 (2011) (informative)**	**Clause / Subclause title (normative)**	**Group I and Group II**	**Group III**	
7.3	7.3	Resistance to light	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
7.4	7.4	Electrostatic charges on external non-metallic materials	Applies	Applies	Excluded
NR	7.5	Accessible metal parts	Applies	Applies	Excluded
7.5	NR	Threaded holes	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
8.1	8.1	Material composition	Applies	Applies	Excluded
8.1.1	8.2	Group I	Applies	Excluded	Excluded
8.1.2	8.3	Group II	Applies	Excluded	Excluded
8.1.3	8.4	Group III	Excluded	Applies	Excluded
8.2	NR	Threaded holes	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
9	9	Fasteners	Excluded	Excluded	Excluded
10	10	Interlocking devices	Excluded	Excluded	Excluded
11	11	Bushings	Excluded	Excluded	Excluded
12	12	Materials used for cementing	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
13	13	Ex Components	Applies	Applies	Applies
14	14	Connection facilities and termination compartments	Excluded	Excluded	Excluded
15	15	Connection facilities for earthing or bonding conductors	Excluded	Excluded	Excluded
16	16	Entries into enclosures	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
17	17	Supplementary requirements for rotating machines	Excluded	Excluded	Excluded
18	18	Supplementary requirements for switchgear	Excluded	Excluded	Excluded
19	19	Supplementary requirements for fuses	Excluded	Excluded	Excluded
20	20	Supplementary requirements for plugs, socket outlets and connectors	Excluded	Excluded	Excluded
21	21	Supplementary requirements for luminaires	Excluded	Excluded	Excluded
22	22	Supplementary requirements for caplights and handlights	Modified	Modified	Excluded
23.1	23.1	General	Applies	Applies	Applies

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed. 5.0 (2007) (informative)	**Ed. 6.0 (2011) (informative)**	**Clause / Subclause title (normative)**	**Group I and Group II**	**Group III**	
23.2	23.2	Batteries	Excluded	Excluded	Excluded
23.3	23.3	Cell types	Applies	Applies	Applies
23.4	23.4	Cells in a battery	Applies	Applies	Applies
23.5	23.5	Ratings of batteries	Applies	Applies	Applies
23.6	23.6	Interchangeability	Applies	Applies	Applies
23.7	23.7	Charging of primary batteries	Applies	Applies	Applies
23.8	23.8	Leakage	Applies	Applies	Applies
23.9	23.9	Connections	Applies	Applies	Applies
23.10	23.10	Orientation	Applies	Applies	Applies
23.11	23.11	Replacement of cells or batteries	Applies	Applies	Applies
23.12	23.12	Replaceable battery pack	Applies	Applies	Applies
24	24	Documentation	Applies	Applies	Applies
25	25	Compliance of prototype or sample with documents	Applies	Applies	Applies
26.1	26.1	General	Applies	Applies	Applies
26.2	26.2	Test configuration	Applies	Applies	Applies
26.3	26.3	Tests in explosive test mixtures	Applies	Applies	Applies
26.4.1	26.4.1	Order of tests	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.4.1.1	26.4.1.1	Metallic enclosures, metallic parts of enclosures and glass parts of enclosures	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.4.1.2	26.4.1.2	Non-metallic enclosures or non-metallic parts of enclosures	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.4.1.2.1	26.4.1.2.1	Group I electrical equipment	Excluded except when 6.1.2.3a) is applied	Excluded	Excluded except when 6.1.2.3a) is applied
26.4.1.2.2	26.4.1.2.2	Group II and Group III electrical equipment	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.4.2	26.4.2	Resistance to impact	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.4.3	26.4.3	Drop test	Applies	Applies	Excluded except when 6.1.2.3a) is applied
26.4.4	26.4.4	Acceptance criteria	Applies	Applies	Excluded except when 6.1.2.3a) is applied
26.4.5	26.4.5	Degree of protection (IP) by enclosures	Applies	Applies	Applies
26.5.1.1	26.5.1.1	General	Applies	Applies	Excluded
26.5.1.2	26.5.1.2	Service temperature	Modified	Modified	Modified

AVA Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed. 5.0 (2007) (informative)	**Ed. 6.0 (2011) (informative)**	**Clause / Subclause title (normative)**	**Group I and Group II**	**Group III**	
26.5.1.3	26.5.1.3	Maximum surface temperature	Modified	Modified	Modified
26.5.2	26.5.2	Thermal shock test	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.5.3	26.5.3	Small component ignition test (Group I and Group II)	Applies	Excluded	Excluded
26.6	26.6	Torque test for bushings	Excluded	Excluded	Excluded
26.7	26.7	Non-metallic enclosures or non-metallic parts of enclosures	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.8	26.8	Thermal endurance to heat	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.9	26.9	Thermal endurance to cold	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.10	26.10	Resistance to light	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
26.11	26.11	Resistance to chemical agents for Group I electrical equipment	Excluded except when 6.1.2.3a) is applied	Excluded	Excluded
26.12	26.12	Earth continuity	Excluded	Excluded	Excluded
26.13	26.13	Surface resistance test of parts of enclosures of non-metallic materials	Applies	Applies	Excluded
26.15	26.14	Measurement of capacitance	Applies	Applies	Excluded
NR	26.15	Verification of ratings of ventilating fans	Excluded	Excluded	Excluded
NR	26.16	Alternative qualification of elastomeric sealing O-rings	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied
27	27	Routine tests	Applies	Applies	Applies
28	28	Manufacturer's responsibility	Applies	Applies	Applies
29	29	Marking	Applies	Applies	Applies
30	30	Instructions	Applies	Applies	Applies
Annex A (Normative)	Annex A (Normative)	Supplementary requirements for cable glands	Excluded	Excluded	Excluded
Annex B (Normative)	Annex B (Normative)	Requirements for Ex Components	Applies	Applies	Applies
Annex C (Informative)	Annex C (Informative)	Example of rig for resistance to impact test	Applies	Applies	Excluded except when 6.1.2.3a) is applied

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed. 5.0 (2007) (informative)	**Ed. 6.0 (2011) (informative)**	**Clause / Subclause title (normative)**	**Group I and Group II**	**Group III**	
Annex D (Informative)	NR	Alternative risk assessment method encompassing "equipment protection levels" for Ex equipment	Applies	Applies	Applies
Annex E (Informative)	Annex D (Informative)	Motors supplied by converters	Excluded	Excluded	Excluded
NR	Annex E (Informative)	Temperature rise testing of electric machines	Excluded	Excluded	Excluded
NR	Annex F (Informative)	Guideline flowchart for tests of non-metallic enclosures or non-metallic parts of enclosures (26.4)	Excluded except when 6.1.2.3a) is applied	Excluded except when 6.1.3 a) is applied.	Excluded except when 6.1.2.3a) is applied

Applies – This requirement of IEC 60079-0 is applied without change.

Excluded – This requirement of IEC 60079-0 does not apply.

Excluded except – This requirement of IEC 60079-0 does not apply except when the conditions stated are met.

Modified – This requirement of IEC 60079-0 is modified as detailed in this standard.

NR – No requirements.

NOTE The clause numbers in the above table are shown for information only. The applicable requirements of IEC 60079-0 are identified by the clause title which is normative. This table was written against the specific requirements of IEC 60079-0, ed. 6.0. The clause numbers for the previous edition are shown for information only. This is to enable the General requirements IEC 60079-0, ed. 5.0, to be used where necessary with this part of IEC 60079. Where there were no requirements, indicated by NR, or there is a conflict between requirements, the later edition requirements take precedence.

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

IEC 60079-7, *Explosive atmospheres – Part 7: Equipment protection by increased safety "e"*

IEC 60079-25, *Explosive atmospheres – Part 25: Intrinsically safe electrical systems*

IEC 60085, *Electrical insulation – Thermal evaluation and designation*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60127 (all parts), *Miniature fuses*

IEC 60317-3, *Specifications for particular types of winding wires – Part 3: Polyester enamelled round copper wire, class 155*

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

IEC 60317-7, *Specifications for particular types of winding wires – Part 7: Polyimide enamelled round copper wire, class 220*

IEC 60317-8, *Specifications for particular types of winding wires – Part 8: Polyesterimide enamelled round copper winding wire, class 180*

IEC 60317-13, *Specifications for particular types of winding wires – Part 13: Polyester or polyesterimide overcoated with polyamide-imide enamelled round copper wire, class 200*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3:2003, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

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

IEC 62013-1, *Caplights for use in mines susceptible to firedamp – Part 1: General requirements – Construction and testing in relation to the risk of explosion*

ANSI/UL 248-1, *Low-Voltage Fuses – Part 1: General Requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60079-0, and the following apply.

3.1
general

3.1.1
intrinsic safety "i"
type of protection based on the restriction of electrical energy within equipment and of interconnecting wiring exposed to the explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects

3.1.2
associated apparatus
electrical equipment which contains both intrinsically safe circuits and non-intrinsically safe circuits and is constructed so that the non-intrinsically safe circuits cannot adversely affect the intrinsically safe circuits

NOTE Associated apparatus may be either:

a) electrical equipment which has another type of protection listed in IEC 60079-0 for use in the appropriate explosive atmosphere, or

b) electrical equipment not so protected and which, therefore, is not normally used within an explosive atmosphere, for example a recorder which is not itself in an explosive atmosphere, but is connected to a thermocouple situated within an explosive atmosphere where only the recorder input circuit is intrinsically safe.

3.1.3
intrinsically safe apparatus
electrical equipment in which all the circuits are intrinsically safe circuits

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

3.1.4
intrinsically safe circuit
circuit in which any spark or any thermal effect produced in the conditions specified in this standard, which include normal operation and specified fault conditions, is not capable of causing ignition of a given explosive atmosphere

3.1.5
simple apparatus
electrical component or combination of components of simple construction with well-defined electrical parameters and which is compatible with the intrinsic safety of the circuit in which it is used

3.2
coating
insulating material such as varnish or dry film laid on the surface of the assembly

NOTE Coating and base material of a printed board form an insulating system that may have properties similar to solid insulation.

[Definition 3.5 of IEC 60664-3]

3.3
conformal coating
electrical insulating material applied as a coating to loaded printed circuit boards to produce a thin layer conforming to the surface in order to provide a protective barrier against deleterious effects from environmental conditions

[Definition 2.1 of IEC 61086-1]

3.4
control drawing
drawing or other document that is prepared by the manufacturer for the intrinsically safe or associated apparatus, detailing the electrical parameters to allow for interconnections to other circuits or apparatus

3.5
diode safety barrier
assemblies incorporating shunt diodes or diode chains (including Zener diodes) protected by fuses or resistors or a combination of these, manufactured as an individual apparatus rather than as part of a larger apparatus

3.6
entity concept
method used to determine acceptable combinations of intrinsically safe apparatus and associated apparatus through the use of intrinsically safe parameters assigned to connection facilities

3.7
faults

3.7.1
countable fault
fault which occurs in parts of electrical apparatus conforming to the constructional requirements of IEC 60079-11

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

3.7.2
fault
any defect of any component, separation, insulation or connection between components, not defined as infallible by IEC 60079-11, upon which the intrinsic safety of a circuit depends

3.7.3
non-countable fault
fault which occurs in parts of electrical apparatus not conforming to the constructional requirements of IEC 60079-11

3.8
fuse rating
I_n
current rating of a fuse as specified in IEC 60127 series, ANSI/UL 248-1 or in the manufacturer's specification

3.9
FISCO
abbreviation of Fieldbus Intrinsically Safe Concept

3.10
infallibility

3.10.1
infallible component
infallible assembly of components
component or assembly of components that is considered as not subject to certain fault modes as specified in IEC 60079-11

NOTE The probability of such fault modes occurring in service or storage is considered to be so low that they are not to be taken into account.

3.10.2
infallible connection
connections, including joints and interconnecting wiring and printed circuit board tracks, that are not considered according to IEC 60079-11 as becoming open-circuited in service or storage

NOTE The probability of such fault modes occurring in service or storage is considered to be so low that they are not to be taken into account.

3.10.3
infallible separation
infallible insulation
separation or insulation between electrically conductive parts that is considered as not subject to short circuits as specified in IEC 60079-11

NOTE The probability of such fault modes occurring in service or storage is considered to be so low that they are not to be taken into account.

3.11
internal wiring
wiring and electrical connections that are made within the apparatus by its manufacturer

3.12
live maintenance
maintenance activities carried out while the associated apparatus, intrinsically safe apparatus and circuits are energized

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

3.13
electrical parameters

3.13.1
maximum input voltage
U_i
maximum voltage (peak a.c. or d.c.) that can be applied to the connection facilities of apparatus without invalidating the type of protection

3.13.2
maximum input current
I_i
maximum current (peak a.c. or d.c.) that can be applied to the connection facilities of apparatus without invalidating the type of protection

3.13.3
maximum input power
P_i
maximum power that can be applied to the connection facilities of apparatus without invalidating the type of protection

3.13.4
maximum internal capacitance
C_i
maximum equivalent internal capacitance of the apparatus which is considered as appearing across the connection facilities

3.13.5
maximum internal inductance
L_i
maximum equivalent internal inductance of the apparatus which is considered as appearing at the connection facilities

3.13.6
maximum internal inductance to resistance ratio
L_i/R_i
maximum value of ratio of inductance to resistance which is considered as appearing at the external connection facilities of the electrical apparatus

3.13.7
maximum output voltage
U_o
maximum voltage (peak a.c. or d.c.) that can appear at the connection facilities of the apparatus at any applied voltage up to the maximum voltage

3.13.8
maximum output current
I_o
maximum current (peak a.c. or d.c.) in apparatus that can be taken from the connection facilities of the apparatus

3.13.9
maximum output power
P_o
maximum electrical power that can be taken from the apparatus

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

3.13.10
maximum external capacitance
C_o
maximum capacitance that can be connected to the connection facilities of the apparatus without invalidating the type of protection

3.13.11
maximum external inductance
L_o
maximum value of inductance that can be connected to the connection facilities of the apparatus without invalidating the type of protection

3.13.12
maximum external inductance to resistance ratio
L_o/R_o
maximum value of ratio of inductance to resistance that can be connected to the external connection facilities of the electrical apparatus without invalidating intrinsic safety

3.13.13
maximum r.m.s. a.c. or d.c. voltage
U_m
maximum voltage that can be applied to the non intrinsically safe connection facilities of associated apparatus without invalidating the type of protection

NOTE 1 This additionally applies to the maximum voltage that can be applied to non-intrinsically safe connection facilities of intrinsically safe apparatus (for example, charging connections on battery operated apparatus, where charging is only done in the non-hazardous area).

NOTE 2 The value of Um may be different at different sets of connection facilities, and may be different for a.c. and d.c. voltages.

3.14
overvoltage category
numeral defining a transient overvoltage condition

[Definition 1.3.10 of IEC 60664-1]

NOTE Overvoltage categories I, II, III and IV are used, see 2.2.2.1 of IEC 60664-1.

3.15
pollution degree
numeral characterizing the expected pollution of the micro-environment

[Definition 1.3.13 of IEC 60664-1]

NOTE Pollution degrees 1, 2, 3 and 4 are used.

3.16
protective extra-low voltage
PELV
extra-low voltage system which is not electrically separated from earth but which otherwise satisfies the requirements for SELV

NOTE A 50 V centre-tapped earth system is a PELV system.

3.17
rated insulation voltage
r.m.s. withstand voltage value assigned by the manufacturer to the equipment or to a part of it, characterizing the specified (long-term) withstand capability of its insulation

[Definition 1.3.9.1 of IEC 60664-1]

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

NOTE The rated insulation voltage is not necessarily equal to the rated voltage of equipment which is primarily related to functional performance.

3.18
recurring peak voltage
maximum peak value of periodic excursions of the voltage waveform resulting from distortions of an a.c. voltage or from a.c. components superimposed on a d.c. voltage

NOTE Random overvoltages, for example due to occasional switching, are not considered as recurring peak voltages.

3.19
safety extra-low voltage
SELV
extra-low voltage system (i.e. normally not exceeding 50 V a.c. or 120 V ripple-free d.c.) electrically separated from earth and from other systems in such a way that a single fault cannot give rise to an electric shock

NOTE A 50 V earth free system is a SELV system.

3.20
encapsulation
encapsulate
process of applying a compound to enclose or placing in or as if in a capsule

3.21
casting
process of pouring a liquid compound at normal ambient pressure into a cast

3.22
moulding
process of placing an object in a tool with a shaping cavity and with plastic material being introduced around the inserted component with pressure applied to either partially or totally encapsulate the inserted component

NOTE This process may also be referred to as injection moulding, over-moulding or insert moulding.

3.23
galvanic isolation
arrangement within an apparatus which permits the transfer of signal or power between two circuits without any direct electrical connection between the two

NOTE Galvanic isolation frequently utilizes either magnetic (transformer or relay) or optocoupled elements.

4 Grouping and classification of intrinsically safe apparatus and associated apparatus

Intrinsically safe and associated apparatus which has a type of protection listed in IEC 60079-0 for use in the appropriate explosive atmosphere, shall be grouped in accordance with equipment grouping requirements of IEC 60079-0 and shall have a maximum surface temperature or temperature class assigned in accordance with the temperature requirements of IEC 60079-0.

Associated apparatus which has no such type of protection shall only be grouped in accordance with the equipment grouping requirements of IEC 60079-0.

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

5 Levels of protection and ignition compliance requirements of electrical apparatus

5.1 General

Intrinsically safe apparatus and intrinsically safe parts of associated apparatus shall be placed in Levels of Protection "ia", "ib" or “ic”.

The requirements of this standard shall apply to all levels of protection unless otherwise stated. In the determination of level of protection “ia", "ib" or “ic”, failure of components and connections shall be considered in accordance with 7.6. Failure of separations between conductive parts shall be considered in accordance with 6.3. The determination shall include opening, shorting and earthing of the external intrinsically safe connection facilities in accordance with 6.2.

The intrinsically safe parameters for the intrinsically safe apparatus and associated apparatus shall be determined taking into account the requirements for spark ignition compliance of 5.5 and thermal ignition compliance of 5.6.

For circuits of associated apparatus which are connected to safety extra low-voltage circuits (SELV) or protective extra low-voltage circuits (PELV) circuits, U_m shall only be applied as a ‘common mode’ voltage, with the nominal operating voltage applied for the differential mode signal between the circuit conductors. (Typical examples are RS-232, RS-485 or 4-20 mA circuits). The certificate number for associated apparatus relying on SELV or PELV circuits shall include the "X" suffix in accordance with the marking requirements of IEC 60079-0 and the specific conditions of use listed on the certificate shall detail the precautions necessary.

Where live maintenance procedures are specified by the manufacturer in the documentation provided, the effects of this live maintenance shall not invalidate intrinsic safety and this shall be considered during the testing and assessment.

NOTE 1 Apparatus may be specified with more than one level of protection, and may have different parameters for each level of protection.

NOTE 2 For the application of U_m, U_i in the following clauses, any voltage up to the maximum voltage may be applied for the assessment.

5.2 Level of protection "ia"

With U_m and U_i applied, the intrinsically safe circuits in electrical apparatus of level of protection "ia" shall not be capable of causing ignition in each of the following circumstances:

a) in normal operation and with the application of those non-countable faults which give the most onerous condition;

b) in normal operation and with the application of one countable fault plus those non-countable faults which give the most onerous condition;

c) in normal operation and with the application of two countable faults plus those non-countable faults which give the most onerous condition.

The non-countable faults applied may differ in each of the above circumstances.

In testing or assessing the circuits for spark ignition, the following safety factors shall be applied in accordance with 10.1.4.2:

– for both a) and b) 1,5

– for c) 1,0

The safety factor applied to voltage or current for determination of surface temperature classification shall be 1,0 in all cases.

Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

If only one countable fault can occur, the requirements of a) and b) shall be considered to give a level of protection of "ia" if the test requirements for "ia" can then be satisfied. If no countable faults can occur the requirements of a) shall be considered to give a level of protection of "ia" if the test requirements for "ia" can then be satisfied.

5.3 Level of protection "ib"

With U_m and U_i applied, the intrinsically safe circuits in electrical apparatus of level of protection "ib" shall not be capable of causing ignition in each of the following circumstances:

a) in normal operation and with the application of those non-countable faults which give the most onerous condition;

b) in normal operation and with the application of one countable fault plus the application of those non-countable faults which give the most onerous condition.

The non-countable faults applied may differ in each of the above circumstances.

In testing or assessing the circuits for spark ignition, a safety factor of 1,5 shall be applied in accordance with 10.1.4.2. The safety factor applied to the voltage or current for the determination of surface temperature classification shall be 1,0 in all cases.

If no countable fault can occur the requirements of a) shall be considered to give a level of protection of "ib" if the test requirements for "ib" can be satisfied.

5.4 Level of protection "ic"

With U_m and U_i applied, the intrinsically safe circuits in electrical apparatus of level of protection "ic" shall not be capable of causing ignition in normal operation and under the conditions specified in this standard.

In testing or assessing the circuits for spark ignition, a safety factor of 1,0 shall be applied in accordance with 10.1.4.2. The safety factor applied to the voltage or current for the determination of surface temperature classification shall be 1,0.

NOTE The concept of countable faults does not apply to this level of protection. Infallible components and assemblies, as in Clause 8, are not applicable. For level of protection “ic”, the term ‘infallible’ should be read as ‘meeting the requirements of 7.1’.

5.5 Spark ignition compliance

The circuit shall be assessed and/or tested for the successful limitation of the spark energy that may be capable of causing ignition of the explosive atmosphere, at each point where an interruption or interconnection may occur, in accordance with 10.1.

For Group III, the spark ignition tests to the requirements of Group IIB shall be applied to circuits exposed to dust.

5.6 Thermal ignition compliance

5.6.1 General

All surfaces of components, enclosures, wiring and the tracks on printed circuit boards which may come in contact with explosive atmospheres shall be assessed and/or tested for the maximum temperature. The maximum temperature allowable after the application of faults, as provided in 5.2, 5.3 and 5.4, shall be in accordance with the temperature requirements of IEC 60079-0. Tests, when required, are specified in 10.2.

NOTE 1 The requirements of this clause are not applicable to associated apparatus protected by another type of protection listed in IEC 60079-0 or located outside the hazardous area.

AVA Documents
Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV

NOTE 2 Care should be taken in the selection of materials to be used adjacent to components that could exhibit excessive temperatures such as cells, batteries, or components that could dissipate power greater than 1,3 W, under the fault conditions defined in Clause 5, to prevent the secondary ignition of the explosive atmosphere by for example, heating or burning of the printed circuit boards, coatings or component packaging.

5.6.2 Temperature for small components for Group I and Group II

Requirements for temperatures of small components used in Group I or Group II equipment are provided in the small component temperature for Group I or Group II electrical equipment requirements of IEC 60079-0 and the test requirements are provided in the small component ignition test of IEC 60079-0.

The 5 K and 10 K margin of safety required by the maximum surface temperature requirements of IEC 60079-0 does not apply to the maximum surface temperature values, 200 °C, 275 °C and 950 °C shown in the table for the assessment of temperature classification according to component size at 40 °C ambient temperature in IEC 60079-0.

NOTE Where a catalytic or other chemical reaction can result specialist advice should be sought.

5.6.3 Wiring within intrinsically safe apparatus for Group I and Group II

The maximum permissible current corresponding to the maximum wire temperature due to self-heating shall either be taken from Table 2 for copper wires, or can be calculated from the following equation for metals in general.

$$I = I_f \left[\frac{t(1+aT)}{T(1+at)} \right]^{1/2}$$

where

- a is the temperature coefficient of resistance of the wire material (0,004 284 K^{-1} for copper, 0,004 201 K^{-1} for gold);
- I is the maximum permissible current r.m.s., in amperes;
- I_f is the current at which the wire melts at the maximum specified ambient temperature, in amperes;
- T is the melting temperature of the wire material in degrees Celsius (1 083 °C for copper, 1 064 °C for gold);
- t is the threshold temperature, in degrees Celsius, of the applicable temperature class. The value of t is the wire temperature due to self-heating and ambient temperature.

Example: fine copper wire (Temperature class =T4)

a = 0,004 284 K^{-1}

I_f = 1,6 A (determined experimentally or specified by the wire manufacturer)

T = 1 083 °C

t for T4 (small component, $t \leq 275$ °C)

Applying the equation

I = 1,3 A (This is the maximum normal or fault current which may be allowed to flow to prevent the wire temperature from exceeding 275 °C.)

Documents
Document Sharing Hub
Full document details: IEC 60079-11 2011 RLV

Table 2 – Temperature classification of copper wiring (in a maximum ambient temperature of 40 °C)

Diameter (see Note 4) mm	**Cross-sectional area** (see Note 4) mm^2	**Maximum permissible current for temperature classification** A		
		T1 to T4 and Group I	**T5**	**T6**
0,035	0,000 962	0,53	0,48	0,43
0,05	0,001 96	1,04	0,93	0,84
0,1	0,007 85	2,1	1,9	1,7
0,2	0,031 4	3,7	3,3	3,0
0,35	0,096 2	6,4	5,6	5,0
0,5	0,196	7,7	6,9	6,7

NOTE 1 The value given for maximum permissible current, in amperes, is the r.m.s. a.c. or d.c. value.

NOTE 2 For stranded conductors, the cross-sectional area is taken as the total area of all strands of the conductor.

NOTE 3 The table also applies to flexible flat conductors, such as in ribbon cable, but not to printed circuit conductors for which see 5.6.4.

NOTE 4 Diameter and cross-sectional area are the nominal dimensions specified by the wire manufacturer.

NOTE 5 Where the maximum power does not exceed 1,3 W the wiring can be assigned a temperature classification of T4 and is acceptable for Group I. For Group I where dust is excluded, a maximum power of 3,3 W is permitted for ambient temperatures of up to 40 °C. Refer to IEC 60079-0, Table 3a) and 3b) where derating is required for ambient temperatures greater than 40 °C.

5.6.4 Tracks on printed circuit boards for Group I and Group II

The temperature classification of tracks of printed circuit boards shall be determined using available data or by actual measurement.

Where the tracks are made of copper, the temperature classification may be determined using Table 3.

For example, on printed circuit boards of at least 0,5 mm thickness, having a conducting track of at least 33 μm thickness on one or both sides, by applying factors given in Table 3, a temperature classification of T4 or Group I shall be given to the printed tracks if they have a minimum width of 0,3 mm and the continuous current in the tracks does not exceed 0,444 A. Similarly, for minimum track widths of 0,5 mm, 1,0 mm and 2,0 mm, T4 shall be given for corresponding maximum currents of 0,648 A, 1,092 A and 1,833 A respectively.

Track lengths of 10 mm or less shall be disregarded for temperature classification purposes.

Where temperature classification of a track is to be experimentally determined, the maximum continuous current shall be used.

Manufacturing tolerances shall not reduce the values stated in this clause by more than 10 % or 1 mm, whichever is the smaller.

In the absence of testing, where the maximum power does not exceed 1,3 W, the tracks are suitable for a temperature classification of T4 or Group I.

In the absence of testing, where dust is excluded and the maximum power does not exceed 3,3 W, the tracks are suitable for Group I.

AVA Documents Document Sharing Hub

Full document details: IEC 60079-11 2011 RLV