

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

- 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.

- 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.

Withdrawing

iTech Standards
(<https://standards.iteh.ai>)
Document Preview

IEC 60079-11:2011/ISH3:2016

<https://standards.iteh.ai/catalog/standards/iec/3c8fd668-6b5f-4d83-9871-72f3c7af8aab/iec-60079-11-2011-ish3-2016>

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, U_i , I_i , P_i are maximum values possible in normal operation. U_o , I_o , P_o are determined in normal operation, but with the most onerous rated load for each case attached. Reduction of maximum voltage from U_m 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.

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	<p>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:</p> <ul style="list-style-type: none"> – 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. <p>This separation distance requirement is different from previous Ex "nL" requirements.</p>
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	<p>Applicable except regarding protective circuitry for functions such as charging in the non-hazardous area.</p> <p>As there is no application of faults, the ratings of components may be ensured without additional protection.</p>
6.3	Separation distances		
6.3.1	General	Applicable	<p>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.</p> <p>NOTE For example, an "ic" circuit is the circuit after the last protective component that establishes the necessary voltage and current limitation.</p>

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: <ul style="list-style-type: none"> • 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	

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 3 rd paragraph. Regarding the 2 nd 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 1 st 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 2 nd 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".

Clause	Requirement	Applicability	Remark
7.2	Connectors for internal connections, plug-in cards and components	Applicable	<p>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.</p> <p>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.</p> <p>Open circuit failure of a connection requirement is not applicable because faults are not considered for 'ic'.</p> <p>Both are not considered a normal operations condition (see 6.5).</p>
7.3	Fuses	Applicable	<p>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 wiring terminals. The prospective short-circuit current of a 250 V mains supply is considered to not be greater than 1 500 A."</p>
7.4	Primary and secondary cells and batteries	Applicable	<p>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.</p>
7.5	Semiconductors		
7.5.1	Transient effects	Applicable	<p>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:</p> <ul style="list-style-type: none"> • 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. <p>NOTE Semiconductors serving as protective components in "ic" circuits are required to comply with the applicable requirements elsewhere in this standard.</p>

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: <ul style="list-style-type: none"> 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 2 nd paragraph, and infallible connections requirements in 5 th and 6 th 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 1 st 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.

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.