IEC 60079-11

Edition 7.0 2023-01

INTERNATIONAL STANDARD

colour inside

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.260.20

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IEC 60079-11
Edition 7.0 2023-01

EXPLOSIVE ATMOSPHERES –

Part 11: Equipment protection by intrinsic safety "i"

INTERPRETATION SHEET 1

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/392/DISH	31G/397/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.

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IEC 60079-11:2023 (Edition 7.0)

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

Background

5.4.1 of IEC 60079-11:2023 states, in part:

All surfaces of intrinsically safe apparatus that come into contact with explosive atmospheres shall be assessed to ensure that, under the conditions specified in 5.2, the apparatus complies with the maximum surface temperature requirements of IEC 60079-0.

Question

Is "all surfaces of intrinsically safe apparatus that come into contact with explosive atmospheres", as referenced in 5.4.1 for thermal ignition compliance, intended to mean the junction temperature of a sealed semiconductor?

ICS 29.260.20

IEC 60079-11:2023-01/ISH1:2024-05(en)

Answer

No. It is not necessary to consider temperatures within a sealed semiconductor for thermal ignition compliance. It is not necessary to test a packaged component to confirm sealing. It is not necessary for the packaging of such a component to conform to the encapsulation requirements of IEC 60079-11.

An example of a sealed semiconductor is one which is fabricated into a package by the semiconductor manufacturer using moulding or an equivalent process, such that the explosive atmosphere is excluded, such as SOIC, DIP, QFN, SOT.

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IEC 60079-11
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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:

DISH	Report on voting
31G/393/DISH	31G/398/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.

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IEC 60079-11:2023 (Edition 7.0)

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

Background

Table 22, "Rating and failure modes of PPTC devices used to limit current", includes ITRIP as a parameter requiring a safety factor of 1,0.

Question 1

Where Table 22 applies a safety factor of 1,0 for ITRIP, is external current limitation required to achieve the safety factor?

IEC 60079-11:2023-01/ISH2:2024-05(en)

ICS 29.260.20

Answer 1

No. A PPTC may be considered to self-limit the current for the purpose of achieving the required safety factor. Faults still need to be applied according to Table 22.

Question 2

Does IEC 60079-11 permit a PPTC device to be used to limit current for the purpose of spark ignition compliance?

Answer 2

No. Subclause 7.16.3 only permits the use of a PPTC device to limit current for the purposes of thermal ignition compliance, power rating of components, and the determination of P_o.

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Edition 7.0 2023-01

EXPLOSIVE ATMOSPHERES –

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INTERPRETATION SHEET 3

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

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

DISH	Report on voting
31G/400/DISH	31G/403/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.

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IEC 60079-11 Edition 7.0 2023

EXPLOSIVE ATMOSPHERES – Part 11: Equipment protection by intrinsic safety “i”

Background

Devices which read from memory during operation are clearly programmable components and need to be considered according to 7.7.8. IEC 60079-11 is not clear whether a component which only reads from memory or internal registers during initialisation – such as a digital potentiometer – is a programmable component according to 7.7.8 or a simpler semiconductor which can be considered according to 7.7.2.

Question

Can a digital potentiometer (or other similar device) which relies on reading from memory or an internal register only during initialization to set the resistance value be used as a component on which intrinsic safety depends for Levels of Protection “ia” and “ib”?

ICS 29.260.20

IEC 60079-11:2023-01/ISH3:2024-08(en)

Answer

No. Such a device is considered a programmable component according to 7.7.8 and its failure modes should be considered accordingly. Memory is fundamental to the main function of the component.

Digital potentiometers (or other similar devices) which can be used as components on which intrinsic safety depends according to 7.7.2 include those which:

1) have their resistance (or other value) set during manufacture of the equipment or component (for example configuration fuse bits or laser trimming),
2) do not rely on reading from memory or internal registers which are designed to be reprogrammable to set the resistance, and;
3) cannot be modified by the end user of the equipment.

NOTE Requirements for components which read from memory during initialization are under consideration for the next edition of IEC 60079-11.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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EXPLOSIVE ATMOSPHERES –

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FOREWORD

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

This seventh edition cancels and replaces the sixth edition published in 2011. This edition constitutes a technical revision.

The significance of changes between IEC 60079-11, Edition 7 (2023) and IEC 60079-11, Edition 6 (2011 + Corrigendum 1 (2012)) are as listed below:

		Type		
Explanation of the significance of changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
A significant number of editorial changes including re-structuring of sections. These are too numerous to list in this table.	All	X		
Protection of catalytic elements for Group IIC or Group IIB + H_2 excluded from the scope of the standard.	1 7.14.2			C2
Extension, with requirements, of ambient pressure down to 60 kPa.	1 6.5.6.1		B1	
Modification to Table 1 showing Clause 14 of IEC 60079-0 as 'Applies'. This does not affect the technical requirements.	1	X		
Definitions removed as they are now in IEC 60079-0. (References are from Ed.6) 3.2 coating 3.3 conformal coating 3.7.1 countable fault 3.7.3 non-countable fault 3.18 recurring peak voltage 3.20 encapsulation 3.21 casting 3.23 galvanic isolation	3	X		
Definitions removed as they are no longer considered necessary. (References are from Ed.6) 3.7.2 fault 3.10.3 Infallible separation	3	X		
Diode safety barriers no longer refers to devices that provide galvanic isolation.	3.1.7 7.7.5		X	
Intrinsic safety parameters and U_m can have brief transients above the stated values, and these do not need to be taken into account.	3.1.12 7.7.3	X		
New definition – spark test apparatus.	3.1.14	X		
New definition – electrochemical capacitor.	3.1.15		X	
New definition – transient rating.	3.1.16.1		X	
New definition – transient energy (previously let-through energy).	3.1.16.2	X		
New definition – non-hazardous area accessory.	3.1.17	X		
Clarification that it is not a requirement of this standard that conformance to industrial standards be verified.	5.1	X		
Clarification of conditions for the assessment added.	5.2.1	X		
Clarification relating to the application of service temperatures.	5.2.1 g)			C1
Statements that Level of Protection "ia" and "ib" requirements are always sufficient for Level of Protection "ic".	5.2.2		X	

		Type		
Explanation of the significance of changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
For Level of Protection "ic", faults are only considered for spark ignition assessment and the determination of U_o, I_o, L_i, C_i and L_i/R_i. A short circuit fault, and subsequent component faults arising, are now termed non-countable faults.	5.2.4 6.5.4.3 6.5.4.4 6.5.4.5			C3
For Level of Protection "ic", the types of components on which intrinsic safety depends are limited.	5.2.4		X	
Clarification of the requirements for non-shock hazard equipment or systems (for example SELV / PELV) for declaration of U_m.	5.2.5 12.1 c)	A1		
Clarification of where spark ignition assessment should and should not be applied.	5.3.1	X		
Clarification that spark ignition assessment may be performed on a representative circuit.	5.3.1 9.1.1	X		
Spark ignition assessment at normal ambient is suitable for service temperatures between -60 °C and 100 °C.	5.3.1		X	
Spark ignition testing of mains apparatus is at U_m rather than 110 % of the mains nominal voltage.	5.3.4.2 d)	X		
Annex G added as option for spark ignition assessment.	5.3.4.1 5.3.4.2 9.2.6 c) Annex G		X	
Clarification of the requirements for circuits with controlled semiconductor limitation, including need to consider both steady state and transient spark ignition compliance for circuits with controlled semiconductor limitation.	5.3.6 Annex D			C4
The exclusion of the IEC 60079-0 10 % safety margin on voltage for thermal ignition assessment extended to Groups I and II.	5.4.1		X	
The 1,3 W limit for T4 for tracks on a printed circuit board now only applies to 40 °C ambient.	5.4.1			C5
The 5K and 10K margin required for temperature tests from IEC 60079-0 now apply for Level of Protection "ic".	5.4.2			C6
Corrected the formula for thermal assessment of wires.	5.4.3			C7
Clarified that only circuit board tracks exposed to the explosive atmosphere require temperature classification.	5.4.4	X		
Added a note identifying examples of available data for determining temperature rise in PCB tracks (From IPC-2221 and IPC-2152).	5.4.4	X		
Clarified which dimensions can be reduced by manufacturer's tolerance (track width, board thickness, and conductor thickness).	5.4.4	X		
Clarified the use of Table 4 by introducing reduction factors for board thickness, number of layers, copper thickness, track under component, and ambient temperature.	5.4.4		X	
Added allowance for linear interpolation of allowed current, track width, track thickness, ambient temperature, and board thickness.	5.4.4		X	
Extrapolation of Table 4 is prohibited.	5.4.4			C1
Reduced the default board thickness for application of Table 4 from 1,6 mm to 1,55 mm to reflect industry standard.	5.4.4		X	

		Type		
Explanation of the significance of changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Clarified that the track under component reduction factor only applies if the portion of the track underneath the component is greater than 10 mm.	5.4.4		X	
Use of the 1,3 W limit for thermal ignition compliance for Group III extended to include Group I.	5.4.5		X	
Board thickness, copper thickness and ambient temperature factors extended in use of Table 4.	5.4.4		X	
Enclosure requirement for Groups IIIA and IIIB aligned with Group I and Group II.	6.2.1		X	
Clarification that the IEC 60079-0 enclosure requirements apply for Group IIIC equipment with separations according to Table 7 (Ed 6 Table 5) that are reliant on an enclosure providing IP5X.	6.2.4 a)1)			C1
Requirement for a Specific Condition of Use added when use of reduced separations is reliant on an enclosure providing IP54.	6.2.5.1			C8
Plugs and sockets can comply with reduced separation requirements.	6.3.3		X	
Use of an enclosure to protect battery charging connections from spark ignition (Ed.6 clause 7.4.9) extended to include all non-hazardous area connection facilities.	6.3.5.2		X	
It is no longer necessary to define U_m for the connection from non-hazardous area connection facilities to accessories listed in the certificate provided the accessory is suitably marked and listed in the instructions.	6.3.5.3 11.1.5 12.1 j)		X	
It is no longer necessary to assess a non-hazardous area accessory in accordance with this standard.	6.3.5.3		X	
Clarification that charging of cells and batteries in the non-hazardous area has to be within the limits specified by their manufacturer, and IEC 60079-0.	6.3.5.3	X		
Conductors, connectors and PCB tracks have to be suitably rated for their failure to be a countable fault.	6.4.1			C9
It is now a stated requirement that circuits remain intrinsically safe after disconnection of a connector.	6.4.1			C1
It is now a requirement that infallible connections remain capable of carrying the current following considered fault disconnections.	6.4.2.2 6.4.2.3			C10
Infallible PCB connection achieved with two 1 mm wide tracks now have copper thickness requirements.	6.4.2.4			C11
The options for infallible PCB connections have been extended.	6.4.2.4		B2	
Clarification that connections complying with IEC 60079-7 Level of Protection "eb" can be considered infallible.	6.4.2.5	X		
Clarification that insulation of component packaging cannot be relied upon for separation of conductive parts unless it is specified by the component manufacturer, except for shorts to its solder pads where they are similar to the recommendations of the component manufacturer.	6.5.1	X		
Alternate spacing requirements from the previous edition Annex F have been transferred to the main body of this document.		A2		
Specific Condition of Use only required for Overvoltage Category (OVC) I/II when using Table 8 – Reduced separations.	6.5.3.2		X	
Dielectric strength requirements have been clarified in Table 8 – Reduced separations.	6.5.3.2			C12

		Type		
Explanation of the significance of changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Specific Condition of Use required when OVC II/I is required for mains apparatus when using Table 9 – Reduced separations for Level of Protection "ic".	6.5.3.3			C13
Table 8 – Reduced separations is derived from Ed.6 Table F.1 but with additional requirements.	6.5.3.2		X	
Routine tests when using Table 8 – Reduced separations no longer have to be performed at the most onerous ambient condition.	6.5.3.2		X	
Table 9 – Reduced separations for Level of Protection "ic" is derived from Ed.6 Table F.2 but with additional requirements.	6.5.3.3		X	
Additional options for infallible separations when exposing connection facilities.	6.5.4.2		X	
Separations tables clarify that the voltages do not need to include non-repetitive transients.	Table 7 Table 8 Table 9	X		
Determination of type and routine testing required when using reduced separations tables.	Table 8 6.5.6.2 6.5.6.3 6.5.6.5 9.7			C14
Additional separation distance options.	Table 8 Table 9		X	
Dielectric strength test is no longer required for all separations through casting compound and solid insulation.	6.5.6.2 6.5.6.3		X	
When Comparative Tracking Index (CTI) Is unknown, a CTI of 100 may be assumed, and some materials are identified as non-tracking.	6.5.6.4		X	
Extended and clarified requirements for assessing creepage distances.	6.5.6.4		X	
Two coats of conformal coating no longer required when spraying.	6.5.6.5		X	
Consideration of composite separations extended to reduced distances tables.	6.5.7		X	
Metal parts used for separation no longer have to be earthed.	6.5.9		X	
Where metal parts connected to the frame or earth are used to separate two circuits, a Specific Condition of Use is now required.	6.5.9.1			C15
Clarification that separation by metal parts requires infallible connection.	6.5.9.1			C1
Relaxation of requirements for non-metallic insulating partitions for Level of Protection "ic".	6.5.10		X	
Added requirements for insulation between internal wiring of separate intrinsically safe circuits.	6.5.11.3		X	
Encapsulation requirements have been separated and extended according to the purpose of the encapsulation.	6.6		X	
Routine verification of encapsulation added.	6.6.1 10.4			C16
The specified COT for encapsulation shall not be exceeded in normal operation. Tighter requirements for damage to compound for temperature greater than COT.	6.6.1 a)			C17

		Type		
Explanation of the significance of changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Free space within encapsulation other than within components is now permitted.	6.6.1 6.6.7		X	
Requirements for specification of coating, encapsulation and moulding materials.	6.7			C18
Components used to protect against polarity reversal have to be rated to 7.1.	6.8			C1
It is now stated that there are circumstances where 2/3rd rating for all three of voltage, current and power are not applicable for Levels of Protection "ia" and "ib".	7.1	X		
Power rating for Level of Protection "ic" does not require a 1,5 safety factor following the application of faults.	7.1		X	
Components for Level of Protection "ic" are considered to fail if they are not within their manufacturer's rating following the application of faults.	7.2			C19
Clarification of the application of manufacturing variations added.	7.3	X		
Resistors of types not listed (film, wire wound and printed) cannot now be considered to fail as a countable fault, nor to limit their own temperature.	7.4.2			C20
Clarified that the voltage rating to which the safety factor is applied is that of the resistor series, and not that based on the resistance.	7.4.2	X		
Clarification of the power rating of resistors in series with supercapacitors.	7.4.2	X		
Cold resistance of a fuse, filament of a bulb or infra-red source is assessed at the service temperature rather than the ambient temperature.	7.4.2			C21
The filament of an infra-red sensor can be used as a resistor for limitation.	7.4.2		X	
Clarification that self-heating of capacitors need not be considered.	7.5.1		X	
An arrangement of two series blocking capacitors need have only half of the infallible separation across each when using Table 7 and Table 9 (this was already permitted for Table 8).	7.5.3		X	
Clarification of the failure modes for inductors and transformers.	7.6.1 7.8.1	X		
References to IEC 60317 updated.	7.6.3	X		
Added requirements and tests for common mode chokes which provides allowances to consider only the leakage inductance of common mode chokes, or the inductance of only one coil.	7.6.5 9.15		X	
Clarification that assessment of semiconductors cannot be based on failure rates.	7.7.1			C1
An enhanced voltage generated by an integrated circuit does not need to be considered as being present on other connected pins.	7.7.1 c)		X	
Added an allowance for low complexity semiconductors to avoid being considered to fail so as to dissipate maximum power.	7.7.1.d)2)		X	
Transient rating of semiconductors only applied to transients caused by current limitation.	7.7.3		X	

		Type		
Explanation of the significance of changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Clarification that a safety factor of 1,0 is required when assessing the transient power rating of a semiconductor on which intrinsic safety depends.	7.7.3	X		
For Level of Protection "ic", transient rating of semiconductors is only necessary for diode safety barriers.	7.7.3		X	
Where two diodes are used in a safety shunt for Level of Protection "ia", the failure of only a single diode has been extended to the failure of a single shunt path. This means that the tracking from the diode to reference voltages (for example, ground) no longer have to be infallible.	7.7.6		X	
Controlled semiconductor current limitation is permitted for Level of Protection "ia".	7.7.7		X	
Clarification of the requirements for programmable components.	7.7.8			C1
Statement that transformers need not be considered to increase the voltage or current beyond that defined by their turns ratio.	7.8.1	X		
Table 17 extended with a 10 A column.	7.8.3		X	
Foil / screen thickness for 10 A added.	7.8.3		X	
Clarification that the requirement for mains transformers includes any transformer that is not galvanically isolated from the mains.	7.8.4.1			C1
Reduced requirements for transformers that are galvanically isolated from the mains.	7.8.4.2		X	
Clarification of requirements for transformers for Level of Protection "ic".	7.8.5 9.17.4	X		
Requirements for transformers for Level of Protection "ic" added.	7.8.5			C22
Clarification of the rating requirements for relays.	7.9.2	X		
Countable fault separation between the coil and contacts of a relay is no longer permitted.	7.9.2 a)			C23
Addition of option for relays depending on reduced separation distances internally to comply with IEC 61810-1.	7.9.2		X	
Relays in Level of Protection "ic" need only comply with the relevant industrial standards.	7.9.2		X	
Clarified that IEC 60079-28 does not apply to self-contained optical isolators.	7.10.1	X		
Addition of options for non-optical signal isolators.	7.10.2		X	
Clarified that a single fuse is sufficient.	7.11	X		
Clarification that the cold resistance of a fuse cannot be used to limit the breaking current.	7.11			C1
A fuse in Level of Protection "ic" shall be considered an ignition risk if its opening is an expected occurrence.	7.11			C24
Clarification that the breaking capacity of fuses connected to U_m may be less than 1 500 A provided that the maximum prospective current is stated in the instructions.	7.11 12.1 j)			C25
Cells which may explode no longer require a statement from the manufacturer of the cell that they are safe for use in any particular apparatus.	7.12.1		X	
Clarification that temperature rise and electrolyte leakage should be considered for cells.	7.12.1			C1

		Type		
Explanation of the significance of changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Clarification that short circuit of a single cell is considered a non-countable fault.	7.12.2			C1
Demonstration of the concentration of hydrogen can come from the manufacturer, rather than the manufacturer of the battery.	7.12.4		X	
Containers for sealed cells and batteries no longer need the pressure test of 9.14.4.	7.12.4		X	
Clarification of conditions for determining cell voltages	7.12.5	X		
Clarified that the requirements only apply to replaceable batteries.	7.12.8	X		
Crystal oscillators are excluded from the requirements for piezoelectric devices, and there are extended requirements for Level of Protection "ic".	7.13		X	
Clarified that thermal assessment of catalytic sensors shall take into account heating due to the catalytic reaction.	7.14.2			C1
Clarification that supercapacitors shall be treated as batteries with a limited capacity but without the ability to limit their own voltage.	7.15 9.14			C26
Requirements and tests for thermal devices added, including PTCs.	7.16 9.12			C27
Clarification that mechanical switches do not require thermal ignition assessment.	7.17	X		
Clarification that the protective diodes in diode safety barriers shall be protected by a fuse or resistor(s) and not controlled semiconductor limitation.	8.1.1	X		
Additional options for earth facilities for diode safety barriers.	8.1.2.2		X	
Requirement for 110 % of the mains supply voltage when applying the spark test apparatus removed as the conditions for test are specified in 5.2.	9.1.1		X	
Clarified that all circuits (not just capacitive) need to have time to recover where applicable during spark testing.	9.1.2	X		
Added allowance for slowing the spark test apparatus down when removing wires is not sufficient to allow rest of the circuit under test.	9.1.2		X	
Clarified that the effect of temperature on an inductor's resistance shall be taken into account during spark testing.	9.1.2			C1
Clarified that the sensitivity of the spark test apparatus may be checked if there is an unexpected failure.	9.1.2	X		
Minimum ignition current for calibration of the spark test apparatus added.	9.1.3	X		
Added formula option for reducing effective capacitance with a resistor.	9.2.3.3		X	
Clarification that consideration of the combination of inductance and capacitance is required internal to equipment and not just at connection facilities.	9.2.6	X		
An assessment that demonstrates that the safety factor is maintained with a combination of both inductance and capacitance is allowed.	9.2.6 b)		X	
Where parameters are specified for combined lumped inductance and capacitance, that shall be stated in the certificate or documentation.	9.2.6	X		
30 N test for casting compound and partitions are not applicable for Level of Protection "ic".	9.4.1 9.4.3		X	

		Type		
Explanation of the significance of changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Test temperature for immersion in water for encapsulated fuses has been lowered by 2 °C for compatibility with other testing.	9.4.2	X		
Parameters for loosely specified components shall be determined taking into account the service temperature, not just the ambient temperature.	9.13	X		
Clarification and modification of the tests for optical isolators.	9.10		X	
Clarified that tests on piezoelectric devices need be performed on only a single sample, unless that sample is damaged during the testing.	9.11	X		
Clarified that primary cells shall be unused and limiting devices shall be removed for the electrolyte leakage test.	9.14.1	X		
Clarified that the current shall be continuous when discharging during the tests.	9.14.1			C1
Cells that have essential features that limit their current may be used for Level of Protection "ia".	9.14.1		X	
Cells that explode or catch fire during short circuit test shall not be used for Levels of Protection "ia" and "ib".	9.14.1	X		
Electrolyte leakage and surface temperature test requirements for cells and batteries modified to cover the number of samples tested, the test temperature, and testing with dust layers.	9.14.1			C28
Added option to conduct short circuit until discharge testing for Level of Protection "ic" to establish compliance with the electrolyte leakage requirement.	9.14.2 a)		X	
Added alternative assessment of damage to encapsulation from leaked electrolyte.	9.14.2		X	
Spark ignition of batteries may be carried out following current limitation where separation is maintained.	9.14.3.2		X	
Requirement added to consider the spark ignition risk of single lithium cells of less than 4,5 V with high short circuit current.	9.14.3.2			C29
For single cells, it is sufficient to measure the temperature in the middle of the cell rather than having to locate the highest temperature point.	9.14.3.3		X	
For thermal ignition assessment of cells and batteries with Level of Protection "ib", added an alternative test for lithium-ion rechargeable cells where it is not possible to obtain samples with current limiting devices disabled. There is an assumption that these cells will leak electrolyte so 7.12.3 applies.	9.14.3.3 b) 9.14.2		X	
Where limiting devices are removed from a cell for testing, it is no longer necessary to also test with 10 samples with the limiting devices still in place.	9.14.3.3		X	
Only a single sample need be tested for thermal ignition compliance testing of cells or batteries for Level of Protection "ic".	9.14.3.3 c)		X	
Transient test for diode safety barriers and safety shunts has been extended to include controlled semiconductor current limitation.	9.16		X	
Clarify that transformer dielectric strength test is a test at room temperature.	9.17.1	X		
Reduced testing requirements for transformers that are galvanically isolated from the mains.	9.17.3		X	

		Type		
Explanation of the significance of changes	**Clause**	**Minor and editorial changes**	**Extension**	**Major technical changes**
Transformer windings requiring galvanic separation between different intrinsically safe circuits are to be tested for a dielectric strength of $2U$ if that is greater than 500 V.	10.3.1			C30
Transformers for Level of Protection "ic" shall be routine tested where there is no applicable industrial standard, or the applicable industrial standard does not specify a routine test.	10.3.2			C31
Marking of IP rating no longer required as this is now a Specific Condition of Use.	11		X	
Flowchart for testing of enclosures added.	Annex I	X		
List of voltage limiting techniques has been deleted.	former 8.7.3	A3		
Requirements for handlights and caplights removed as these are covered elsewhere (including in other standards).	former 9.3	X		

NOTE The technical changes referred to include the significance of technical changes in the revised IEC Standard, but they do not form an exhaustive list of all modifications from the previous version.

Explanations:

A) Definitions

Minor and editorial changes clarification
decrease of technical requirements
minor technical change
editorial corrections

These are changes which modify requirements in an editorial or a minor technical way. They include changes of the wording to clarify technical requirements without any technical change, or a reduction in level of existing requirement.

Extension addition of technical options

These are changes which add new or modify existing technical requirements, in a way that new options are given, but without increasing requirements for equipment that was fully compliant with the previous standard. Therefore, these will not have to be considered for products in conformity with the preceding edition.

Major technical changes addition of technical requirements
increase of technical requirements

These are changes to technical requirements (addition, increase of the level or removal) made in a way that a product in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition. These changes have to be considered for products in conformity with the preceding edition. For these changes additional information is provided in clause B) below.

NOTE These changes represent current technological knowledge. However, these changes should not normally have an influence on equipment already placed on the market.

B) Information about the background of Changes

A1 U_m is to be applied across galvanic isolations.

A2 The Annex for 'Alternative separation distances for assembled printed circuit boards and separation of components' in the previous edition is now incorporated in the main text and the alternate spacing tables are now Table 8 and Table 9.

A3 Except for c) batteries for which there is no longer a suggestion that they can be used as voltage limiting shunt devices. Nonetheless, there is no intent to change their use as such.

B1 Apparatus may be used at lower atmospheric pressure than the default 80 kPa specified in IEC 60079-0 with additional requirements such as an increase in clearance for associated apparatus operated at less than 80 kPa.

B2 The values used were based on those in IPC-6012B and tolerances have been taken into account.

C1 It is recognized that the clarified requirements were, in many cases, already applied. The change is to ensure that they are uniformly and consistently applied.

C2 Catalytic sensors have been demonstrated to auto-ignite hydrogen without electrical stimulus so are not suitable for protection by intrinsic safety.

C3 Failure of separations and subsequent failure of components are considered non-countable faults for "ic". This is expected to be a change in terminology only but is highlighted here as it could change the assessment methodology in some instances.

C4 The steady state maximum voltage and current presents a different spark ignition risk than a transient. A transient is where either of these (voltage or current) is exceeded. Therefore, steady states and transients need to be considered separately. The Annex on transients has been revised.

C5 Modified to align with assessment for wires.

C6 Since thermal assessment for Level of Protection "ic" is substantively under normal operation, the margin is considered a required safety factor.

C7 The formula used for calculating the temperature rise of wiring has been corrected.

C8 Where reduced separation distances rely on an enclosure providing an ingress protection of IP54, and cable glands, thread adapters and blanking elements are necessary to complete the enclosure to maintain the Ingress Protection (IP) rating these also need to comply with IEC 60079-0.

C9 Conductors, connectors and PCB tracks have to be suitably rated for their failure to be a countable fault.

C10 It is now a requirement that infallible connections remain capable of carrying the current following considered fault disconnections.

C11 Infallible PCB connection achieved with two 1 mm wide tracks now have copper thickness requirements.

C12 The safety of reduced separations relies on a suitable dielectric strength for the insulating materials, and these have been added to Table 8.

C13 A Specific Condition of Use is required when Over Voltage Category II/I is required for mains apparatus when using Table 9 – Reduced separations for Level of Protection "ic".

C14 The previous edition made references to the tests in IEC 60664-1 and IEC 60664-3, however, it did not state which tests applied. This edition clarifies which tests apply by including them in the text.

C15 This is to be compatible with the Specific Condition of Use already required where insulation between an intrinsically safe circuit and the frame or earth does not meet the dielectric strength requirements.

C16 A routine inspection requirement was added for encapsulated parts to ensure that the application of the encapsulant is acceptable during manufacture.

C17 The Continuous Operating Temperature requirements are a modification of those specified in IEC 60079-0. When temperatures higher than the COT are possible, there must be no damage internally or externally, whereas for Ed.6 the requirement was no visible damage.

C18 The specifications required for coating, encapsulation and moulding are a modification of those detailed in IEC 60079-0.

C19 Ed.6 did not state how to consider failure of components where the application of failure of separation resulted in them being operated outside of their manufacturer's specification. This is considered necessary, but for spark ignition only.

C20 This is a consequence of the re-organisation of the requirements for components.

C21 The cold resistance was previously permitted to be measured at the minimum ambient temperature.

C22 It was recognised that when the requirements for Ex nL were transferred into IEC 60079-11 as Ex ic not all components were addressed. This meant that an Ex ia transformer construction was required for Ex ic equipment.

C23 Countable fault separation between the coil and contacts of a relay is no longer permitted.

C24 A fuse in Level of Protection "ic" shall be considered an ignition risk if its opening is an expected occurrence.

C25 Fuses connected to the mains supply are permitted to have a breaking capacity of less than 1 500 A. However, it is necessary that users and installers are made aware when this is the case and therefore it is a requirement to include the maximum prospective current in the instructions.

C26 Requirements for supercapacitors added.

C27 Requirements for the use of thermal devices (PTCs etc.) have been added.

C28 Electrolyte leakage, surface temperature test and test under dust requirements for cells, batteries and supercapacitors modified, increasing the number of samples tested and defining the temperature at which the tests are conducted.

C29 Spark ignition has been demonstrated during short circuit of some lithium cells.

C30 Routine tests for transformers with primary and secondary windings in an intrinsically safe circuit changed.

C31 Addition of a specific routine test for transformers used in Ex ic circuits.

The text of this International Standard is based on the following documents:

Draft	Report on voting
31G/352/FDIS	31G/359/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

This document supplements and modifies the general requirements of IEC 60079-0, except as indicated in Table 1.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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 document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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

The contents of the corrigendum 1 (2023-06) and the interpretation sheets 1 (2024-05), 2 (2024-05) and 3 (2024-08) have been included in this copy.

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

EXPLOSIVE ATMOSPHERES –

Part 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 explosive atmospheres, 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 ignition of a surrounding explosive atmosphere. This includes electrical equipment which contains circuits that are intrinsically safe only under certain conditions, for example under battery supply with mains supply removed.

This document 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 assessed for use in such atmospheres by applying this document.

This document applies to sensors connected to intrinsically safe circuits but does not apply to the protection of catalytic elements for Group IIC or Group IIB + H_2.

This document does not apply to Ex Equipment cable glands.

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

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

Unless otherwise stated, the requirements in this document are applicable to both intrinsically safe apparatus and associated apparatus, and the generic term "apparatus" is used throughout the standard.

As this document applies only to electrical equipment, the term "equipment" used in the standard always means "electrical equipment".

This document applies to apparatus for use under the atmospheric conditions of IEC 60079-0 with additional requirements for use at extended atmospheric pressures in the range from 60 kPa (0,6 bar), up to 110 kPa (1,1 bar).

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.6 (2011) (informative)	Ed.7 (2017) (informative)	Clause / Subclause title (normative)	Group I and Group II	Group III	
3	3	Terms and definitions	Applies	Applies	Applies
4	4	Equipment grouping	Applies	Applies	Applies
5	5	Temperatures			
5.1	5.1	Environmental influences	Applies	Applies	Applies
5.2	5.2	Service temperature	Applies	Applies	Applies
5.3	5.3	Maximum surface temperature	Applies	Applies	Excluded
6	6	Requirements for all electrical apparatus			
6.1	6.1	General	Applies	Applies	Applies
6.2	6.2	Mechanical strength	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
6.3	6.3	Opening times	Excluded	Excluded	Excluded
6.4	6.4	Circulating currents in enclosures (e.g. of large electric machines)	Excluded	Excluded	Excluded
6.5	6.5	Gasket retention	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
6.6	6.6	Electromagnetic and ultrasonic energy radiating equipment			
-	6.6.1	General	Applies	Applies	Excluded
6.6.1	6.6.2	Radio frequency sources	Applies	Applies	Excluded
6.6.3	6.6.3	Ultrasonic sources	Applies	Applies	Excluded
6.6.2	6.6.4	Lasers, luminaires and other non-divergent continuous wave optical sources	Modified	Modified	Excluded
7	7	Non-metallic enclosures and non-metallic parts of enclosures			
7.1	7.1	General	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
7.2	7.2	Thermal endurance	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
7.3	7.3	Resistance to ultraviolet light	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
7.4	7.4	Electrostatic charges on external non-metallic materials	Applies	Applies	Excluded

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed.6 (2011) (informative)	**Ed.7 (2017)** (informative)	**Clause / Subclause title** (normative)	**Group I and Group II**	**Group III**	
7.5	7.5	Attached external conductive parts	Applies	Applies	Excluded
8	8	Metallic enclosures and metallic parts of enclosures	Applies	Applies	Excluded
9	9	Fasteners	Excluded	Excluded	Excluded
10	10	Interlocking devices	Applies	Applies	Excluded
11	11	Bushings	Excluded	Excluded	Excluded
12	-	Materials used for cementing	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 are applied	Excluded except when 6.2.5.1 is applied
-	12	(Reserved for future use)	-	-	-
13	13	Ex Components	Applies	Applies	Applies
14	14	Connection facilities			
14.1	14.1	General	Applies	Applies	Applies
14.2	-	Termination compartment	Applies	Applies	Applies
14.3	14.2	Type of Protection	Applies	Applies	Modified
14.4	14.3	Creepage and clearance	Applies	Applies	Applies
15	15	Connection facilities for earthing or bonding conductors	Excluded	Excluded	Excluded
16	16	Entries into enclosures			
16.1	16.1	General	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
16.2	16.2	Identification of entries	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
16.3	16.3	Cable Glands	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
16.4	16.4	Blanking elements	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
16.5	16.5	Thread adapters	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
16.6	16.6	Temperature at branching point and entry point	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
16.7	16.7	Electrostatic charges of cable sheaths	Applies	Applies	Applies

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed.6 (2011) (informative)	**Ed.7 (2017)** (informative)	**Clause / Subclause title** (normative)	**Group I and Group II**	**Group III**	
17	17	Supplementary requirements for electric machines	Excluded	Excluded	Excluded
18	18	Supplementary requirements for switchgear	Excluded	Excluded	Excluded
19	-	Supplementary requirements for fuses	Excluded	Excluded	Excluded
-	19	Reserved for future use	-	-	-
20	20	Supplementary requirements for external plugs, socket outlets and connectors for field wiring connection	Excluded	Excluded	Excluded
21	21	Supplementary requirements for luminaires	Excluded	Excluded	Excluded
22	22	Supplementary requirements for caplights and handlights			
22.1	22.1	Group I caplights	Applies	Excluded	Excluded
22.2	22.2	Group II and Group III caplights and handlights	Excluded	Excluded	Excluded
23	23	Equipment incorporating cells and batteries			
23.1	23.1	General	Applies	Applies	Applies
23.2	23.2	Interconnection of cells to form batteries	Excluded	Excluded	Excluded
23.3	23.3	Cell types	Modified	Modified	Modified
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	26	Type tests			
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

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed.6 (2011) (informative)	**Ed.7 (2017)** (informative)	**Clause / Subclause title** (normative)	**Group I and Group II**	**Group III**	
26.4	26.4	Tests of enclosures			
26.4.1	26.4.1	Order of tests	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
26.4.2	26.4.2	Resistance to impact	Excluded except see [a]	Excluded except see [a]	Excluded except see [a]
26.4.3	26.4.3	Drop test	Applies	Applies	Applies
26.4.4	26.4.4	Acceptance criteria	Applies	Applies	Applies
26.4.5	26.4.5	Degree of protection (IP) by enclosures	Applies	Applies	Applies
26.5	26.5	Thermal tests			
26.5.1	26.5.1	Temperature measurement			
26.5.1.1	26.5.1.1	General	Applies	Applies	Excluded
26.5.1.2	26.5.1.2	Service temperature	Applies	Applies	Applies
26.5.1.3	26.5.1.3	Maximum surface temperature	Modified	Modified	Excluded
26.5.2	26.5.2	Thermal shock test	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 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 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
26.8	26.8	Thermal endurance to heat	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
26.9	26.9	Thermal endurance to cold	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
26.10	26.10	Resistance to UV light	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
26.11	26.11	Resistance to chemical agents for Group I equipment	Excluded except when 6.2.5.1 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
26.14	26.14	Measurement of capacitance	Applies	Applies	Excluded

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed.6 (2011) (informative)	**Ed.7 (2017)** (informative)	**Clause / Subclause title** (normative)	**Group I and Group II**	**Group III**	
26.15	26.15	Verification of ratings of ventilating fans	Excluded	Excluded	Excluded
26.16	26.16	Alternative qualification of elastomeric sealing O-rings	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
NR	26.17	Transferred charge test	Applies	Excluded	Excluded
27	27	Routine tests	Applies	Applies	Applies
28	28	Manufacturer's responsibility	Applies [b]	Applies [b]	Applies
29	29	Marking			
29.1	29.1	Applicability	Applies	Applies	Applies
29.2	29.2	Location	Applies	Applies	Applies
29.3	29.3	General	Applies	Applies	Applies
29.4	29.4	Ex marking for explosive gas atmospheres	Applies	Excluded	Applies
29.5	29.5	Ex marking for explosive dust atmospheres	Excluded	Applies	Applies
29.6	29.6	Combined types (or levels) of protection	Applies	Applies	Applies
29.7	29.7	Multiple types of protection	Applies	Applies	Applies
29.8	29.8	Ga equipment using two independent Gb types (or levels) of protection	Applies	Excluded	Excluded
NR	29.9	Boundary wall	Applies	Applies	Excluded
29.9	29.10	Ex Components	Applies	Applies	Applies
29.10	29.11	Small Ex Equipment and small Ex Components	Applies	Applies	Applies
29.11	29.12	Extremely small equipment and extremely small Ex Components	Applies	Applies	Applies
29.12	29.13	Warning markings	Applies	Applies	Applies
29.13	-	Alternate marking of Equipment Protection Levels (EPLs)	Applies	Applies	Applies
29.13.1	-	Alternate marking of Type of Protection for explosive gas atmospheres	Applies	Excluded	Applies
29.13.2	-	Alternate marking of Type of Protection for explosive dust atmospheres	Excluded	Applies	Applies
29.14	29.14	Cells and batteries	Applies	Applies	Applies
29.15	29.15	Electrical machines operated with a converter	Excluded	Excluded	Excluded
29.16	29.16	Examples of marking	Examples only	Examples only	Examples only
30	30	Instructions			
30.1	30.1	General	Applies	Applies	Applies

Clause or subclause of IEC 60079-0			IEC 60079-0 clause application to IEC 60079-11		
			Intrinsically safe apparatus		Associated apparatus
Ed.6 (2011) (informative)	**Ed.7 (2017)** (informative)	**Clause / Subclause title** (normative)	**Group I and Group II**	**Group III**	
30.2	30.2	Cells and batteries	Applies	Applies	Applies
30.3	30.3	Electric machines	Excluded	Excluded	Excluded
30.4	30.4	Ventilating fans	Excluded	Excluded	Excluded
-	30.5	Cable Glands	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
Annex A	Annex A	Supplementary requirements for cable glands	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied	Excluded except when 6.2.5.1 is applied
Annex B	Annex B	Requirements for Ex Components	Applies	Applies	Applies
Annex C	Annex C	Example of rig for resistance to impact test	Informative Annex	Informative Annex	Informative Annex
Annex D	Annex D	Electric machines connected to converters	Informative Annex	Informative Annex	Informative Annex
Annex E	Annex E	Temperature evaluation of electric machines	Informative Annex	Informative Annex	Informative Annex
Annex F	Annex F	Guideline flowchart for tests of non-metallic enclosures or non-metallic parts of enclosures (26.4)	Informative Annex	Informative Annex	Informative Annex
-	Annex G	Guidance flowchart for tests of cable glands	Informative Annex	Informative Annex	Informative Annex
-	Annex H	Shaft voltages resulting in motor bearing or shaft brush sparking. Discharge energy calculation	Informative Annex	Informative Annex	Informative Annex

Applies – This Clause / Subclause of IEC 60079-0 is applied without change.

Excluded – This Clause / Subclause of IEC 60079-0 does not apply.

Modified – This Clause / Subclause of IEC 60079-0 is modified as detailed in this document.

NOTE 1 The applicable Clauses / Subclauses of IEC 60079-0 are identified by the Clause / Subclause title which is normative. This document was written against the specific requirements of IEC 60079-0:2017 (Ed.7). The Clause / Subclause numbers for the 7th and previous edition are shown for information only. This is to enable the general requirements of IEC 60079-0:2011 (Ed.6) to be used where necessary with this part of IEC 60079. Where there were no requirements in the 6th edition but there are for the 7th edition (indicated by NR against the 6th edition only), or where there is a conflict between requirements, the later edition requirements take precedence.

NOTE 2 A shaded row in the above table indicates that this is a Clause heading. In cases where the applicability is the same for all the subclauses the 'Applies' or 'Excluded' is listed in the heading row and the subclauses are not expanded. Where the application of the individual sub-clauses may be different, these are expanded in the above table and the applicability for each is listed.

[a] Excluded except when 6.2.5.1 is applied, or as required by 9.4.1 or 9.11.

[b] Excluded for simple apparatus. See 3.1.5 and 5.5.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60317-0-1, *Specifications for particular types of winding wires – Part 0-1: General requirements – Enamelled round copper wire*

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

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

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

IEC 60691, *Thermal-links – Requirements and application guide*

IEC 60747-5-5, *Semiconductor devices – Part 5-5: Optoelectronic devices – Photocouplers*

IEC 60747-17, *Semiconductor devices – Part 17: Magnetic and capacitive coupler for basic and reinforced insulation*

IEC 60851-5, *Winding wires – Test methods – Part 5: Electrical properties*

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

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