
Električne naprave za potencialno eksplozivne atmosfere - Lastna varnost "i"

Electrical apparatus for potentially explosive atmospheres - Intrinsic safety "i"

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EUROPEAN STANDARD

EN 50020

NORME EUROPÉENNE

EUROPÄISCHE NORM

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English version

Electrical apparatus for potentially explosive atmospheres - Intrinsic safety 'i'

Matériel électrique
pour atmosphères explosibles -
Sécurité intrinsèque 'i'

Elektrische Betriebsmittel
für explosionsgefährdete Bereiche -
Eigensicherheit 'i'

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

This European Standard was prepared by SC 31-3, Intrinsically safe apparatus and systems "i", of Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres.

The text of the draft was submitted to the CENELEC Unique Acceptance Procedure and was approved by CENELEC as EN 50020 on 2002-02-01.

This European Standard supersedes EN 50020:1994 and its corrigendum February 1998.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2003-02-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-06-30

This European Standard is to be read in conjunction with EN 50014:1997, *Electrical apparatus for potentially explosive atmospheres – General requirements*, and with the third editions of the European Standards for the specific types of protection.

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1 Scope

1.1 This European Standard specifies the construction and testing of intrinsically safe apparatus, intended for use in potentially explosive atmospheres and for associated apparatus, which is intended for connection to intrinsically safe circuits which enter such atmospheres.

1.2 This European Standard supplements EN 50014 the requirements of which apply to intrinsically safe apparatus and to associated apparatus except as indicated in the following list.

If associated apparatus is protected by a type of protection listed in EN 50014, then the requirements of that method of protection together with the relevant parts of EN 50014 also apply to the associated apparatus. The list of exclusions which follows is directly applicable to associated apparatus intended for use in situations where there is no potentially hazardous atmosphere and in other circumstances should be used in combination with the requirements of the other method of protection.

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Clause of EN 50014:1997		Clause excluded	
		Intrinsically safe apparatus	Associated apparatus
3.1	Electrical apparatus	Yes	Yes
4.2.2	Marking of maximum surface temperature	No	Yes
5.1	Maximum surface temperature	No	Yes
5.3	Surface temperature and ignition temperature	No	Yes
6.2	Enclosure opening delay	Yes	Yes
7.1.1	Definition of plastics material	No	Yes
7.1.2	Requirements of plastics material compliance	Yes	Yes
7.1.3	Verification of plastics material compliance	No	Yes
7.2	Thermal endurance	Yes	Yes
7.3	Electrostatic charges on plastics enclosures	No	Yes
7.4	Threaded holes in plastics	Yes	Yes
8.1	Light metal enclosure materials	No	Yes
8.2	Threaded holes in light metals	Yes	Yes
9	Fasteners	Yes	Yes
10	Interlocking devices	Yes	Yes
11	Bushings	Yes	Yes
12	Materials used for cementing	Yes if	Yes
14	Connection facilities and terminal compartments	Yes	Yes
15	Connection facilities for earthing or bonding conductors	Yes	Yes
16	Cable and conduit entries	Yes	Yes
17 to 22	Supplementary requirements for certain electrical apparatus	Yes	Yes
23.4.3.1	Test for resistance to impact	Yes	Yes
23.4.3.2	Drop test (no prior impact test necessary)	No	Yes
23.4.3.3	Required results	No	Yes
23.4.5	Torque test for bushings	Yes	Yes
23.4.6.1	Temperature measurement	No	Yes
23.4.6.2	Thermal shock test	Yes	Yes
23.4.7.1 to 23.4.7.7	Tests on non-metallic enclosures	Yes	Yes
23.4.7.8	Insulation resistance test of parts of enclosures of plastics materials	No	Yes
Annex B	Ex cable entries	Yes	Yes

1.3 This standard is applicable to electrical apparatus in which the electrical circuits themselves are incapable of causing an explosion in the surrounding explosive atmosphere.

1.4 This standard is also applicable to electrical apparatus or parts of electrical apparatus located outside the potentially explosive atmosphere or protected by another type of protection listed in EN 50014, where the intrinsic safety of the electrical circuits in the potentially explosive atmosphere, may depend upon the design and construction of such electrical apparatus or parts of such electrical apparatus. The electrical circuits exposed to the potentially explosive atmosphere are evaluated for use in such an atmosphere by applying this standard.

NOTE Methods of interconnection of intrinsically safe apparatus and associated apparatus are specified in EN 50039.

1.5 Where intrinsically safe apparatus is required to be Category 1 G equipment in accordance with EN 50284 it must comply with the requirements in this standard and also comply with the relevant requirements of EN 50284. In particular 4.3, 4.4 and 4.5 impose additional requirements.

1.6 Where intrinsically safe apparatus is required to be Category M1 equipment in accordance with EN 50303 it must comply with the requirements of this standard and also comply with the relevant requirements of EN 50303.

NOTE Associated apparatus intended for interconnection to Category 1 G and Category M1 equipment only requires to comply with the requirements of "ia" associated apparatus in accordance with this standard but should be marked in accordance with the relevant Category 1 standard.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

<u>Publication</u>	<u>Year</u>	<u>Title</u>
EN 50014 + corr. April + A1 + A2	1997 1998 1999 1999	Electrical apparatus for potentially explosive atmospheres - General requirements
EN 50019		Electrical apparatus for potentially explosive atmospheres - Increased safety 'e'
EN 50039		Electrical apparatus for potentially explosive atmospheres - Intrinsically safe electrical systems 'i'
EN 50284	1999	Special requirements for construction, test and marking of electrical apparatus for equipment group II, Category 1 G
EN 50303	2000	Group I, Category M1 equipment intended to remain functional in atmospheres endangered by firedamp and/or coal dust
EN 60127-1		Miniature fuses - Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links (IEC 60127-1)
EN 60127-2		Miniature fuses - Part 2: Cartridge fuse-links (IEC 60127-2)
EN 60127-3		Miniature fuses - Part 3: Sub-miniature fuse-links (IEC 60127-3)
EN 60317-3 + A1	1994 1998	Specifications for particular types of winding wires - Part 3: Polyester enamelled round copper wire, class 155 (IEC 60317-3:1990 + A1:1997)
EN 60317-7 + A1 + A2	1994 1997 1998	Specifications for particular types of winding wires - Part 7: Polyimide enamelled round copper wire, class 220 (IEC 60317-7:1990 + A1:1997 + A2:1997)

<u>Publication</u>	<u>Year</u>	<u>Title</u>
EN 60317-8 + A1 + A2	1994 1997 1998	Specifications for particular types of winding wires - Part 8: Polyesterimide enamelled round copper wire, class 180 (IEC 60317-8:1990 + A1:1997 + A2:1997)
EN 60529		Degrees of protection provided by enclosures (IP code)
HD 214 S2	1980	Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions (IEC 60112:1979)
HD 566 S1	1990	Thermal evaluation and classification of electrical insulation (IEC 60085:1984)

3 Definitions

For the purpose of this European Standard, the definitions in EN 50014 and the following definitions apply:

3.1

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 gas atmosphere

3.2

electrical apparatus

assembly of electrical components, electrical circuits or parts of electrical circuits normally contained in a single enclosure

NOTE 1 The term "normally" has been introduced to indicate that an apparatus may occasionally be in more than one enclosure, for example, a telephone or a radio transceiver with a hand microphone.

NOTE 2 This definition is more precise than that contained in EN 50014.

3.3

intrinsically safe apparatus

electrical apparatus in which all the circuits are intrinsically safe circuits

3.4

associated apparatus

electrical apparatus, which contains both intrinsically safe circuits and non-intrinsically safe circuits and is constructed so that the non-intrinsically safe circuit, cannot adversely affect the intrinsically safe circuits

NOTE Associated apparatus may be either

- electrical apparatus which has another type of protection listed in EN 50014 for use in the appropriate explosive gas atmosphere, or
- electrical apparatus not so protected and which, therefore, will not be used within an explosive gas atmosphere, for example a recorder which is not itself in an explosive gas atmosphere, but is connected to a thermocouple situated within an explosive atmosphere where only the recorder input circuit is intrinsically safe.

3.5

normal operation

operation of intrinsically safe apparatus or associated apparatus such that it conforms electrically and mechanically with the design specification produced by its manufacturer

3.6

fault

any defect of any component, separation, insulation or connection between components, not defined as infallible by this standard, upon which the intrinsic safety of a circuit depends

3.7**countable fault**

fault which occurs in parts of electrical apparatus conforming to the constructional requirements of this standard

3.8**non-countable fault**

fault which occurs in parts of electrical apparatus not conforming to the constructional requirements of this standard

3.9**infallible component or infallible assembly of components**

component or assembly of components that is considered as not subject to certain fault modes as specified in this standard

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**infallible separation or insulation**

separation or insulation between electrically conductive parts that is considered as not subject to short circuits

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**simple apparatus**

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

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3.12**internal wiring**

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

3.13**minimum igniting current (MIC)**

minimum current in resistive or inductive circuits that causes the ignition of the explosive test mixture in the spark-test apparatus according to Annex B

3.14**minimum igniting voltage**

minimum voltage of capacitive circuits that causes the ignition to the explosive test mixture in the spark-test apparatus according to Annex B

3.15**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 intrinsic safety

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

3.16**maximum input voltage (U_i)**

maximum voltage (peak a.c. or d.c.) that can be applied to the connection facilities for intrinsically safe circuits without invalidating intrinsic safety

3.17

maximum output voltage (U_o)

maximum output voltage (peak a.c. or d.c) in an intrinsically safe circuit that can appear under open circuit conditions at the connection facilities of the apparatus at any applied voltage up to the maximum voltage, including U_m and U_i

NOTE Where there is more than one applied voltage, the maximum output voltage is that occurring under the most onerous combination of applied voltages.

3.18

maximum input current (I_i)

maximum current (peak a.c. or d.c) that can be applied to the connection facilities for intrinsically safe circuits without invalidating intrinsic safety

3.19

maximum output current (I_o)

maximum current (peak a.c. or d.c) in an intrinsically safe circuit that can be taken from the connection facilities of the apparatus

3.20

maximum input power (P_i)

maximum input power in an intrinsically safe circuit that can be dissipated within an apparatus when it is connected to an external source without invalidating intrinsic safety

3.21

maximum output power (P_o)

maximum electrical power in an intrinsically safe circuit that can be taken from the apparatus

3.22

maximum external capacitance (C_o)

maximum capacitance in an intrinsically safe circuit that can be connected to the connection facilities of the apparatus without invalidating intrinsic safety

3.23

maximum internal capacitance (C_i)

total equivalent internal capacitance of the apparatus, which is considered as appearing across the connection facilities of the apparatus

3.24

maximum external inductance (L_o)

maximum value of inductance in an intrinsically safe circuit that can be connected to the connection facilities of the apparatus

3.25

maximum internal inductance (L_i)

total equivalent internal inductance of the apparatus, which is considered as appearing at the connection facilities of the apparatus

3.26

maximum external inductance to resistance ratio (L_o/R_o)

maximum value of ratio of inductance to resistance of any external circuit which maybe connected to the connection facilities of the electrical apparatus without invalidating intrinsic safety

3.27

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

3.28**clearance**

shortest distance in air between two conductive parts

NOTE This distance applies only to parts that are exposed to the atmosphere and not to parts which are insulated parts or covered with casting compound.

3.29**distance through casting compounds**

shortest distance through a casting compound between two conductive parts

3.30**distances through solid insulation**

shortest distance through solid insulation between two conductive parts

3.31**creepage distance in air**

shortest distance along the surface of an insulating medium in contact with air between two conductive parts

3.32**creepage distance under coating**

shortest distance between conductive parts along the surface of an insulating medium covered with insulating coating

3.33**fuse rating (I_n)**

current rating of a fuse according to EN 60127 or to its manufacturer's specification

3.34**sealed gas tight cell or battery**

cell or battery which remains closed and does not release either gas or liquid when operated within the limits of charge or temperature specified by the manufacturer

NOTE Such cells and batteries may be equipped with a safety device to prevent dangerously high internal pressure. The cell or battery does not require addition to the electrolyte and is designed to operate during its life in its original sealed state.

3.35**sealed valve-regulated cell or battery**

cell or battery, which is closed under normal conditions but which has an arrangement which allows the escape of gas if the internal pressure exceeds a predetermined value. The cell or battery cannot normally receive an addition to the electrolyte

3.36**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

4 Grouping and classification of intrinsically safe apparatus and associated apparatus

Intrinsically safe apparatus and associated apparatus shall be grouped and classified in accordance with clauses 4 and 5 of EN 50014.

NOTE Where reference is made to Directive 94/9/EC then apparatus is required to be allocated a Category as defined in subclauses 3.26 to 3.30 of EN 50014.

5 Intrinsically safe levels of protection of electrical apparatus

5.1 General

Intrinsically safe apparatus and intrinsically safe parts of associated apparatus shall be allocated a level of protection "ia" or "ib".

The requirements of this standard shall apply to both levels of protection unless otherwise stated. In the determination of level of protection "ia" or "ib", failure of components and connections shall be considered in accordance with 7.6.

NOTE 1 Apparatus may be specified as both "ia" and "ib" and may have different parameters for each level of protection.

In the determination of the permitted output parameters C_o , L_o , L_o/R_o for a source of power a safety factor of 1,5 shall be used in all circumstances.

Where the test apparatus specified in Annex B is used for high currents, then the permitted inductance is very low. In these circumstances the inductance shall be accurately specified in the certification documentation and controlled. The use of high currents in field wiring is not permitted.

The application of U_m includes any voltage up to that value and these values have to be taken into account during assessment and testing. However a slow increase of the voltage from the rated value to U_m shall not be assumed.

NOTE 2 Guidance on the assessment of intrinsically safe circuits for spark ignition is contained in Annex A. Details of the spark test apparatus are given in Annex B.

5.2 Level of protection "ia"

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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 10.4.2:

- | | |
|--|-----|
| – for both a) and b) | 1,5 |
| – for c) | 1,0 |
| – for output parameters, C_o , L_o , L_o/R_o | 1,5 |

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

If only one countable fault can occur, the requirements of b) are considered to give a level of protection of "ia" if the test requirements for "ia" can be satisfied. If no countable faults can occur, the requirements of a) are 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 plus 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 10.4.2. 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) are considered to give a level of protection of “ib” if the test requirements of “ib” can be satisfied.

5.4 Simple apparatus

The following apparatus shall be considered to be simple apparatus:

- a) passive components, for example switches, junction boxes, resistors and simple semiconductor devices;
- b) sources of stored energy with well-defined parameters, for example capacitors or inductors, whose values shall be considered when determining the overall safety of the system;
- c) sources of generated energy, for example thermocouples and photocells, which do not generate more than 1,5 V, 100 mA and 25 mW. Any inductance or capacitance present in these sources of energy shall be considered as in b).

Simple apparatus shall conform to all relevant requirements of this standard but is not considered to contain a potential source of ignition capable of causing an explosion and need not be marked in accordance with clause 12. In particular, the following aspects shall always be considered:

- 1) simple apparatus shall not achieve safety by the inclusion of voltage and/or current-limiting and/or suppression devices;
- 2) simple apparatus shall not contain any means of increasing the available voltage or current, for example circuits for the generation of ancillary power supplies;
- 3) where it is necessary that the simple apparatus maintains the integrity of the isolation from earth of the intrinsically safe circuit, it shall be capable of withstanding the test voltage to earth in accordance with 6.4.12. Its terminals shall conform to 6.3.1;
- 4) non-metallic enclosures and enclosures containing light metals when located in the hazardous area shall conform to 7.3 and 8.1 of EN 50014;
- 5) when simple apparatus is located in the hazardous area, it shall be temperature classified. When used in an intrinsically safe circuit within their normal rating and at a maximum ambient temperature of 40 °C, switches, plugs, sockets and terminals can be allocated a T6 temperature classification for Group II applications. Other types of simple apparatus shall be temperature classified in accordance with clauses 4 and 6 of this standard;
- 6) where simple apparatus is to be located such that Category 1 G or M1 equipment is normally required, then the apparatus shall also comply with the additional requirements of EN 50284 or EN 50303 as applicable.

Where simple apparatus forms a part of an apparatus containing other electrical circuits, then the combination of apparatus shall be considered as a whole.

NOTE Sensors, which utilise catalytic reaction or other electro-chemical mechanisms, are not normally simple apparatus. Specialist advice on their application should be sought.

6 Apparatus construction

NOTE The requirements given in this clause apply, unless otherwise stated in the relevant subclauses, only to those features of intrinsically safe apparatus and associated apparatus which contribute to this type of protection and they are additional to the general requirements of EN 50014 except for those excluded in 1.2.

6.1 Enclosures

Intrinsically safe apparatus and associated apparatus require an enclosure which is adequate so as to prevent the invalidation of the method of protection. Particular care is required where intrinsic safety can be impaired by access to conducting parts, for example if the circuits contain infallible creepage distances in air.

For Group I apparatus, a degree of protection of IP 54 in accordance with EN 60529 will normally be required.

For Group II apparatus, a degree of protection of IP 20 may be acceptable if it is intended to be used only in dry, clean and well controlled environments.

The "enclosure" may not be physically the same for protection against contact with live parts and the ingress of solid foreign bodies and liquids.

The designation of the surfaces, which form the boundaries of the enclosure, shall be the responsibility of the manufacturer. The manufacturer shall also specify the environment in which the apparatus is intended to be used. This information shall be recorded in the definitive documentation (see clause 13).

6.2 Wiring and small component temperatures

6.2.1 Dust layers on Group I equipment

For the purpose of this clause where reference is made to T4 and Group I, the Group I equipment shall be equipment in which coal dust can not form a layer in the location of or on the component being considered.

Where it is assumed for the purpose of this standard that dust is excluded from Group I apparatus then the 'X' marking requirement of 5.1.1 of EN 50014 shall be applied.

6.2.2 Wiring within apparatus

The maximum permissible current corresponding to the maximum wire temperature due to self-heating shall either be taken from Table 1 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 (0,004 265 K⁻¹ for copper),

I is the maximum permissible current r.m.s., in amperes,

I_f is the current at which the wire melts in an ambient temperature of 40 °C, in amperes,

T is the melting temperature of the wire material in degrees Celsius (1 083 °C for copper),

t is the wire temperature due to self-heating and ambient temperature, in degrees Celsius.