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Electrical apparatus for potentially explosive atmospheres - Group I - Intrinsically safe systems - Part 1: Construction and testing

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Electrical apparatus for potentially explosive atmospheres – Group I – Intrinsically safe systems Part 1: Construction and testing

Matériels électriques pour atmosphères explosibles –
Système de sécurité intrinsèque du groupe I
Partie 1: Construction et essais

Elektrische Betriebsmittel für explosionsgefährdete Bereiche –
Gruppe I: Eigensichere Systeme
Teil 1: Konstruktion und Prüfung

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

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Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared jointly by a mining working group, convened under 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 Unique Acceptance Procedure and was approved by CENELEC as EN 50394-1 on 2003-10-01.

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) 2004-10-01

- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2006-10-01

This European Standard was prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association to set down requirements for the design and construction of equipment in support of the essential safety and health requirements described in the European Directive 94/9/EC "Equipment and protective systems intended for use in potentially explosive atmospheres".

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Introduction

When the European Directive 94/9/EC came into force on 1 March 1996, the requirements relating to intrinsically safe electrical systems were identified as requiring revision.

The EU Commission issued the following interpretation, following a request from CENELEC TC 31:

"a) intrinsically safe systems are not protective systems as defined in Article 1(3b) of the directive. They can be equipment, as defined in Article 1(3a), or components, as defined in Article 1(3c) and are in such cases within the scope of the directive;

b) intrinsically safe systems have to undergo the relevant conformity assessment procedures of the directive, if they are placed on the market as a complete system and, therefore, to be considered as equipment or components;

c) in case an intrinsically safe system comprises several separate products, which are designed to be assembled by the user, each single product, which is within the scope of the directive and placed on the market separately, has to undergo the relevant conformity assessment procedure of the directive;

d) the resulting system has to be seen as an installation and it is, as such, not subject to the procedures and requirements of the directive. This does not exclude that there might be national regulations related to the use of intrinsically safe systems, which have to be applied. In this context the use of EN 50039 could be useful."

As a result of the above interpretation, CENELEC SC 31-3 decided to produce a revised version of EN 50039 with separate parts for mining (Group I) and non-mining industries (Group II). Accordingly, this standard is the mining industry document dealing with the construction and testing of Group I intrinsically safe systems.

1 Scope

1.1 This European Standard contains the requirements for construction and testing of Group I intrinsically safe electrical systems intended for use, as a whole or in part, in atmospheres susceptible to firedamp.

1.2 This European Standard supplements EN 50020, the requirements of which apply to electrical apparatus used in intrinsically safe electrical systems.

It is intended to apply to

– systems placed on the market by a manufacturer or their authorised representative, or

– systems assembled by the user, using products separately conforming with EN 50020.

NOTE If the user intends to assemble a system using a product not conforming with EN 50020, then the user assumes the responsibilities of the system manufacturer and needs to follow the conformity assessment procedure.

1.3 This European Standard does not deal with the selection of suitable equipment, or the installation of intrinsically safe electrical apparatus, associated electrical apparatus, to form an intrinsically safe electrical system.

NOTE National Regulations may impose additional requirements for the selection, installation and use of intrinsically safe systems in mines.

2 Normative references

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

Publication	Title
EN 50014	Electrical apparatus for potentially explosive atmospheres - General requirements
EN 50020	Electrical apparatus for potentially explosive atmospheres - Intrinsic safety ‘i’
EN 50303	Group I Category M1 equipment intended to remain functional in atmospheres endangered by firedamp and/or coal dust

3 Definitions

For the purpose of this European Standard, the following definitions apply. They supplement the definitions, which are given in EN 50014, EN 50020, and EN 50303.

3.1
intrinsically safe electrical system
interconnected items of electrical apparatus, described in a descriptive system document, in which the circuits or parts of circuits intended to be used in potentially explosive atmospheres, are intrinsically safe circuits

3.2
conformity-assessed intrinsically safe electrical system
a complete system placed on the market, conforming with 3.1 which has undergone the relevant conformity assessment procedures and complies with the requirements of this standard

3.3
user constructed intrinsically safe electrical system
a system conforming with 3.1 and assembled by the user comprising products separately conforming to EN 50020 (which may consist of associated apparatus, intrinsically safe apparatus and/or simple apparatus and interconnecting wiring supplied from one or more linear power supplies or a power supply with trapezoidal/non-linear output characteristic) for which an assessment report has been issued confirming that the complete electrical system complies with this standard

3.4
descriptive system document
a document prepared by the system designer in which the items of electrical apparatus, their electrical parameters and the parameters for the interconnecting wiring are specified

NOTE The term “system designer” is intended to describe the person, who is responsible for the intrinsic safety of the system.

3.5
equipment Group I category M1 in accordance with EN 50014
equipment designed and, where necessary, equipped with additional special means to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a very high level of protection. Equipment in this category is intended for use in underground parts of mines as well as those parts of surface installations of such mines endangered by firedamp and/or combustible dust. Equipment in this category is intended to remain functional, even in the event of rare incidents relating to equipment, with an explosive atmosphere present, and is characterised by means of protection such that

a) either, in the event of failure of one means of protection, at least an independent second means provides the requisite level of protection, or
b) the requisite level of protection is assured in the event of two faults occurring independently of each other.

NOTE At the present time, only “level of protection ‘ia’ ”, meets the requirement of (b) above.

3.6
equipment Group I category M2 in accordance with EN 50014
equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection. Equipment in this category is intended for use in underground parts of mines as well as those parts of surface installations of such mines likely to be endangered by firedamp and/or combustible dust. This equipment is intended to be de-energised in the event of an explosive atmosphere. The means of protection relating to equipment in this category assure the requisite level of protection during normal operation and also in the case of more severe operating conditions, in particular those arising from rough handling and changing environmental conditions

NOTE The definitions in 3.5 and 3.6 above are an extract of the definitions in EN 50014.

3.7
accessories
passive components such as terminal boxes, junction boxes, plugs, sockets, and switches

3.8
linear power supply
a power source from which the available output current is determined by a resistor. The output voltage decreases linearly as the output current increases

3.9
power supply with trapezoidal output characteristics
a power source from which the available output current is determined by a resistor. The output voltage is controlled by the addition of a zener diode clamp on the output terminals (see Annex E for more detail)

3.10
non-linear power supply
a power source where the output voltage and output current have a non-linear relationship. For example a supply with a constant voltage output up to constant current limit controlled by semiconductors

3.11
maximum cable capacitance (C_c)
maximum capacitance of the interconnecting cable that can be connected into an intrinsically safe circuit without invalidating intrinsic safety

3.12
maximum cable inductance (L_c)
maximum inductance of the interconnecting cable that can be connected into an intrinsically safe circuit without invalidating intrinsic safety

3.13
maximum cable inductance to resistance ratio (L_c/R_c)
maximum value of the ratio inductance (L_c) to resistance (R_c) of the interconnecting cable that can be connected into an intrinsically safe circuit without invalidating intrinsic safety

4 Categories of intrinsically safe electrical systems (in accordance with EN 50014)

Each part of an intrinsically safe electrical system shall meet the requirements for either category M1 or M2, depending upon whether it is intended for operation in an explosive atmosphere or a potentially explosive atmosphere respectively. The complete system need not necessarily be in an single category, providing it is clear which parts relate to which category as outlined in 4.1 and 4.2 below.

NOTE Intrinsically safe systems, or parts thereof, may have different categories to those of the intrinsically safe electrical apparatus and associated electrical apparatus included in the system or part thereof.

4.1 Category M1

Parts of intrinsically safe electrical systems are of category M1 if they comply with either

a) the requirements applicable to electrical apparatus of “level of protection ‘ia’” (see 5.1 of EN 50020), or

b) the requirements of EN 50303 as they apply to intrinsically safe apparatus/circuits.

The faults shall be applied to the electrical system as an entity and not to each item of electrical apparatus in the system.

4.2 Category M2

Parts of intrinsically safe electrical systems are of category M2 if they comply with the requirements applicable to electrical apparatus of at least “level of protection ‘ib’” (see 5.1 of EN 50020); but the fault shall be applied to the electrical system as an entity and not to each item of electrical apparatus in the system

5 Interconnecting wiring/cables used in an intrinsically safe electrical system

5.1 The electrical parameters and all characteristics of the interconnecting wiring specific to an intrinsically safe electrical system, insofar as intrinsic safety depends on them, shall be specified in the descriptive system document. Interconnecting wiring/cables shall meet the requirements of Annex A.

NOTE This clause is not intended to prevent the use of bare conductors in a signalling system and these should be considered as simple apparatus and not interconnecting wiring.

5.2 A multicore cable shall not contain any intrinsically and non-intrinsically safe circuits at the same time.

5.3 Where a multicore cable is to be used, the descriptive system document shall identify which of the cables described in A.3.3 are to be used.

6 Accessories for intrinsically safe electrical systems

Accessories shall comply with the following requirements:

– Clauses 6 and 7 of EN 50014;
– Clause 6 and 12.2 of EN 50020 if their construction can affect the intrinsic safety of that system. Such accessories shall be shown on the descriptive system document.

7 Type tests and assessment

7.1 General

7.1.1 Group I conformity-assessed intrinsically safe systems shall be subjected to type tests and assessment in accordance with EN 50020, but taking into account the specific requirements of this European Standard.

7.1.2 Where a system contains apparatus, which does not separately conform to EN 50020 or is not simple apparatus then that system shall be assessed/tested as a whole. The system shall be analysed as if it is a single apparatus, taking into account faults within the apparatus and failures within the field wiring as listed in 7.2.

NOTE It is recognised that applying faults to the system, as a whole is less stringent than applying faults to each piece of apparatus, nevertheless, this is considered to achieve an acceptable level of safety. Where all the necessary information is available it is permissible to apply the fault count to the system as a whole when apparatus conforming to EN 50020 is being used. This is an alternative solution to the more usual straightforward comparison of input and output characteristics of the separately assessed/tested apparatus.

7.1.3 Where a system contains only apparatus conforming to EN 50020 and simple apparatus, the compatibility of all the apparatus included in the system shall be demonstrated. Faults within the apparatus have already been considered and no further consideration of these faults is necessary. Where a system contains a single linear source of power then the output parameters of the power source take into account the possible cable failures, and consequently these need not be further considered. Annex C contains further details of the analysis of these simple circuits.

7.1.4 When a system contains more than one linear source of power, then the effect of the combined sources of power shall be analysed. Annex D illustrates the analysis to be used in the most frequently occurring combinations.

7.1.5 Annex E gives further details of the analysis of a system which contains a power supply with a trapezoidal output characteristic.

7.1.6 If an intrinsically safe system contains more than one source of power and one or more of these sources is non-linear, the assessment method described in Annex D cannot be used. Annex F explains how the system analysis can be done if the combination contains non-linear power supplies.

7.1.7 Where an apparatus has a well-defined inductance and resistance either by virtue of its assessment or construction then the safety of the inductive aspects of the system utilising a linear power source shall be confirmed by the process defined in Annex G.

7.1.8 Where simple apparatus can possibly interconnect separate intrinsically safe circuits, for example a resistance thermometer with two separate resistance windings then the interconnected circuits shall be assessed as a single circuit.

7.1.9 Figure 1 illustrates the principles of system analysis.

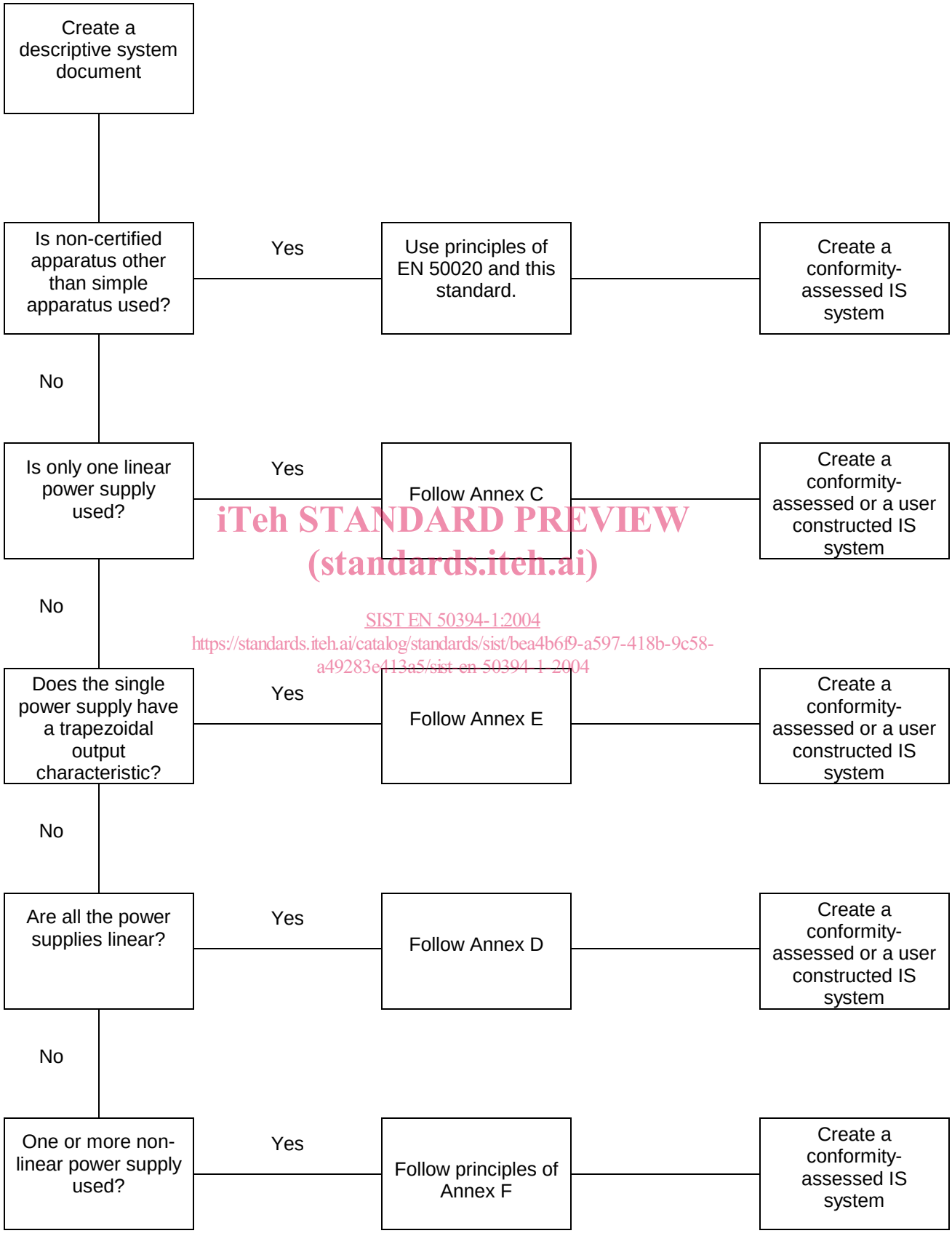

Figure 1 - Systems analysis flowchart