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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



31J/301/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 60079-14 ED6	
DATE OF CIRCULATION: 2019-12-06	CLOSING DATE FOR COMMENTS: 2020-02-28
SUPERSEDES DOCUMENTS: 31J/299/RR	

IEC SC 31J : CLASSIFICATION OF HAZARDOUS AREAS AND INSTALLATION REQUIREMENTS	
SECRETARIAT: Croatia	SECRETARY: Mr Marino Kelava
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 18,SC 61D	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☒ ENVIRONMENT ☐ QUALITY ASSURANCE ☒ SAFETY	

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TITLE:
Explosive atmospheres - Part 14: Electrical installations design, selection and erection

NOTE FROM TC/SC OFFICERS:
Please refer to 31J/298/RM for maintenance decision.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EXPLOSIVE ATMOSPHERES –

Part 14: Electrical installations design, selection, erection and initial inspection

FOREWORD

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International Standard IEC 60079-14 has been prepared by subcommittee 31J: Classification of hazardous areas and installation requirements, of IEC technical committee 31: Equipment for explosive atmospheres.

This sixth edition cancels and replaces the fifth edition published in 2013. This edition constitutes a technical revision.

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

Edition 6 represents a major technical revision of the requirements for electrical installations, design, selection and erection and should be considered as introducing all new requirements. The normal "Table of Significant Changes" has not been included for this reason. In particular:

- The structure of the document is completely new. The content of Edition 5 was restructured in "design", "selection" and "erection";
- The requirements for cables, cable entry devices and wiring methods are adapted to the state of the art;

- The requirements for motors are adapted to the state of the art.

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

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

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

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 National Committees are requested to note that for this document the stability date is 2022

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

INTRODUCTION

Preventive measures to reduce the explosion risk from flammable materials are based on three principles, which are normally applied in the following order:

- 1) substitution
- 2) control
- 3) mitigation

Substitution involves, for example, replacing a flammable material by one which is either not flammable or less flammable.

Control involves, for example:

- a) reducing the quantity of flammables;
- b) avoiding or minimising releases;
- c) controlling the release;
- d) preventing the formation of an explosive atmosphere;
- e) collecting and containing releases; and
- f) avoiding ignition sources.

NOTE 1 With the exception of item f), all of the above is part of the process of hazardous area classification.

Mitigation involves, for example:

- a) reducing the number of people exposed;
- b) providing measures to avoid the propagation of an explosion;
- c) providing explosion pressure relief;
- d) providing explosion pressure suppression; and
- e) providing suitable personal protective equipment.

NOTE 2 The above items are part of consequence management when considering risk.

Once the principles of substitution and control (items a) to e)) have been applied, the remaining hazardous areas should be classified into zones according to the likelihood of an explosive atmosphere being present (see IEC 60079-10-1 or IEC 60079-10-2). Such classification, which may be used in conjunction with an assessment of the consequences of an ignition, allows Equipment Protection Levels (EPL) to be determined and hence appropriate Types of Protection to be specified for each location.

For an explosion to occur, an explosive atmosphere and a source of ignition need to co-exist. Protective measures aim to reduce, to an acceptable level, the likelihood that the electrical installation could become a source of ignition.

By careful design of the electrical installation, it is frequently possible to locate much of the equipment in less hazardous or non-hazardous areas.

When Ex Equipment is installed in areas where explosive concentrations and quantities of flammable gases vapours or dusts could be present in the atmosphere, protective measures are applied to reduce the likelihood of explosion due to ignition for example by arcs, sparks or hot surfaces, produced either in normal operation or under specified fault conditions.

In general, possible ignition sources are:

- Hot surfaces;
- Flames and hot gases (including hot particles);
- Electrical equipment;
- Stray electric currents, cathodic corrosion protection;
- Mechanically generated impact, friction and grinding
- Static electricity;
- Lightning;
- Radio frequency (RF), electromagnetic waves;
- Electromagnetic;
- Ionizing radiation;
- Ultrasonic;
- Adiabatic compression and shock; and
- Exothermic reactions, including self-ignition of dusts.

The focus of this standard is the electrical installation, thus, in electrical Ex Equipment, potential ignition sources include, for example, electrical arcs and sparks, static electricity, lightning and hot surfaces caused by transformation of electrical energy in heat energy as well as caused by friction of moving parts of electrical equipment.

Many types of dust that are generated, processed, handled and stored, are combustible. When ignited they can burn rapidly and with considerable explosive force if mixed with air in the appropriate proportions. It is often necessary to use Ex Equipment in locations where such materials are present, and suitable precautions should therefore be taken to ensure that all such equipment is adequately protected so as to reduce the likelihood of ignition of the external explosive atmosphere.

Dust can be ignited by equipment in several ways:

- by surfaces of the equipment that are above the minimum ignition temperature of the dust concerned. The temperature at which a type of dust ignites is a function of the properties of the dust, whether the dust is in a cloud or layer, the thickness of the layer and the geometry of the heat source;
- by arcing or sparking of electrical parts such as switches, contacts, commutators, brushes, or the like;
- by discharge of an accumulated electrostatic charge;
- by radiated energy (e.g. electromagnetic radiation);
- by mechanical sparking or frictional sparking associated with the equipment.

In order to avoid dust ignition hazards it is important that:

- the temperature of surfaces on which dust can be deposited, or which would be in contact with a dust cloud, is kept below the temperature limitation specified in this standard;
- any electrical sparking parts, or parts having a temperature above the temperature limit specified in this standard:
 - i) are contained in an enclosure which adequately prevents the ingress of dust, or
 - ii) the energy of electrical circuits is limited so as to avoid arcs, sparks or temperatures capable of igniting dust;
- any other ignition sources are avoided.

482 Several Types of Protection are available for Ex Equipment in hazardous areas (see IEC 60079-
483 0), and this standard gives the specific requirements for design, selection and erection of elec-
484 trical installations in explosive atmospheres.

485 This part of the IEC 60079 series is supplementary to other relevant IEC standards, for example
486 IEC 60364 series as regards electrical installation requirements or IEC 60204 series for elec-
487 trical safety of machinery. This part also refers to IEC 60079-0 and its associated standards for
488 the construction, testing and marking requirements of suitable electrical Ex Equipment.

489 This standard provides the specific requirements for the design, selection, erection and the
490 required initial inspection of electrical Ex Equipment in hazardous areas. This standard is also
491 based on manufacturer's instructions being followed. On-going inspection, maintenance and
492 repair aspects also play an important role in control of hazardous area installations and the
493 user's attention is drawn to IEC 60079-17, IEC 60079-19 and manufacturer's instructions for
494 further information concerning these aspects.

495 In any industrial installation, irrespective of size, there can be numerous sources of ignition
496 apart from those associated with electrical Ex Equipment. Precautions are necessary to ensure
497 safety from other possible ignition sources, but guidance on this aspect is outside the scope of
498 this standard.

499

EXPLOSIVE ATMOSPHERES –

Part 14: Electrical installations design, selection, erection and initial inspection

1 Scope

This part of the IEC 60079 series contains the specific requirements for the design, selection, erection and initial inspection of electrical installations of Ex Equipment in, or associated with, explosive atmospheres.

Where the Ex Equipment is required to meet other environmental conditions, for example, protection against ingress of water and resistance to corrosion, additional protection requirements are necessary.

The requirements of this standard apply only to the use of Ex Equipment under standard atmospheric conditions as defined in IEC 60079-0. For other conditions, additional precautions are necessary, and the Ex Equipment Certificate should identify these other conditions. For example, most flammable materials and many materials which are normally regarded as non-flammable might burn vigorously under conditions of oxygen enrichment.

NOTE 1 The standard atmospheric conditions defined in IEC 60079-0 relate to the explosion characteristics of the atmosphere and not the operating range of the Ex Equipment for example

- Temperature: –20 °C to 60 °C;
- Pressure: 80 kPa (0,8 bar) to 110 kPa (1,1 bar); and
- air with normal oxygen content, typically 21 % v/v.

These requirements are in addition to the requirements for installations in non-hazardous areas.

NOTE 2 For voltages up to 1 000 V a.c. or 1 500 V d.c. requirements of this standard are based on installation requirements in the IEC 60364 series, but other relevant national requirements can apply.

This standard applies to all electrical Ex Equipment including fixed, transportable, portable and personal, and installations, permanent or temporary.

MT-COMMENT 1: Including of “personal equipment” to this standard needs to be discussed further considering the outcomes of IEC SC 31J WG2.

This standard does not apply to:

- electrical installations in mines susceptible to firedamp;

NOTE 3 This standard can apply to electrical installations in mines where explosive gas atmospheres other than firedamp can be formed and to electrical installations in the surface installation of mines.

- inherently explosive situations and dust from explosives or pyrophoric substances (for example explosives manufacturing and processing);
- rooms used for medical purposes;
- electrical installations in areas where the hazard is due to flammable mist; and
- installation of non-electrical Ex Equipment (unless being part of an equipment assembly according IEC TS 60079-46).

NOTE 4 Additional guidance on the requirements for hazards due to hybrid mixtures of dust or flyings and flammable gas or vapour is provided in Annex I.

No account is taken in this standard of the toxic risks that are associated with flammable gases, liquids and dusts in concentrations that are usually very much less than the lower explosive

limit. In locations where personnel could be exposed to potentially toxic concentrations of flammable material, appropriate precautions should be taken. Such precautions are outside the scope of this Standard.

2 Normative references

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

IEC 60060-1, *High-voltage test techniques - Part 1: General definitions and test requirements*

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

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

IEC 60079-11, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"*

IEC 60079-15, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*

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

IEC 60079-28, *Explosive atmospheres – Part 28: Protection of equipment and transmission systems using optical radiation*

IEC 60079-29-1, *Explosive atmospheres – Part 29-1: Gas detectors – Performance requirements of detectors for flammable gases*

IEC 60079-29-2, *Explosive atmospheres – Part 29-2: Gas detectors – Selection, installation, use and maintenance of detectors for flammable gases and oxygen*

IEC 60079-29-3, *Explosive atmospheres – Part 29-3: Gas detectors – Guidance on functional safety of fixed gas detection systems*

IEC 60079-29-4, *Explosive atmospheres – Part 29-4: Gas detectors – Performance requirements of open path detectors for flammable gases*

IEC TS 60079-32-1, *Explosive atmospheres - Part 32-1: Electrostatic hazards, guidance*

IEC 60228, *Conductors of insulated cables*

IEC 60245-4, *Rubber insulated cables – rated voltages up to and including 450/57 V – Part 4: Cords and flexible cables*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-43, *Low-voltage electrical installations – Part 4-43: Protection for safety – Protection against overcurrent*

IEC 60947-1, *Low voltage switchgear and controlgear – Part 1: general rules*

IEC 62305-3, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

578 IEC 62626-1, *Combines flexible materials for electrical insulation – Part 1: Definitions and gen-*
579 *eral requirements*

580 **3 Terms and definitions**

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

583 ISO and IEC maintain terminological databases for use in standardization at the following ad-
584 dresses

- 585 • IEC Electropedia: available at <http://www.electropedia.org/>
- 586 • ISO Online browsing platform: available at <http://www.iso.org/obp>

587 NOTE Additional definitions applicable to explosive atmospheres can be found in IEC 60050-426.

588 **3.1 General**

589 **3.1.1** 590 **competent body**

591 individual or organization which can demonstrate appropriate technical knowledge and relevant skills to make the
592 necessary assessments of the safety aspect under consideration

593 **3.1.2** 594 **verification dossier** 595 set of documents showing the compliance of electrical equipment and installations

596 **3.1.3** 597 **electrical equipment** 598 items applied as a whole or in part for the utilization of electrical energy

599 Note 1 to entry: These include, amongst others, items for the generation, transmission, distribution, storage, meas-
600 urement, regulation, conversion and consumption of electrical energy and items for telecommunications.

601 **3.2 Hazardous areas**

602 **3.2.1** 603 **hazardous area** 604 area in which an explosive atmosphere is present, or may be expected to be present, in quan- 605 tities such as to require special precautions for the construction, installation and use of equip- 606 ment

607 Note to entry: For the purposes of this standard, an area is a three-dimensional region or space.

608 **3.2.2** 609 **non-hazardous area** 610 area in which an explosive atmosphere is not expected to be present in quantities such as to 611 require special precautions for the construction, installation and use of equipment

612 **3.2.3** 613 **group <of electrical equipment for explosive atmospheres>** 614 classification of electrical equipment related to the explosive atmosphere for which it is to be 615 used

616 Note 1 to entry: Electrical equipment for use in explosive atmospheres is divided into three groups:

- 617 – Group I: electrical equipment for mines susceptible to firedamp;
- 618 – Group II (which can be divided into subgroups): electrical equipment for places with an explosive gas atmos-
619 sphere, other than mines susceptible to firedamp;
- 620 – Group III (which can be divided into subgroups): electrical equipment for places with an explosive dust atmos-
621 sphere.

622

623 **3.2.4**624 **hybrid mixture**

625 mixture of a flammable gas or vapour with a combustible dust

626 Note 1 to entry: According IEC 60079-10-2 the term “dust” is defined as including both dust and flyings.

627 **3.2.5**628 **maximum permissible surface temperature**629 highest temperature that a surface of electrical equipment is allowed to reach in practical service to avoid ignition
630631 Note 1 to entry: This definition does not apply to gases. The maximum permissible surface temperature will depend
632 upon the type of dust, whether as a cloud or layer, including layer thickness and the application of a safety factor
633 (see 7.3.8.3).634 **3.2.6**635 **zones**636 hazardous areas classified into zones based upon the frequency of the occurrence and duration
637 of an explosive atmosphere638 **3.2.7**639 **Zone 0**640 place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas or vapour is present continuously or for long periods or frequently
641642 **3.2.8**643 **Zone 1**644 place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas or vapour is likely to occur in normal operation occasionally
645646 **3.2.9**647 **Zone 2**648 place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas or vapour is not likely to occur in normal operation but, if it does
649 occur, will persist for a short period only
650651 **3.2.10**652 **Zone 20**653 area in which an explosive atmosphere in the form of a cloud of dust in air is present continuously, or for long periods or frequently
654655 **3.2.11**656 **Zone 21**657 area in which an explosive atmosphere in the form of a cloud of dust in air is likely to occur, occasionally, in normal operation
658659 **3.2.12**660 **Zone 22**661 area in which an explosive atmosphere in the form of a cloud of dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only
662

3.3 Flameproof enclosure

3.3.1

flameproof enclosure “d”

Type of Protection in which the parts capable of igniting an explosive gas atmosphere are provided with an enclosure which can withstand the pressure developed during an internal explosion of an explosive mixture and which prevents the transmission of the explosion to the explosive gas atmosphere surrounding the enclosure

3.3.2

pressure-piling

increased pressure resulting from an ignition, in a compartment or subdivision of an enclosure due to a gas mixture being pre-compressed, e.g. due to a primary ignition in another compartment or subdivision

Note 1 to entry: This may lead to a higher maximum pressure than would otherwise be expected.

3.4 Increased safety

3.4.1

increased safety “e”

Type of Protection applied to electrical equipment in which additional measures are applied so as to give increased security against the possibility of excessive temperatures and of the occurrence of arcs and sparks in normal service or under specified abnormal conditions

3.4.2

initial starting current

I_A

highest r.m.s. value of current absorbed by an a.c. motor at rest or by an a.c. magnet with its armature clamped in the position of maximum air gap, when supplied at the rated voltage and rated frequency

3.4.3

starting current ratio

I_A/I_N

ratio between initial starting current I_A and rated current I_N

3.4.4

time

t_E

time taken for an a.c. rotor or stator winding, when carrying the initial starting current I_A , to be heated up to the limiting temperature from the temperature reached in rated service at the maximum ambient temperature

3.5 Intrinsic safety

3.5.1

intrinsic safety “i”

Type of Protection based upon the restriction of electrical energy within the apparatus and of interconnecting wiring exposed to an explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects

3.5.2

associated apparatus

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

Note 1 to entry: Associated apparatus may be either:

- a. electrical equipment which has another Type of Protection listed in IEC 60079-0 for use in the appropriate explosive atmosphere, or
- b. electrical equipment not so protected and which, therefore, is not normally used within an explosive atmosphere, for example a recorder which is not itself in an explosive atmosphere, but is connected to a thermocouple situated within an explosive atmosphere where only the recorder input circuit is intrinsically safe.

3.5.3

intrinsically safe apparatus

electrical apparatus in which all the circuits are intrinsically safe

3.5.4

galvanic isolation

arrangement within an item of intrinsically safe apparatus or associated apparatus which permits the transfer of signals or power between two circuits without any direct electrical connection between the two

Note 1 to entry: Galvanic isolation frequently utilizes either magnetic (transformer or relay) or opto-coupled elements.

3.5.5

simple apparatus

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

3.5.6

intrinsically safe circuit

circuit in which any spark or any thermal effect produced in the conditions specified in IEC 60079-11, which include normal operation and specified fault conditions, is not capable of causing ignition of a given explosive atmosphere

Note 1 to entry: The circuit may also contain associated apparatus.

3.5.7

intrinsically safe electrical system

assembly of interconnected items of electrical equipment, described in a descriptive system document, in which the circuits or parts of circuits intended to be used in an explosive atmosphere are intrinsically safe

3.5.8

intrinsically safe sub-circuit

part of an intrinsically safe circuit which is galvanically isolated from another part or other parts of the same intrinsically safe circuit

3.6 Intrinsic safety parameters

3.6.1

maximum external inductance to resistance ratio

L_o/R_o

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

3.7 Pressurization

3.7.1

pressurization “p”

technique of guarding against the ingress of the external atmosphere into an enclosure by maintaining a protective gas therein at a pressure above that of the external atmosphere

3.7.2**continuous dilution**

continuous supply of a protective gas, after purging, at such a rate that the concentration of a flammable substance inside the pressurized enclosure is maintained at a value outside the explosive limits at any potential ignition source (that is, outside the dilution area)

Note 1 to entry: The dilution area is an area in the vicinity of an internal source of release where the concentration of a flammable substance is not diluted to a safe concentration.

3.7.3**leakage compensation**

flow of protective gas sufficient to compensate for any leakage from the pressurized enclosure and its ducts

3.7.4**static pressurization**

maintenance of an overpressure within a pressurized enclosure without the addition of protective gas in the hazardous area

3.8 Type of Protection “n”**3.8.1****Type of Protection “n”**

Type of Protection applied to electrical equipment such that, in normal operation and in certain specified abnormal conditions, it is not capable of igniting a surrounding explosive atmosphere

Note 1 to entry: Additionally, the requirements of the equipment standard are intended to ensure that a fault capable of causing ignition is not likely to occur.

Note 2 to entry: An example of a specified abnormal condition is a luminaire with a failed lamp.

3.8.2**energy-limited apparatus**

electrical equipment in which the circuits and components are constructed according to the concept of energy limitation

3.8.3**associated energy-limited apparatus**

electrical equipment which contains both energy-limited and non-energy-limited circuits and is constructed so that the non-energy-limited circuits cannot adversely affect the energy-limited circuits

3.9**oil-immersion “o”**

Type of Protection in which the electrical equipment or parts of the electrical equipment are immersed in a protective liquid in such a way that an explosive gas atmosphere which may be above the liquid or outside the enclosure cannot be ignited

3.10**powder filling “q”**

Type of Protection in which the parts capable of igniting an explosive gas atmosphere are fixed in position and completely surrounded by filling material to prevent the ignition of an external explosive atmosphere

Note 1 to entry: The Type of Protection may not prevent the surrounding explosive gas atmosphere from penetrating into the equipment and components and being ignited by the circuits. However, due to the small free volumes in the filling material and due to the quenching of a flame which may propagate through the paths in the filling material, an external explosion is prevented.

3.11**encapsulation “m”**

Type of Protection whereby parts that are capable of igniting an explosive atmosphere by either sparking or heating are enclosed in a compound in such a way that the explosive atmosphere cannot be ignited under operating or installation conditions

3.12**protection by enclosure “t”**

Type of Protection whereby all electrical equipment is protected by an enclosure to avoid ignition of a dust layer or cloud

3.13 Electrical supply systems**3.13.1****protective extra-low voltage system****PELV**

electric system in which the voltage cannot exceed the value of extra-low voltage:

- under normal conditions, and
- under single fault conditions, except earth faults in other electric circuits

[SOURCE: IEC 60050-826:2004, 826-12-32]

3.13.2**safety extra-low voltage system****SELV**

electric system in which the voltage cannot exceed the value of extra-low voltage:

- under normal conditions and
- under single fault conditions, including earth faults in other electric circuits

[SOURCE: IEC 60050-826:2004, 826-12-31]

3.14 Equipment**3.14.1****equipment, fixed**

equipment fastened to a support, or otherwise secured in a specific location when energized

3.14.2**equipment, transportable**

equipment not intended to be carried by a person during operation nor intended for fixed installation

3.14.3**equipment, portable**

equipment intended to be carried by a person during operation

Note 1 to entry: Portable equipment carried by a person during operation is sometimes referred to as hand-held equipment.

3.14.4**equipment, personal**

equipment intended to be supported by a person's body during normal use

3.15**radio frequency identification****RFID**

data collection technology that uses electronic tags for storing data

Note 1 to entry: The tag, also known as an “electronic label”, “transponder” or “type plate” is made up of an RFID chip attached to an antenna. Transmitting in the kilohertz, megahertz and gigahertz ranges, tags may be battery-powered or derive their power from the RF waves coming from the reader.

Note 2 to entry: This note applies to the French language only.

4 General

4.1 General requirements

Hazardous areas are classified into Zones 0, 1 and 2 for gases and vapours according to IEC 60079-10-1, and into Zones 20, 21 and 22 for dusts according to IEC 60079-10-2 in order to facilitate the selection of appropriate Ex Equipment and the design of suitable electrical installations.

Electrical equipment should, as far as is reasonably practicable, be located in non-hazardous areas. Where it is not possible to do this, it should be located as Ex Equipment in an area where an explosive atmosphere is least likely to occur.

Electrical installations in hazardous areas shall also comply with the appropriate requirements for electrical installations in non-hazardous areas. However, the requirements for non-hazardous areas are insufficient for installations in hazardous areas.

NOTE 1 Where cables could be subjected to dust layers then additional derating of current carrying capacity would apply according to relevant installation code for cables included in IEC 60364.

Where additional protection is required to meet other environmental conditions, for example, protection against ingress of water and resistance to corrosion the method used shall not adversely affect the integrity of the Ex Equipment.

Ex Equipment shall be installed and used within the electrical ratings for power, voltage, current, frequency, duty and such other characteristics where non-conformity might jeopardize the safety of the installation. Care shall be taken to ensure that the voltage and frequency are appropriate to the supply system with which the Ex Equipment is used and that the temperature classification has been established for the correct voltage, frequency and other parameters.

Ex Equipment for use in hazardous areas are commonly designed for IEC standard voltages according IEC 60038. If a supply voltage is outside of these standardized voltages, then Ex Equipment should be specially selected.

NOTE 2 IEC 60079-17 accepts for older installations the details for the equipment and installation requirements that applied at the date of the installation.

4.2 Particular requirements

All Ex Equipment and their wiring in hazardous areas shall be designed, selected and erected in accordance

- with Clause 6.1 for design, and
- with Clauses 7.1 to 7.3 for selection, and
- with Clauses 8.1 to 8.2 for erection, and
- with Clauses given in Table 1 for special types of equipment, and
- Table 2 for additional requirements for Type of Protections.

Table 1 – Clauses of this standard for requirements for special types of equipment

Type of equipment	Design	Selection	Erection
Cables and wiring systems	6.2	7.4	8.2
Conduits		7.6	8.4
Entry devices and other fittings	6.3	7.5	8.3

Luminaires and lamps		7.7	
Electrical machines	6.4	7.8	
Electrical heating systems	6.5		8.5
Plugs and socket outlets	6.6		
RFID tags	6.7		
Cells and batteries	6.8		
Gas detection equipment	6.9		
Transportable, portable and personal equipment	Annex J		

Table 2 – Clauses of this standard for additional requirements for Type of Protections

Type of Protection	Design	Selection	Erection
“d” – Flameproof Enclosure	6.10		8.6
“e” – Increased Safety	6.11		8.7
“i” – Intrinsic Safety	6.12		8.8
“m” – Encapsulation	6.13		8.9
“n” – Type of Protection “n”	6.14		8.7 and 8.10
“o” – Liquid Immersion (former: oil)	6.15		8.11
“op” – Optical Radiation			8.12
“p” – Pressurization	6.16		8.13
Pressurized Rooms	6.17		8.14
Analyser Houses	6.18		8.15
“q” – Powder Filling	6.19		8.16
“t” – Dust Protection by Enclosure			8.17

Installations should be designed, and Ex Equipment and materials should be installed with a view to providing ease of access for inspection and maintenance (IEC 60079-17).

In exceptional circumstances, it is only by the application of methods or conditions of control that the required degree of safety for hazardous areas can be obtained. Such methods may include the use of procedures and/or the use of monitoring devices, such as gas detectors, or pressure, temperature or flow devices. Depending on the degree and type of hazard involved, the associated conditions of control initiated by the monitoring device may include one of the following:

- (a) Automatic disconnection of the power supply.
- (b) Automatic initiation of an alarm followed by an associated manual procedure to restore the integrity of the system.
- (c) A manual procedure, whereby one or other of the parameters necessary for an explosive condition is retained under continuous control.

NOTE Conditions of control would apply where it is not practicable to comply with other requirements of this standard.

All the measures or conditions or control actions shall be documented according to Clause 5 by a competent body who:

- is familiar with the requirements for this, and any other relevant standards and codes of practice concerning the use of Ex Equipment and systems for use in hazardous areas, and,
- has access to all information necessary to carry out the assessment.

4.3 Conditions of Use

4.3.1 General

All markings (such as advisory markings, warning markings) and all information given on the name plate together with the related information given in the instructions of the Ex Equipment shall be considered during the design, selection and erection for the installation.

Only Ex Equipment having an Ex Equipment Certificate shall be installed.

4.3.2 Specific Conditions of Use

The symbol "X" is used to provide a means of identifying essential requirements for installation, use and maintenance of the Ex Equipment, contained in the Ex Equipment Certificate, called "Specific Conditions of Use". The applicable Specific Conditions of Use shall be considered during the design, selection and erection for the installation.

NOTE 1 Older certificates have used the term "Special Conditions for Safe Use" which is equivalent to the term "Specific Conditions of Use" currently used on Ex Equipment Certificates.

NOTE 2 In some cases, it is possible that the Specific Conditions of Use with the symbol "X" are replaced by advisory markings on the Ex Equipment with reference to a specific instruction document.

4.3.3 Use of Ex Components

Ex Components, such as empty enclosures or terminals, having only an Ex Component Certificate, for example marked with a "U", shall not be used in the hazardous area unless as part of an Ex Equipment, when these Ex Components inside of the Ex Equipment are permitted by a full Ex Equipment Certificate.

4.4 Static electricity

All requirements, information and guidance about the ignition source "static electricity" can be found in IEC TS 60079-32-1. The applicable requirements of IEC TS 60079-32-1 shall be considered for design, selection and erection of an electrical installation.

4.5 Optical radiation

All requirements, information and guidance about the "optical radiation" ignition source can be found in IEC 60079-28. The applicable requirements of IEC 60079-28 shall be considered for design, selection and erection of an electrical installation.

5 Documentation

5.1 General

It is necessary to ensure that any installation complies with the relevant certificates (see 5.3) as well as with this standard and any other requirements specific to the plant on which the installation takes place. To achieve this result, a verification dossier shall be prepared for every installation.

For any circumstances which require an additional assessment, the result of this assessment shall be documented in the verification dossier.

The verification dossier shall be kept as hard copy and in electronic form for the live time of the installation. Plant changes shall be recorded.

NOTE Methods accepted by legislation in each country can have an impact on the form in which the documentation will be legally accepted.

In order to correctly install or extend an existing installation, the following information, additional to that required for non-hazardous areas, is required as part of the verification dossier, where applicable:

5.2 Site

- area classification documents (see IEC 60079-10-1 and IEC 60079-10-2) with plans showing the classification and extent of the hazardous areas including the zoning (and maximum permissible dust layer thickness if the hazard is due to dust);

- optional assessment of consequences of ignition (see 7.3.5);
- where applicable, gas, vapour or dust classification in relation to the group or subgroup of the Ex Equipment;
- temperature class or ignition temperature of the gas or vapour involved;
- where applicable, the material characteristics including electrical resistivity, the minimum ignition temperature of the dust cloud, minimum ignition temperature of the dust layer and minimum ignition energy of the dust cloud;
- external influences and ambient temperature (see 7.3.2), including solar radiation;
- any use of conditions of control for exceptional circumstances
- evidence of competence for persons or parties who carry out design, selection, erection and initial inspection

5.3 Ex Equipment

- manufacturer's instructions for selection, installation and initial inspection;
- documents for Ex Equipment with Specific Conditions of Use ;
- descriptive system document for the intrinsically safe system (see 6.12.2.9);
- details of any relevant calculation or records of the routine test, for example for purging rates for instruments or analyser houses;
- manufacturer's/qualified person's declaration (see 5.5).

Consideration should be given to obtaining information for maintenance and repair to meet the requirements of IEC 60079-17 and IEC 60079-19 respectively.

5.4 Installation

- necessary information to ensure correct installation of the Ex Equipment provided in a form which is suitable to the personnel responsible for this activity (see IEC 60079-0, Instructions);
- documentation relating to the suitability of the Ex Equipment for the area and environment to which it will be exposed, for example temperature ratings, Type of Protection, IP rating, corrosion resistance;
- the plans showing types and details of wiring systems;
- records of selection criteria for cables, cable entry systems and conduits for compliance with the requirements for the particular Type of Protection;
- drawings and schedules relating to circuit identification;
- records of the initial inspection (see Clause 9).
- installer's/qualified person's declaration (see 5.5)

NOTE Records of inspection for assemblies or pre-installed items can be accepted as part of initial inspection records.

5.5 Personnel competency

The design of the installation, the selection of Ex Equipment and the erection covered by this standard shall be carried out only by persons whose training has included instruction on the various Types of Protection and installation practices, relevant rules and regulations and on the general principles of area classification. The competency of person(s) shall be relevant to the type of work to be undertaken. (see Annex A).

Appropriate continuing education or training shall be undertaken by personnel on an ongoing basis.

6 Design

6.1 General

The design of the installation shall meet the requirements described in this Clause. A verification dossier shall be prepared according Clause 5. The requirements of 6.1.10, 6.1.11 and 6.1.12 are not applicable to intrinsically safe and energy-limited circuits.

6.1.1 Equipment above hazardous areas (Design)

Special consideration shall be given to situations when equipment that is not explosion-protected and connecting electrical circuits that could become a source of ignition, or could produce hot particles or hot surfaces are located above a hazardous area. Such equipment that is not explosion-protected shall be either totally enclosed or provided with suitable guards or screens, to prevent it or hot particles from falling into the hazardous area.

Assessment shall take into account a possibility of such equipment that is not explosion-protected or its parts, including connecting electrical circuits, falling into the hazardous area and creating a source of ignition due to a damage or fault.

NOTE Such items include:

- switches, plugs and sockets, that could produce arcs, sparks or hot particles;
- motors or generators that have sliding contacts or brushes;
- heaters, heating elements or other equipment that could produce arcs, sparks or hot particles;
- auxiliary equipment such as ballasts, capacitors and starting switches for all types of discharge luminaires;
- all exposed lamps;
- all unsupported cables.

Low pressure sodium vapour discharge lamps shall not be installed above a hazardous area.

6.1.2 Circuits traversing a hazardous area

Where circuits traverse a hazardous area in passing from one non-hazardous area to another, the wiring system in the hazardous area shall be appropriate to the EPL requirements for the route.

6.1.3 Light metals as construction materials

If light metals are used as construction materials an ignition hazard assessment shall be conducted to show an acceptable level of safety. Particular consideration shall be given to the location of items that incorporate light metals in the external construction.

NOTE 1 Construction materials could include; cable trays, mounting plates, weather protection and enclosures.

NOTE 2 IEC 60079-0 requires that materials used in Group II installations for the identified Equipment Protection Levels shall not contain, by mass, more than:

- for EPL “Ga”
 - 10 % in total of aluminium, magnesium, titanium and zirconium, with no more than
 - 7,5 % in total of magnesium, titanium and zirconium;
- for EPL “Gb”
 - 7,5 % in total of magnesium, titanium and zirconium;
- for EPL “Gc”
 - no requirements except for moving parts such as; fan impellers, fan hoods and ventilating screens, which shall comply with the requirements for EPL Gb.

Materials used in Group III installations for the identified Equipment Protection Levels shall not contain, by mass, more than:

- for EPL “Da”
 - 7,5 % in total of magnesium, titanium and zirconium;
- for EPL “Db”
 - 7,5 % in total of magnesium, titanium and zirconium;
- for EPL “Dc”

- 1048 ○ no requirements except for moving parts such as; fan impellers, fan hoods and ventilating screens,
1049 which shall comply with the requirements for EPL Db.

1050 NOTE 3 These requirements recognise the ignition hazard due to dissimilar metal contact. Other metallic items
1051 such as walkways and ladders could also present a similar ignition hazard.

1052 **6.1.4 Danger from live parts**

1053 In order to avoid sparks liable to ignite the explosive atmosphere, the possible inadvertent con-
1054 tact with bare live parts other than single intrinsically safe or energy-limited parts shall be pre-
1055 vented.

1056 NOTE When more than one intrinsically safe circuit can be contacted at the same time the resultant spark could be
1057 ignition capable.

1058 **6.1.5 Danger from exposed and extraneous conductive parts**

1059 **6.1.5.1 General**

1060 The limitation of earth-fault currents (magnitude and/or duration) in frameworks or enclosures
1061 and the prevention of elevated potentials on equipotential bonding conductors are essential for
1062 safety.

1063 Although it is impracticable to cover all possible systems, the following applies to electrical
1064 systems, other than intrinsically safe or energy-limited circuits with voltages up to
1065 1 000 V a.c. r.m.s./1 500 V d.c.

1066 **6.1.5.2 TN type of system earthing**

1067 If a type of system earthing TN is used, it shall be type TN-S (with separate neutral N and
1068 protective conductor PE) in the hazardous area, for example the neutral and the protective
1069 conductor shall not be connected together, or combined in a single conductor, in the hazardous
1070 area. At any point of transition from TN-C to TN-S, the protective conductor shall be connected
1071 to the equipotential bonding system in the non-hazardous area.

1072 **6.1.5.3 TT type of system earthing**

1073 If a type of system earthing TT (separate earths for power system and exposed conductive
1074 parts) is used, then it shall be protected by a residual current device.

1075 NOTE Where the earth resistivity is high, such a system may not be acceptable.

1076 **6.1.5.4 IT type of system earthing**

1077 If a type of system earthing IT (neutral isolated from earth or earthed through an sufficiently
1078 high impedance) is used, an insulation monitoring device shall be provided to indicate the first
1079 earth fault.

1080 NOTE 1 If the first fault is not removed, a subsequent fault on the same phase will not be detected, possibly leading
1081 to a dangerous situation.

1082 NOTE 2 Local bonding, known as supplementary equipotential bonding, can be necessary (see IEC 60364-4-41).

1083 **6.1.5.5 SELV and PELV systems**

1084 Safety extra-low voltage systems (SELV) shall be in accordance with 414 of IEC 60364-4-41.
1085 Live parts of SELV circuits shall not be connected to earth, or to live parts or to protective
1086 conductors forming part of other circuits. Any exposed conductive parts may be unearthed or
1087 earthed (e.g. for electro-magnetic compatibility).

1088 Protective extra-low voltages systems (PELV) shall be in accordance with 414 of IEC 60364-4-
1089 41. PELV circuits are earthed. Any exposed conductive parts shall be connected to a common
1090 earthing (and potential equalization) system.

1091 Further information for safety isolating transformers for SELV and PELV can be found in
1092 IEC 61558-2-6.

1093 **6.1.5.6 Electrical separation**

1094 Electrical separation shall be in accordance with 413 of IEC 60364-4-41 for the supply of only
1095 one item of Ex Equipment.

1096 **6.1.6 Potential equalization**

1097 **6.1.6.1 General**

1098 Potential equalization is required for installations in hazardous areas. For TN, TT and IT sys-
1099 tems, all exposed and extraneous conductive parts shall be connected to the equipotential
1100 bonding system. The bonding system may include protective conductors, metal conduits, metal
1101 cable sheaths, steel wire armouring and metallic parts of structures, but shall not include neutral
1102 conductors. Connections shall be secure against self-loosening and shall minimise the possi-
1103 bility of corrosion which could reduce the effectiveness of connection.

1104 An internal earth continuity plate may be fitted, for example, to allow for use of metallic Cable
1105 Glands without the use of separate individual earthing tags. The material and dimensions of the
1106 earth continuity plate should be appropriate for the anticipated fault current.

1107 The armour or screens of cables may be earthed or unearthed in the hazardous area. If the
1108 armour or screens of cables are only earthed outside the hazardous area (e.g. in the control
1109 room) then:

- 1110 • this point of earthing shall be connected to the potential equalization system of the haz-
1111 arduous area;
- 1112 • in a TN system, the armour or screen in the hazardous area shall be treated like unused
1113 cores.

1114 NOTE The requirement for treating the armour or screens like unused cores is due to a possibility, that dangerous
1115 sparks could be created at the ending of the armour or screen.

1116 Exposed conductive parts need not be separately connected to the equipotential bonding sys-
1117 tem if they are firmly secured to and are in conductive contact with structural parts or piping
1118 which are connected to the equipotential bonding system. Extraneous conductive parts which
1119 are not part of the structure or of the electrical installation, for example frames of doors or
1120 windows, need not be connected to the equipotential bonding system, if there is no danger of
1121 voltage displacement.

1122 Cable Glands which incorporate clamping devices which clamp the braiding or armour of the
1123 cable can be used to provide equipotential bonding.

1124 The minimum size for bonding conductors for the main connection to a protective rail shall be
1125 6 mm² and supplementary connections shall be a minimum of 4 mm². Consideration should also
1126 be given to using larger conductors for mechanical strength.

1127 Metallic enclosures of intrinsically safe or energy-limited apparatus need not be connected to
1128 the equipotential bonding system, unless required by the Ex Equipment documentation or to
1129 prevent accumulation of static charge.

1130 Installations with cathodic protection shall not be connected to the equipotential bonding system
1131 unless the system is specifically designed for this purpose.

1132 Potential equalization between vehicles and fixed installations could require special arrange-
1133 ments, for example where insulated flanges are used to connect pipelines.

6.1.6.2 Temporary bonding

Temporary bonding includes earth connections that are made to moveable items such as drums, vehicles and portable Ex Equipment for control of static electricity or potential equalisation.

It is recommended that the final connection of a temporary bonding connection should be made either:

- in a non-hazardous area; or
- using a connection that meets the EPL requirements of the location; or
- using a documented procedure which reduces the hazard of sparking to an acceptable level.

For temporary bonding the resistance between metallic parts shall be less than 1 MΩ. This shall be ensured either by measuring or by monitoring of the value. Conductors and connections shall be durable, flexible and of sufficient mechanical strength to withstand in-service movement. Mechanical strength of the conductor shall be equivalent to at least 4 mm² copper, or shall be part of a flexible cabling system incorporating a monitoring and control system.

Consideration should be given to the use of a permanent monitoring system to demonstrate that the connection system is always below 1 MΩ.

6.1.7 Lightning protection

In the design of electrical installations, steps shall be taken to reduce to a safe level the effects of lightning (IEC 62305-3 Annex C is not an appropriate reference as the lightning protection does not cover the aspects of explosion protection – additional guidance is needed).

6.1.8 Electromagnetic radiation

6.1.8.1 General

In the design of electrical installations, steps shall be taken to reduce to a safe level the effects of electromagnetic radiation.

6.1.8.2 Radio frequency received and transmitted in hazardous areas

Ungrounded structures and antennas located in hazardous areas can act as receivers for transmissions from outside of the hazardous area. The threshold power of radio frequency (9 kHz to 60 GHz) received in the hazardous area for continuous transmissions and for pulsed transmissions whose pulse durations exceed the thermal initiation time shall not exceed the values shown in Table 3 - Radio frequency power thresholds. Programmable or software control intended for setting by the user shall not be permitted.

NOTE 1 The values in Table 3 would be of concern for high power transmitters located close to a hazardous area. Additional information on the application of higher power radiating sources for normal commercial signals at a distance from the plant can be found, in CLC/TR 50427. The results of the TR are based on far field conditions.

Table 3 – Radio frequency power thresholds

Ex Equipment for	Threshold power W	Thermal initiation time μs
Group IIA	6	100
Group IIB	3,5	80
Group IIC	2	20
Group III	6	200

For pulsed radar and other transmissions where the pulses are short compared with the thermal initiation time, the threshold energy values Z_{th} shall not exceed those given in Table 4.

1171

Table 4 – Radio-frequency energy thresholds

Ex Equipment for	Threshold energy Z_{th} μJ
Group IIA	950
Group IIB	250
Group IIC	50
Group III	1 500

1172 NOTE 2 In Table 3 and Table 4, the same values are applied for “Ga”, “Gb”, “Gc”, “Da”, “Db”, or “Dc” Ex Equipment
1173 due to the large safety factors involved.

1174 NOTE 3 In Table 3 and Table 4, the values apply in normal operation, provided that the user of the Ex Equipment
1175 does not have access to adjust the Ex Equipment to give higher values.

1176 NOTE 4 These requirements are derived from IEC 60079-0.

1177 **6.1.9 Cathodically protected metallic parts**

1178 **6.1.9.1 General**

1179 Cathodically protected metallic parts located in hazardous areas are live extraneous conductive
1180 parts which shall be considered potentially dangerous (especially if equipped with an impressed
1181 current system) despite their low negative potential. The insulating elements required for the
1182 cathodic protection, for example insulating elements in pipes, should if possible be located
1183 outside the hazardous area.

1184 Sacrificial cathodic protection systems could be regarded as inherently safe based on the very
1185 low voltages and low currents associated with such systems.

1186 No cathodic protection connection shall be provided in locations requiring EPL “Ga” or “Da”
1187 unless it is specially designed for this application.

1188 Surge protection devices shall be provided across insulating joints where there is a possibility
1189 of voltage differential. For example, pipe joints where there is a possibility of lightning induced
1190 voltages on one section of the pipe.

1191 In the absence of IEC standards on cathodic protection, national or other standards should also
1192 be followed.

1193 **6.1.9.2 Impressed current systems**

1194 Impressed current connections made to cathodically protected structures inside the hazardous
1195 area shall meet all of the following:

- 1196 – Use a cable lug of sufficient strength to provide a secure connection.
- 1197 – be connected to dedicated bolts that are not likely to be disturbed, including for any plant
1198 maintenance activities. This would preclude connection as part of other functions for exam-
1199 ple pipe flange bolts or bolts used for supports.
- 1200 – be wrapped in permanent sealing tape or other effective manner to prevent inadvertent con-
1201 tact, removal or damage.
- 1202 – be clearly labelled with signage near the connection warning the connection should not be
1203 disconnected or reconnected when the cathodic protection system is switched on.

1204 Signage or labelling shall be provided at the cathodic protection current source warning of con-
1205 nections in a hazardous area and that the system shall be turned off for any work in the haz-
1206 ardous area.

1207 Ex Equipment connected by cables onto cathodically protected metal shall be:

- 1208 – kept to a minimum, and,
- 1209 – be electrically insulated from the cathodically protected metal in a secure manner. For ex-
- 1210 ample, by use of insulating flanges for instrument connections.

1211 **6.1.10 Electrical protection**

1212 Overload protection for Ex Equipment is required if overload in use cannot be avoided. Lower
1213 values of disconnection time than those stated in IEC 60364-4-43 could be required for instal-
1214 lations in areas requiring EPL “Ga”, “Gb”, “Da” and “Db”.

1215 Precautions shall be taken to prevent operation of poly phase Ex Equipment where the loss of
1216 one or more phases can cause overheating to occur.

1217 Protection devices shall be either:

- 1218 a) such that auto-reclosing under fault conditions is prevented; or
- 1219 b) in circumstances where automatic disconnection of the Ex Equipment could introduce a
1220 safety risk which is more dangerous than that arising from the possibility of ignition
1221 alone, a warning alarm could be used as an alternative to automatic disconnection pro-
1222 vided that operation of the warning alarm is immediately apparent so that prompt reme-
1223 dial action will be taken.

1224 **6.1.11 Switch-off**

1225 Where switchgear includes a disconnecter, it shall disconnect all poles (see IEC 60947-1).

1226 For functional or emergency purposes, at (a) suitable point(s), there shall be a means of switch-
1227 ing off electrical supplies to the hazardous area.

1228 Ex Equipment which should continue to operate to prevent additional danger shall not be in-
1229 cluded and shall be on (a) separate circuit(s).

1230 NOTE The switching devices installed in the general switchgear are normally adequate with respect to switch-off
1231 facilities.

1232 Switch off should consider isolation of all circuit power supply conductors including the neutral.

1233 Suitable points for switch off should be assessed relevant to the site distribution, personnel on
1234 site and the nature of site operations.

1235 **6.1.12 Electrical isolation**

1236 A means of isolation shall be provided to isolate all live conductors, including the neutral, to
1237 allow electrical work to be carried out safely. Where all conductors are not isolated by the same
1238 device the means of isolation of other conductors shall be clearly identified.

1239 The preferred means of isolation is by a device that operates in all relevant conductors at the
1240 same time. The means of isolation could include fuses and neutral links where relevant.

1241 Labelling shall be provided immediately adjacent to each means of isolation to permit rapid
1242 identification of the circuit or group of circuits thereby controlled.

1243 There shall be effective measures or procedures to prevent the restoration of supply to the Ex
1244 Equipment whilst the possibility of exposing unprotected live conductors to an explosive atmos-
1245 phere continues.

6.2 Cables

6.2.1 Cable surface temperature

The surface temperature of cables shall not exceed the temperature limits i.e. temperature class or maximum surface temperature, for the installation. Further information on dust see 7.3.8.3

NOTE Where cables are identified as having a high operating temperature (e.g. 105 °C), this temperature relates to the copper temperature of the cable and not the cable sheath. Due to heat losses, it is unlikely that cable temperature will exceed T₆.

6.2.2 Overhead lines

Uninsulated conductors should not be installed in or above hazardous areas.

Where overhead wiring with uninsulated conductors provides power or communication services to a hazardous area, it shall be terminated in a non-hazardous area and the service continued into the hazardous area with cable or conduit.

NOTE Uninsulated conductors include items such as partially insulated crane conductor rail systems and low and extra-low voltage track systems.

6.3 Entry devices and other fittings

Entry devices and other fittings shall meet or exceed the IP rating of the Ex Equipment to which the entry devices or other fittings are connected.

6.4 Electrical machines

6.4.1 General

Electrical machines shall additionally be protected against overload unless it can withstand continuously the starting current at rated voltage and frequency or, in the case of generators, the short-circuit current, without inadmissible heating. The overload protective device shall be:

- a) a current-dependent, time lag protective device monitoring all three phases, set at not more than the rated current of the machine, which will operate in 2 h or less at 1,20 times the set current and will not operate within 2 h at 1,05 times the set current, or
- b) a device for direct temperature control by embedded temperature sensors, or
- c) another equivalent device.

For motors with Type of Protection “eb” or “ec” terminal boxes, when using converters, care should be taken to ensure that any overvoltage spikes and temperatures, which could occur in the terminal box, are taken into consideration.

In general, motors designed for continuous operation, involving easy and infrequent starts, which do not produce appreciable additional heating, are acceptable with inverse-time delay overload protection. Motors designed for arduous starting conditions or which are to be started frequently are acceptable only when suitable protective devices ensure that the limiting temperature is not exceeded.

Automatic reclosing (automatic restarting) is not recommended due to the increased possibility of rotor sparking or insulation system sparking during the reclosing. If a motor must be automatically restarted, additional protective measures such as a specifically timed re-closure to match phase, Type of Protection “p” or “d”, transient voltage limiting devices, etc. should be considered.

Operation: Where the duty of the motor is not S1 or S2 the user should obtain the appropriate parameters for the determination of suitability given a definition of operation.

6.4.2 Motors with Type of Protection “d” – Flameproof enclosures, “p” – Pressurized enclosures and “t” – Protection by enclosures

6.4.2.1 Motors with a converter supply

Motors supplied by a converter require that either:

- a) the motor has been type-tested for this duty as a unit in association with the converter specified in the descriptive documents according to IEC 60079-0 and with any protective device provided or specified, or
- b) if the motor has not been type-tested for this duty as a unit in association with the converter, then means (or Ex Equipment) for direct temperature control by embedded temperature sensors specified in the motor documentation or other effective measures for limiting the surface temperature of the motor housing shall be provided. The effectiveness of the temperature control shall take into account power, speed range, torque and frequency for the duty required and shall be verified and documented. The action of the protective device shall result in effectively stopping the current flowing through the motor windings. Control circuit intervention such as ceasing modulation, effectively stopping the current flow through the motor and any internal heat generation of the machine is acceptable. See Annex M for additional guidance.

NOTE 1 In some cases, the highest surface temperature occurs on the motor shaft.

NOTE 2 A current-dependent time lag protective device (in accordance with 6.4.1) is not regarded as an “other effective measure”.

6.4.2.2 Reduced-voltage starting (soft starting)

Motors with a soft start supply require that either:

- a) the motor has been type tested as a unit in association with the soft start device specified in the descriptive documents and with the protective device provided or specified, or
- b) if the motor has not been type tested as a unit in association with the soft start device, then means for direct temperature control by embedded temperature sensors specified in the motor documentation or other effective measures for limiting the surface temperature (in accordance with 6.4.1) of the motor housing shall be provided, or the speed control device ensures that the motor run up is such that the surface temperature is not exceeded. The effectiveness of the temperature control or proper run up shall be verified and documented. The action of the protective device shall result in effectively stopping current flowing through the motor windings. See Annex M for additional guidance.

NOTE It is considered that soft starting is used for a short time period.

6.4.3 Motors with Level of Protection “eb” – Increased safety

6.4.3.1 Mains supply-operated

In order to meet the requirements of 6.4.1 inverse-time delay overload protective devices shall be such that not only is the motor current monitored, but the stalled motor is disconnected within the time t_E stated on the marking plate. The current-time characteristic curves giving the delay time of the overload relay or release as a function of the ratio of the starting current to the rated current (I_A/I_N) shall be retained by the user.

The curves will indicate the value of the delay time from the cold state related to an ambient temperature of 20 °C and for a range of starting current ratios (I_A/I_N) of at least 3 to 10. The tripping time of the protective devices shall be equal to these values of delay $\pm 20\%$.

The properties of delta wound motors in the case of the loss of one phase should be specifically addressed. Unlike star wound motors, the loss of one phase could not be detected, particularly if it occurs during operation. The effect will be current imbalance in the lines feeding the motor and increased heating of the motor. A delta wound motor with a low torque load during start-up might also be able to start under this winding failure condition and therefore the fault could exist

undetected for long periods. Therefore, for delta wound motor, phase imbalance protection shall be provided which will detect motor imbalances before they can give rise to excessive heating effects.

Arduous starting conditions are considered to exist if an inverse-time delay overload protective device, correctly selected as above, disconnects the motor before it reaches its rated speed. Generally, this will happen if the total starting time exceeds $1,7 t_E$.

Starting: It is preferred that the direct-on-line starting time for the motor is less than the t_E time so that the motor protection device does not trip the motor during start-up. Where the starting time exceeds 80 % of the t_E time, the limitations associated with starting whilst maintaining operation within the machine instruction manual should be ascertained from the motor manufacturer.

As the voltage dips during a direct-on-line start, the starting current decreases and the run-up time increases. Although these effects could tend to cancel out for small voltage dips, for voltages less than 85 % of U_N during start-up, the motor manufacturer should declare the associated limitations on start-up.

Motors could be limited by the manufacturer to a fixed number of start attempts.

In addition to the requirements of 6.4.1, protection relays for machines in accordance with Level of Protection “eb” should:

- a) monitor the current in each phase, and,
- b) provide close overload protection to the fully loaded condition of the motor.

Inverse-time delay overload protection relays may be acceptable for motors of duty type S1 which have easy and infrequent starts. Where the starting duty is arduous or starting is required frequently, the protection device should be selected so that it ensures limiting temperatures are not exceeded under the declared operational parameters of the motor. Where the starting time exceeds $1,7 t_E$, an inverse-time relay would be expected to trip the motor during start-up.

NOTE Under some circumstances, for example for duty types other than S1, the motor may be provided with the temperature detection and protection. If this is the case, the t_E time may not be identified.

6.4.3.2 Winding temperature sensors

In order to meet the requirements of 6.4.1 winding temperature sensors associated with protective devices shall be adequate for the thermal protection of the motor even when the motor is stalled. The use of embedded temperature sensors to control the limiting temperature of the motor is only permitted if such use is specified in the motor documentation.

NOTE The type of built-in temperature sensors and associated protective device will be identified on the motor.

6.4.3.3 Machines with rated voltage greater than 1 kV

Machines with a rated voltage exceeding 1 kV shall be selected taking into account the values in Table E.1 of Annex E. If the total sum of the risk factors is greater than 6, special measures shall be employed to ensure that the enclosure does not contain an explosive gas atmosphere at the time of starting.

NOTE 1 If the machine is intended to operate under “special measures”, the Ex Equipment Certificate will have the symbol “X” suffix in accordance with IEC 60079-0.

NOTE 2 Special measures could include pre-start ventilation, the application of fixed gas detection inside the machine or other methods specified in the manufacturer’s instructions.

NOTE 3 For all Ex “e” motors above 1 kV, manufactured according to the latest IEC 60079-7 standards, the stators will have been type tested in a gas environment and fitted with anti-condensation heaters.

6.4.3.4 Motors with converter supply

- a) Motors supplied by a converter shall have been type tested for this duty in association with the converter and the protective device. The motor should be used within its electrical rating and the converter configuration should be set to match the motor rating information with respect to frequency range and any other specified parameters such as minimum carrier frequency. The converter configuration shall enable to adjust the parameter. or
- b) The motor is type tested for converter operation, but the type and manufacturer of the converter is not specified. In this case, the properties of the selected converter, the maximum converter input voltage and the converter settings must comply with the specifications in the type test certificate of the motor. The device for direct temperature monitoring must also comply with the information in the type test certificate of the motor. The temperature monitoring device shall be type-tested. The action of the protective device shall result in effectively stopping current flowing through the motor windings. Control circuit intervention such as ceasing modulation, effectively stopping the current flow through the motor and stopping any internal heat generation of the machine is acceptable. See Annex M for additional guidance.

NOTE 1 Permanent magnet motors operate as a generator while coasting after power is removed. For motors of Level of Protection “eb”, where the voltage can be greater than the rated voltage, the motor-converter system will be suitable for the voltages that will result.

NOTE 2 The type of built-in temperature sensors and associated protective device will be identified on the motor.

6.4.3.5 Reduced-voltage starting (soft starting)

Motors with a soft start supply require either:

- a. the motor has been type tested as a unit in association with the soft start device specified in the descriptive documents and with the protective device provided, or
- b. if the motor has not been type tested as a unit in association with the soft start device, then, means for direct temperature control by embedded temperature sensors specified in the motor documentation or other effective measures for limiting the temperature of the motor shall be provided or the speed control device ensures that the motor run up is such that the temperature is not exceeded. The effectiveness of the temperature control or proper run up shall be verified and documented. The action of the protective device shall result in effectively stopping current flowing through the motor windings. See Annex M for additional guidance.

NOTE It is considered that soft starting is used for a short time period during acceleration.

6.4.4 Motors with Level of Protection “ec” or “nA”**6.4.4.1 Motors with converter supply**

Motors supplied by a converter require that either:

- a. the motor has been type tested, in accordance with IEC 60079-7 or IEC 60079-15, with the specific converter or with a comparable converter in reference to the output voltage and current specifications, or
- b. if the motor has not been type tested for this duty as a unit in association with the converter, then means for direct temperature control by embedded temperature sensors specified in the motor documentation or other effective measures for limiting the temperature of the motor shall be provided. The effectiveness of the temperature control taking into account power, speed range, torque and frequency for the duty required shall be verified and documented. The action of the protective device shall result ineffectively stopping the current flowing through the motor windings. Control circuit intervention such as ceasing modulation, effectively stopping the current flow through the motor and stopping any internal heat generation is acceptable See Annex M for additional guidance.
- c. Alternatively, the motor shall have its temperature class determined by calculation in accordance with IEC 60079-7.

6.4.4.2 Reduced-voltage starting (soft starting)

Motors with a soft start supply require either:

- a. the motor has been type tested as a unit in association with the soft start device specified in the descriptive documents and with the protective device provided, or
- b. if the motor has not been type tested as a unit in association with the soft start device, then means for direct temperature control by embedded temperature sensors specified in the motor documentation or other effective measures for limiting the surface temperature of the motor shall be provided, or the speed control device ensures that the motor run up is such that the surface temperature is not exceeded. The effectiveness of the temperature control or proper run up shall be verified and documented. The action of the protective device shall result in effectively stopping the current flowing through the motor windings. See Annex M for additional guidance.

NOTE It is considered that soft starting is used for a short time period.

6.4.4.3 Machines with rated voltage greater than 1 kV

Machines with a rated voltage exceeding 1 kV shall be selected taking into account the values of Annex E). For motors rated more than 100 kW and with duty types S3, S4, S5, S7, S8 or S10, if the total sum of the risk factors is greater than 6, special measures shall be employed to ensure that the enclosure does not contain an explosive gas atmosphere at the time of starting.

For machines in accordance to IEC 60079-15 Ed.3 and older if the sum of the risk factors is greater than 6, then anti-condensation space heater shall be employed, or special measures shall be applied to ensure that the enclosure does not contain an explosive gas atmosphere at the time of starting. Alternatively, the machine is type-tested under explosive atmospheres.

NOTE 1 If the machine is intended to operate under "special measures", the Ex Equipment Certificate will have the symbol "X" suffix in accordance with IEC 60079-0.

NOTE 2 Special measures could include pre-start ventilation, the application of fixed gas detection inside the machine or other methods specified in manufacturer's instructions.

6.4.5 Switching motors above 1kV**6.4.5.1 General**

Switching overvoltages can occur if vacuum circuit breakers or vacuum contactors are used, and switching transients known as multiple restrikes can occur when the high voltage motor is switched off. These transients depend on various installations system and design factors, such as:

- arc-extinguishing principle of the contactor or switch;
- size of the motor;
- length of the power supply cable;
- system capacitance, and other factors.

In some cases, multiple restrikes can result in switching overvoltages which are too high for the insulation of the motor stator winding leading to insulation deterioration and incendive sparks. In practice, this generally occurs when high-voltage motors with starting currents $I_A > 600$ A are disconnected during startup or during a stalled or overload condition.

Vacuum circuit breakers or vacuum contactors are commonly associated with high voltage transients. Surge suppressors should be installed in the switchgear, between the circuit breaker and the motor cable termination, for each of the three conductors to ground.

1475 The peak voltages which arise as a result can damage the winding insulation, which can lead
1476 to insulation deterioration and incendive sparks. If vacuum circuit breakers or vacuum contac-
1477 tors are used for motor switching, the motor installation design should consider using an appro-
1478 priate surge suppressor, such as a zinc oxide varistor with spark gap.

1479 NOTE This starting current limit corresponds to the following upper power limits, depending on the relationship
1480 between the starting current I_A and rated current I_N and on the voltage dip (up to approximately 20 %) while the
1481 motor is starting up:

- 1482 - approximately 750 kW for motors supplied at up to 3,0 kV;
- 1483 - approximately 1 500 kW for motors supplied at up to 6,0 kV;
- 1484 - approximately 2 500 kW for motors supplied at up to 10,0 kV.

1485 **6.4.5.2 Overvoltages resulting from switching operations**

1486 Regardless of the motor size and the arc-extinguishing principle of the switch being used (e.g.
1487 even in the case of oil-free, SF₆ or air break switches), the following should be kept in mind
1488 when commissioning high-voltage motors/switchgear for high-voltage motors from 3 kV to
1489 13,8 kV.

1490 Shutting down the motor during startup can cause overvoltages. This can damage the motor
1491 and cause incendive sparks inside the motor enclosure and main terminal box. Precautions
1492 should be taken to avoid shutting down the motor during startup, for instance, it should be
1493 checked for errors in the starting control or for excessively sensitive protection settings. Shut-
1494 downs during startup, for checking the direction of rotation or other tests should be kept to an
1495 absolute minimum.

1496 **6.5 Electric heating systems**

1497 **6.5.1 General**

1498 Electric heating systems can be:

- 1499 – liquid immersion heater; or
- 1500 – process gas heater; or
- 1501 – air heater; or
- 1502 – trace heating systems.

1503 **6.5.2 Earth fault protection**

1504 Electric heating systems shall have the following protection in addition to overcurrent protection
1505 unless it is installed as part of other Ex Equipment, for example electric motor anti-condensation
1506 heater:

- 1507 a) For TT or TN type systems, a residual current device (RCD) with a rated residual operating
1508 current not exceeding 100 mA shall be used in addition to the protection required by 6.1.10.

1509 NOTE 1 This requirement is applied in order to limit the heating effect due to earth-fault and earth-leakage
1510 currents.

1511 Preference should be given to RCDs with a rated residual operating current of 30 mA.

1512 NOTE 2 Additional information on RCDs is given in IEC 61008-1.

- 1513 b) For an IT type system, an insulation monitoring device shall be used to disconnect the sup-
1514 ply whenever the insulation resistance is not greater than 50 ohms per volt of rated voltage.

1515 NOTE 3 For trace heating circuits, the circuit resistance can limit the short circuit current which could prevent
1516 satisfactory operation of the short circuit protective device.