

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Explosive atmospheres –
Part 14: Electrical installations design, selection and erection**

**Atmosphères explosives –
Partie 14: Conception, sélection et construction des installations électriques**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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EXPLOSIVE ATMOSPHERES –

Part 14: Electrical installations design, selection and erection

INTERPRETATION SHEET 1

This interpretation sheet has been prepared by subcommittee 31J: Classification of hazardous areas and installation requirements, of IEC technical committee 31: Equipment for explosive atmospheres.

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

ISH	Report on voting
31J/268/ISH	31J/270/RVD

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

INTERPRETATION SHEET

Interpretation sheet for IEC 60079-14:2013, Explosive atmospheres – Part 14: Electrical installations design, selection and erection

Following decision No 1 of the SC 31J meeting in Frankfurt in 2016, the issuing of an Interpretation Sheet for IEC 60079-14:2013 was requested, in order to clarify the issues relating to the installation of the converter supply or reduced voltage starting of electric motors.

Details of interpretation:

Interpretation of sub clauses 11.2.1 b), 11.2.2 b), 11.3.5 b), 11.4.1 b) 11.4.2 b), 11.5.1 b), 11.5.2 b), 11.6.1 b) and 11.6.2 b) for Motors with converter supply or reduced voltage starting

The motor has not been type-tested for this duty as a unit in association with the converter. In this case, means (or 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 consideration power, speed range, torque and frequency for the duty required and shall be verified and documented. ***The action of the protective device shall cause the motor to be electrically disconnected.***

Question

Is physical disconnection, such as a switch (circuit breaker) or contactor, required to accomplish the intent of this requirement ?

Interpretation

The intention of this requirement is to protect the machine from excessive surface temperatures.

Any action within the control circuit for the motor that accomplishes one of the following satisfactorily meets the intent of this requirement:

- direct physical disconnection resulting in no output voltage to the motor, or,
- control circuit intervention such as ceasing modulation, resulting in the motor not operating.

NOTE In this case, voltage to a motor may still exist, but the motor does not operate.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

IEC 60079-14 Edition 5.0 2013-11

EXPLOSIVE ATMOSPHERES –

Part 14: Electrical installations design, selection and erection

INTERPRETATION SHEET 2

This interpretation sheet has been prepared by subcommittee 31J: Classification of hazardous areas and installation requirements, of IEC technical committee 31: Equipment for explosive atmospheres.

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

DISH	Report on voting
31J/302/DISH	31J/303/RVDISH

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

Background

With changes to the Type of Protection designations in the IEC 60079 Series, a number of these Type of Protection designations are not identified in the current edition of IEC 60079-14. This may create confusion for end users regarding the correct application of equipment with these Types of Protection.

Question

How should equipment be marked with new Type of Protection designations be handled in accordance with IEC 60079-14?

Interpretation

Equipment marked with new Type of Protection designations shall be applied in accordance with IEC 60079-14 requirements based on the following points and IEC 60079-14:2013, Table 2.

- Ex "eb" should be treated as equivalent to Ex "e"
- Ex "ec" should be treated as equivalent to Ex "nA"
- Ex "db" should be treated as equivalent to Ex "d"
- Ex "dc" requirements should be based on Ex "d" requirements but is only suitable for EPL Gc
- Ex "ob" should be treated as equivalent to Ex "o"
- Ex "oc" requirements should be based on Ex "o" requirements but is only suitable for EPL Gc

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EXPLOSIVE ATMOSPHERES –**Part 14: Electrical installations design, selection and erection**

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 fifth edition cancels and replaces the fourth edition published in 2007. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

Explanation of the significance of the changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
Introduction of initial inspection	Scope		X	
Introduction of definition "electrical equipment"	3.1.3	X		
Introduction of definition "hybrid mixture"	3.2.4		X	
Note added to the definition "associated apparatus"	3.5.2	X		
Introduction of definition "radio frequency identification"	3.15	X		
List for documents improved and extended: site, equipment, installation and personnel	4.2	X		
New subclause for initial inspection	4.3		X	
Specific requirements given in this standard based on the current edition of the IEC standards in the IEC 60079 series.	4.4.1.2	X		
New selection criteria for radiating equipment according to IEC 60079-0	5.7		X	
New selection criteria for ultrasonic equipment according to IEC 60079-0	5.8		X	
Specific requirements for cells and batteries used in transportable, portable and personal equipment aligned with IEC 60079-11	5.10			C1
New structure for the selection of rotating electrical machines	5.11	X		
New selection criteria for cells and batteries	5.14		X	
New selection criteria for radio frequency identification tags	5.15		X	
New selection criteria for gas detection equipment	5.16		X	
The requirements for material composition of metallic installation material aligned with the requirements for light metal according to IEC 60079-0	6.1		X	
Above hazardous area, the restriction of 3,5 m deleted	6.3.7	X		
New structure of the requirements for static electricity according to IEC 60079-0 added	6.5		X	
New requirements for electromagnetic radiation in accordance with IEC 60079-0	6.7		X	
Improvement of the text for cables, cables for fixed and flexible cables for fixed installation for easier reading	9.3.1 9.3.2 9.3.3	X		
New structure of the requirements for cable entry system and blanking elements with subclauses	10			
– General	10.1			
– Connections of cables to equipment	10.2			
– Selection of cable glands with the new Table 10	10.3			
– Additional requirements for cable glands other than Ex "d", Ex "t" or Ex "nR"	10.4			
– Additional requirements for Ex "d"	10.5			
– Additional requirements for Ex "t"	10.6			
– Additional requirements for Ex "t"	10.7			
– Additional requirements for Ex "nR"	10.8			
New structure for the requirements for rotating electrical machines for all types of protections	11		X	

Explanation of the significance of the changes	Clause	Type		
		Minor and editorial changes	Extension	Major technical changes
New structure for the requirements for electric heating systems including temperature monitoring, limiting temperature, safety device and additional requirements for electrical heat tracing system	13		X	
New subclause to limit the dissipation power of terminal boxes as a function of the numbers of wire in relation to the cross-section and the permissible continuous current with an example	15.4		X	
Improvement of the text for simple apparatus with its definition, limits and the variation in maximum power dissipation based on the ambient temperature and an alternative equation to calculate the max. surface temperature.	16.4		X	
New requirements for terminal boxes if containing more than one intrinsically safe circuit to avoid short-circuits between independent intrinsically safe circuits	16.5			C2
Improvement of the text for terminal boxes with non-intrinsically and intrinsically safe circuits	16.5.4	X		
New subclause for pressurized rooms and analyser houses	17.4		X	
New clause for optical radiation	22		X	
New annex for initial inspection with the equipment specific inspection schedule for all types of protections	Annex C		X	
New annex for electrical installations in extremely low ambient temperature	Annex D		X	
New annex for the restricted migration of gas through cables	Annex E		X	
New annex for installation of electrical trace heating systems	Annex F		X	
New annex for the requirements for type of protection "op" – Optical radiation	Annex K		X	
New annex for hybrid mixtures	Annex M		X	

Explanation of the types of significant changes:	
A) Definitions	
1. Minor and editorial changes:	– Clarification – Decrease of technical requirements – Minor technical change – Editorial corrections
These are changes which modify requirements in an editorial or a minor technical way. They include changes of the wording to clarify technical requirements without any technical change, or a reduction in the level of existing requirement.	
2. Extension:	– Addition of technical options
These are changes which add new or modify existing technical requirements, in a way that new options are given, but without increasing the requirements for the design, selection and erection of existing installations that are fully compliant with the previous standard. Therefore, these will not have to be considered for existing installations in conformity with the preceding edition.	
3. Major technical changes:	– Addition of technical requirements – Increase of technical requirements
These are changes to technical requirements (addition, increase of the level or removal) made in a way that an existing installation in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition. These changes have to be considered for existing installations in conformity with the preceding edition, for which additional information is provided in B) below. These changes represent the latest state-of-the-art technology. However, these changes should not normally have an influence on existing installations.	
B) Information about the background of “major technical changes”	
C1 Due to the risk of gassing producing hydrogen from all cell types, adequate provision for venting is required as the gassing can create an explosive condition in small enclosures. This condition would apply to torches, multi meters, pocket gas sensors and similar items. Alternatively, where the equipment meets the requirements for Equipment Group IIC, the requirement of degassing apertures or limitation of hydrogen concentration does not apply. C2 An individual intrinsically safe circuit is also safe under short-circuit conditions. The short-circuit between two independent intrinsically safe circuits is not considered. Therefore the terminal boxes have to meet additional requirements for IP rating as well for the mechanical impact to make sure that the integrity of the enclosure is given also under worst case conditions.	

The text of this standard is based on the following documents:

FDIS	Report on voting
31J/225/FDIS	31J/230/RVD

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

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

A list of all parts of the IEC 60079 series, under the general title *Explosive atmospheres*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

The contents of the corrigendum of January 2016, interpretation sheet 1 of February 2017 and interpretation sheet 2 of March 2020 have been included in this copy.

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

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 are part of the process of hazardous area classification.

Mitigation involves, for example:

- 1) reducing the number of people exposed;
- 2) providing measures to avoid the propagation of an explosion;
- 3) providing explosion pressure relief;
- 4) providing explosion pressure suppression; and
- 5) 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 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 electrical equipment in less hazardous or non-hazardous areas.

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

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 electrical 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. In electrical equipment, potential ignition sources include electrical arcs and sparks, hot surfaces and frictional sparks.

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:
 - are contained in an enclosure which adequately prevents the ingress of dust, or
 - 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.

Several types of protection are available for electrical equipment in hazardous areas (see IEC 60079-0), and this standard gives the specific requirements for design, selection and erection of electrical installations in explosive atmospheres.

This part of the IEC 60079 series is supplementary to other relevant IEC standards, for example IEC 60364 series as regards electrical installation requirements. This part also refers to IEC 60079-0 and its associated standards for the construction, testing and marking requirements of suitable electrical equipment.

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

In any industrial installation, irrespective of size, there may be numerous sources of ignition apart from those associated with electrical equipment. Precautions may be necessary to ensure safety from other possible ignition sources, but guidance on this aspect is outside the scope of this standard.

EXPLOSIVE ATMOSPHERES –

Part 14: Electrical installations design, selection and erection

1 Scope

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

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

The requirements of this standard apply only to the use of equipment under standard atmospheric conditions as defined in IEC 60079-0. For other conditions, additional precautions may be necessary, and the equipment should be certified for 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 equipment i.e.

- 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 equipment including fixed, portable, transportable and personal, and installations, permanent or temporary.

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.

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 M.

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 may 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 60034-1, *Rotating electrical machines – Part 1: Rating and performance*

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

IEC 60079 (all parts), *Explosive atmospheres*

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

IEC 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

IEC 60079-6, *Explosive atmospheres – Part 6: Equipment protection by oil immersion "o"*

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

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of areas - Explosive gas atmospheres*

IEC 60079-10-2, *Explosive atmospheres – Part 10-2: Classification of areas – Combustible dust atmospheres*

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

IEC 60079-13, *Explosive atmospheres – Part 13: Equipment protection by pressurized room "p"*

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

IEC/TR 60079-16, *Electrical apparatus for explosive gas atmospheres – Part 16: Artificial ventilation for the protection of analyzer(s) houses*

IEC 60079-17, *Explosive atmospheres – Part 17: Electrical installations inspection and maintenance*

IEC 60079-18, *Explosive atmospheres – Part 18: Equipment protection by encapsulation "m"*

IEC 60079-19, *Explosive atmospheres – Part 19: Equipment repair, overhaul and reclamation*

IEC 60079-26, *Explosive atmospheres – Part 26: Equipment with equipment protection level (EPL) "Ga"*

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

IEC 60079-30-1, *Explosive atmospheres – Part 30-1: Electrical resistance trace heating – General and testing requirements*

IEC 60243-1, *Electrical strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60950 (all parts), *Information technology equipment – Safety*

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

IEC 61285, *Industrial process control – Safety of analyser houses*

IEC 61558-2-6, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers*

IEC 62305-3:2010, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

3 Terms and definitions

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

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

3.1 General

3.1.1

competent body

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

3.1.2

verification dossier

set of documents showing the compliance of electrical equipment and installations

3.1.3

electrical equipment

items applied as a whole or in part for the utilization of electrical energy

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

3.2 Hazardous areas

3.2.1

hazardous area

area in which an explosive atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment

Note 1 to entry: For the purposes of this standard, an area is a three-dimensional region or space.

3.2.2

non-hazardous area

area in which an explosive atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of equipment

3.2.3

group <of electrical equipment for explosive atmospheres>

classification of electrical equipment related to the explosive atmosphere for which it is to be used

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

- Group I: electrical equipment for mines susceptible to firedamp;
- Group II (which can be divided into subgroups): electrical equipment for places with an explosive gas atmosphere, other than mines susceptible to firedamp (see 5.5);
- Group III (which can be divided into subgroups): electrical equipment for places with an explosive dust atmosphere (see 5.5).

3.2.4

hybrid mixture

mixture of a flammable gas or vapour with a combustible dust

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

3.2.5

maximum permissible surface temperature

highest temperature that a surface of electrical equipment is allowed to reach in practical service to avoid ignition

Note 1 to entry: This definition does not apply to gases. The maximum permissible surface temperature will depend upon the type of dust, whether as a cloud or layer, including layer thickness and the application of a safety factor (see 5.6.3).

3.2.6

zones

hazardous areas classified into zones based upon the frequency of the occurrence and duration of an explosive atmosphere

3.2.7

Zone 0

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

3.2.8

Zone 1

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

3.2.9

Zone 2

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 occur, will persist for a short period only

3.2.10

Zone 20

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

3.2.11

Zone 21

area in which an explosive atmosphere in the form of a cloud of dust in air is likely to occur, occasionally, in normal operation

3.2.12

Zone 22

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

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

fixed

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

3.14.2

transportable

equipment not intended to be carried by a person nor intended for fixed installation which can be moved when energized

3.14.3

portable

equipment intended to be carried by a person which can be moved when energized

3.14.4

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 electrical 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 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.

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

Products 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 equipment should be specially selected and certified.

All electrical equipment and wiring in hazardous areas shall be selected and installed in accordance with Clauses 5 to 13 inclusive and the additional requirements for the particular type of protection (Clauses 14 to 23).

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

Equipment and systems used in exceptional circumstances, for example research, development, pilot plant where explosion protected equipment is not available, need not meet the requirements of this standard, provided that the installation is under the supervision of a competent body and one or more of the following conditions, as appropriate, are met:

- measures are taken to ensure that an explosive atmosphere does not occur; or
- measures are taken to ensure that this equipment is disconnected before an explosive atmosphere occurs, in which case ignition after disconnection, e.g. due to heated parts, shall be prevented also; or
- measures are taken to ensure that persons and the environment are not endangered by fires or explosions.

In addition, the measures or conditions or control shall be documented by a competent body who:

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

4.2 Documentation

It is necessary to ensure that any installation complies with the relevant equipment certificate (see also Clause 5) 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 and shall be either kept on the premises or stored in another location. In the latter case, a document shall be left on the premises indicating who the owner or owners are and where that information is kept, so that when required, copies may be obtained.

NOTE The verification dossier can be kept as hard copy or in electronic form. 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:

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 5.3);
- where applicable, gas, vapour or dust classification in relation to the group or subgroup of the electrical 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 5.9).

EQUIPMENT

- manufacturer's instructions for selection, installation and initial inspection;
- documents for electrical equipment with conditions of use, e.g. for equipment with certificate numbers which have the suffix "X";
- descriptive system document for the intrinsically safe system (see 16.2.4.2);

- details of any relevant calculation, e.g. for purging rates for instruments or analyser houses;
- manufacturer's/qualified person's declaration (see 4.4.2).

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

INSTALLATION

- necessary information to ensure correct installation of the 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 equipment for the area and environment to which it will be exposed, e.g. temperature ratings, type of protection, IP rating, corrosion resistance;
- the plans showing types and details of wiring systems;
- records of selection criteria for cable entry systems for compliance with the requirements for the particular type of protection;
- drawings and schedules relating to circuit identification;
- records of the initial inspection (Annex C).
- installer's/qualified person's declaration (see 4.5)

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

4.3 Initial inspection

Equipment shall be installed in accordance with its documentation. It shall be ensured that replaceable items are of the correct type and rating. On completion of the erection and prior to first use, initial detailed inspection of the equipment and installation shall be carried out in accordance with Annex C, which is based on the "detailed" grade of inspection in IEC 60079-17.

NOTE IEC 60079-17 includes further information relevant to the initial inspection.

4.4 Assurance of conformity of equipment

4.4.1 Equipment with certificates according to IEC standards

4.4.1.1 General

Equipment with certificate according to the IEC 60079 series or the IEC 61241 series, meets the requirements for hazardous areas, when selected and installed in accordance with this standard.

4.4.1.2 IEC standards

The requirements given in this standard are based on the current editions of the IEC standards in the IEC 60079 series. If equipment is not certified in accordance with current editions of the IEC 60079 series it may not be compatible with the requirements given in this standard. It may be required that additional measures should be applied to ensure safe operation.

NOTE Information about the current editions of IEC standards, either for product safety or for equipment for explosive atmospheres, can be found on the IEC website. Information about the changes related to the previous editions is given in the foreword of the standards.

4.4.2 Equipment without certificates according to IEC standards

Apart from simple apparatus used within an intrinsically safe circuit, the selection of equipment for use in a hazardous area, which either has no certificate at all or it has a

certificate but not in accordance with one of the standards listed in 4.4.1, shall be restricted to circumstances where equipment with suitable certification is not obtainable. The justification for the use of such equipment, along with the installation and marking requirements, shall be made by the user, manufacturer or third party and be recorded in the verification dossier. The following requirements of this standard, under these conditions, may not be applicable.

4.4.3 Selection of repaired, second hand or existing equipment

When it is intended that existing, second hand or repaired equipment is to be installed in a new installation, it shall only be reused if:

- it can be verified that the equipment is unmodified and is in a condition that meets the content of the original certificate (including any repair or overhaul). If there is doubt that the equipment is unmodified the original manufacturer should be contacted,
- any changes to equipment standards relevant to the item considered do not require additional safety precautions, and
- the basis used for the certification of that product does not conflict with the requirements given in this standard.

The act of introducing equipment where specifications are not identical to an existing installation may cause that installation to be deemed “new”.

In the situation where equipment is dual certified (e.g. as intrinsically safe apparatus and independently as flameproof equipment) care should be taken that the type of protection used for its new intended location has not been compromised by the way in which it was originally installed and subsequently maintained. Different protection concepts have different maintenance requirements. In the above example: equipment originally installed as flameproof should only be used as flameproof unless it can be verified that there has been no damage to the safety components within the intrinsically safe circuit on which safety depends by, for example, an over-voltage at the supply terminals or if it was originally installed as intrinsically safe then a check is required to ensure that there has been no damage to the flame paths before it can be used as flameproof.

4.5 Qualifications of personnel

The design of the installation, the selection of 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 the person 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 a regular basis.

NOTE Competency can be demonstrated in accordance with a training and assessment framework relevant to national regulations or standards or user requirements.

5 Selection of equipment

5.1 Information requirements

In order to select the appropriate electrical equipment for hazardous areas, the following information is required:

- classification of the hazardous area including the equipment protection level requirements where applicable;
- where applicable, gas, vapour or dust classification in relation to the group or subgroup of the electrical equipment;
- temperature class or ignition temperature of the gas or vapour involved;

- minimum ignition temperature of the dust cloud and minimum ignition temperature of the dust layer;
- intended application of the equipment;
- external influences and ambient temperature.

It is recommended that the equipment protection levels (EPL) requirements are recorded on the area classification drawing. This should also apply even if consequences have not been subjected to risk assessment (see 5.3).

5.2 Zones

Hazardous areas are classified into zones. Zoning does not take account of the potential consequences of an explosion.

NOTE Editions of this standard prior to IEC 60079-14: 2007 (edition 4) allocated types of protection to zones, on a statistical basis such that where there was a more frequent probability of the occurrence of an explosive atmosphere, then a greater level of safety against the possibility of an ignition source was applied.

5.3 Relationship between equipment protection levels (EPLs) and zones

Where only the zones are identified in the area classification documentation, then the relationship between EPLs and zones from Table 1 shall be followed.

Table 1 – Equipment protection levels (EPLs) where only zones are assigned

Zone	Equipment protection levels (EPLs)
0	“Ga”
1	“Ga” or “Gb”
2	“Ga”, “Gb” or “Gc”
20	“Da”
21	“Da” or “Db”
22	“Da”, “Db” or “Dc”

Where the EPLs are identified in the area classification documentation, those requirements for selection of the equipment shall be followed.

As an alternative to the relationship given in Table 1 between EPLs and zones, EPLs can be determined on the basis of a risk, i.e. taking into account the consequences of an ignition. This may, under certain circumstances, require a higher EPL or permit a lower EPL than that defined in Table 1. Refer to IEC 60079-10-1 and IEC 60079-10-2.

5.4 Selection of equipment according to EPLs

5.4.1 General

For new installations or equipment use, conformity of equipment shall be verified according to 4.4.

5.4.2 Relationship between EPLs and types of protection

The recognised types of protection according to IEC standards have been allocated default EPLs according to Table 2. Where the equipment is marked with a type of protection code and an EPL that differs from Table 2 then the equipment EPL marking shall take precedence.

Table 2 – Default relationship between types of protection and EPLs

EPL	Type of protection	Code	According to
"Ga"	Intrinsically safe	"ia"	IEC 60079-11
	Encapsulation	"ma"	IEC 60079-18
	Two independent types of protection each meeting EPL "Gb"		IEC 60079-26
	Protection of equipment and transmission systems using optical radiation	"op is"	IEC 60079-28
	Special protection	"sa"	IEC 60079-33
"Gb"	Flameproof enclosures	"d"	IEC 60079-1
	Increased safety	"e"	IEC 60079-7
	Intrinsically safe	"ib"	IEC 60079-11
	Encapsulation	"m" "mb"	IEC 60079-18
	Oil immersion	"o"	IEC 60079-6
	Pressurized enclosures	"p", "px", "py", "pxb" or "pyb"	IEC 60079-2
	Powder filling	"q"	IEC 60079-5
	Fieldbus intrinsically safe concept (FISCO)		IEC 60079-27
	Protection of equipment and transmission systems using optical radiation	"op is" "op sh" "op pr"	IEC 60079-28
	Special protection	"sb"	IEC 60079-33
"Gc"	Intrinsically safe	"ic"	IEC 60079-11
	Encapsulation	"mc"	IEC 60079-18
	Non-sparking	"n" or "nA"	IEC 60079-15
	Restricted breathing	"nR"	IEC 60079-15
	Energy limitation	"nL"	IEC 60079-15
	Sparkling equipment	"nC"	IEC 60079-15
	Pressurized enclosures	"pz" or "pzc"	IEC 60079-2
	Protection of equipment and transmission systems using optical radiation	"op is" "op sh" "op pr"	IEC 60079-28
	Special protection	"sc"	IEC 60079-33
"Da"	Encapsulation	"ma"	IEC 60079-18
	Protection by enclosure	"ta"	IEC 60079-31
	Intrinsically safe	"ia" or "iaD"	IEC 60079-11 or IEC 61241-11
	Special protection	"sa"	IEC 60079-33
"Db"	Encapsulation	"mb"	IEC 60079-18
	Protection by enclosure	"tb" or "tD"	IEC 60079-31 IEC 61241-1
	Pressurized enclosures	"pD"	IEC 61241-4
	Intrinsically safe	"ib" or "ibD"	IEC 60079-11 or IEC 61241-11

EPL	Type of protection	Code	According to
	Special protection	"sb"	IEC 60079-33
"Dc"	Encapsulation	"mc"	IEC 60079-18
	Protection by enclosure	"tc" or "tD"	IEC 60079-31 IEC 61241-1
	Pressurized enclosures	"pD"	IEC 61241-4
	Intrinsically safe	"ic"	IEC 60079-11
	Special protection	"sc"	IEC 60079-33
New protection marking codes with identification of EPLs may be introduced in the future.			

5.4.3 Equipment for use in locations requiring EPL "Ga" or "Da"

Electrical equipment and circuits can be used in locations requiring EPL "Ga" or "Da" if the equipment is either marked as EPL "Ga" or "Da" respectively or uses a type of protection listed in Table 2 as meeting the requirements of EPL "Ga" or "Da" respectively. The installation shall comply with the requirements of this standard as appropriate to the type of protection employed. When "Ga" is marked in accordance with IEC 60079-26 for combined types of protection, the installation shall simultaneously comply with the requirements of this standard as appropriate to the types of protection employed.

5.4.4 Equipment for use in locations requiring EPL "Gb" or "Db"

Electrical equipment and circuits can be used in locations requiring EPL "Gb" or "Db" if the equipment is either marked as EPL "Ga" or "Gb" and "Da" or "Db" respectively or uses a type of protection listed in Table 2 as meeting the requirements of EPL "Ga" or "Gb" and "Da" or "Db" respectively. The installation shall comply with the requirements of this standard as appropriate to the type of protection employed.

Where equipment meeting the requirements of EPL "Ga" or "Da" is installed in a location which only requires equipment to EPL "Gb" or "Db" respectively, it shall be installed in full accordance with the requirements of all the types of protection employed except as varied by the additional requirements for the individual protection techniques.

5.4.5 Equipment for use in locations requiring EPL "Gc" or "Dc"

Electrical equipment and circuits can be used in locations requiring EPL "Gc" or "Dc" respectively if the equipment is either marked as EPL "Ga" or "Gb" or, "Gc" and "Da" or "Db" or "Dc" respectively, or uses any type of protection listed in Table 2. The installation shall comply with the requirements of this standard as appropriate to the type of protection employed.

Where equipment meeting the requirements of EPL "Ga" or "Gb" and "Da" or "Db" respectively is installed in a location which only requires equipment to EPL "Gc" or "Dc" it shall be installed in full accordance with the requirements of all the types of protection employed except as varied by the additional requirements for the individual protection techniques.

5.5 Selection according to equipment grouping

Electrical equipment shall be selected in accordance with Table 3.

Table 3 – Relationship between gas/vapour or dust subdivision and equipment group

Location gas/vapour or dust subdivision	Permitted equipment group
IIA	II, IIA, IIB or IIC
IIB	II, IIB or IIC
IIC	II or IIC
IIIA	IIIA, IIIB or IIIC
IIIB	IIIB or IIIC
IIIC	IIIC

Where electrical equipment is marked indicating suitability with a particular gas or vapour, it shall not be used with other gases or vapours without a thorough assessment being carried out by a competent body and the assessment results showing that it is suitable for such use.

5.6 Selection according to the ignition temperature of the gas, vapour or dust and ambient temperature

5.6.1 General

The electrical equipment shall be so selected that its maximum surface temperature will not reach the ignition temperature of any gas, vapour or dust which may be present.

If the marking of the electrical equipment does not include an ambient temperature range, the equipment is designed to be used within the temperature range -20 °C to 40 °C . If the marking of the electrical equipment includes an ambient temperature range, the equipment is designed to be used within this range.

If the ambient temperature is outside the temperature range, or if there is a temperature influence from other factors, e.g. the process temperature or exposure to solar radiation, the effect on the equipment shall be considered and measures taken documented.

Cable glands normally do not have a temperature class or ambient operating temperature range marking. They do have a rated service temperature and unless marked, the service temperature is by default in a range of -20 °C to 80 °C . If different service temperatures are required, care should be taken, that the cable gland and the associated parts are suitable for such applications.

5.6.2 Gas or vapour

Symbols for the temperature classes marked on the electrical equipment have the meaning indicated in Table 4.

Table 4 – Relationship between gas or vapour ignition temperature and temperature class of equipment

Temperature class required by the area classification	Ignition temperature of gas or vapour in °C	Allowable temperature classes of equipment
T1	> 450	T1 – T6
T2	> 300	T2 – T6
T3	> 200	T3 – T6
T4	> 135	T4 – T6
T5	> 100	T5 – T6
T6	> 85	T6

5.6.3 Dust

5.6.3.1 General

Dust layers exhibit two properties as layer thickness increases: a reduction in minimum ignition temperature and an increase in thermal insulation.

The maximum permissible surface temperature for equipment is determined by the deduction of a safety margin from the minimum ignition temperature of the dust concerned, when tested in accordance with the methods specified in IEC 61241-2-1 (ISO/IEC 80079-20-2, under consideration) for both, dust cloud and layer.

For installations where the layer thickness is greater than 5 mm, the maximum surface temperature shall be determined with particular reference to the layer thickness and all the characteristics of the material(s) being used. Examples of excessively thick dust layers can be found in Annex L.

5.6.3.2 Temperature limitations because of the presence of dust clouds

The maximum surface temperature of equipment when tested in the dust-free test method in accordance with IEC 60079-0 shall not exceed two-thirds of the minimum ignition temperature in degrees Celsius of the dust/air mixture concerned:

$$T_{\max} \leq 2/3 T_{\text{CL}}$$

where T_{CL} is the minimum ignition temperature of the cloud of dust.

5.6.3.3 Temperature limitation because of presence of dust layers

Where the equipment is not marked with a dust layer thickness as part of the T rating, a safety factor shall be applied taking the dust layer thickness into account as:

- up to 5 mm thickness:

The maximum surface temperature of the equipment when tested in the dust-free test method in accordance with IEC 60079-0 shall not exceed a value of 75 °C below the minimum ignition temperature for the 5 mm layer thickness of the dust concerned:

$$T_{\max} \leq T_{5 \text{ mm}} - 75 \text{ °C}$$

where $T_{5 \text{ mm}}$ is the minimum ignition temperature of the 5 mm layer of dust.

- above 5 mm up to 50 mm thickness:

Where there is a possibility that dust layers in excess of 5 mm may be formed on equipment, the maximum permissible surface temperature shall be reduced. For guidance, examples of the reduction in maximum permissible surface temperature of equipment used

in the presence of dust having minimum ignition temperatures in excess of 250 °C for a 5 mm layer are shown in the graph below (Figure 1) for increasing depth of layers.

- For dust layers above 50 mm, see 5.6.3.4

Before applying the information in Figure 1, reference should be made to IEC 61241-2-1.

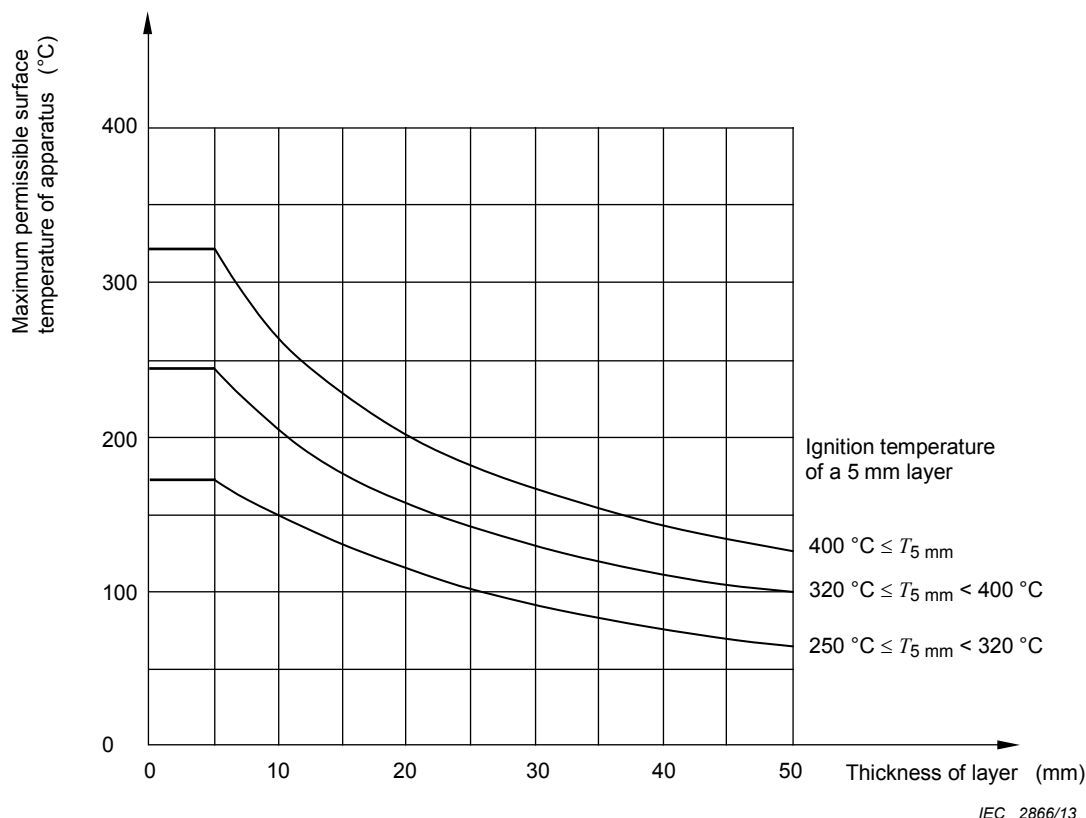


Figure 1 – Correlation between the maximum permissible surface temperature and depth of dust layers

Laboratory verification shall be carried out for equipment where the ignition temperature of a 5 mm layer is below 250 °C, or where there is any doubt concerning the application of the graph (see 5.6.3.4).

5.6.3.4 Unavoidable dust layers

Where it cannot be avoided that a dust layer forms around the sides and bottom of equipment, or where equipment is totally submerged in dust, because of the insulation effect a much lower surface temperature may be necessary. If equipment protection level “Da” is required in such situations, all specific requirements for EPL “Da” shall be fulfilled.

For installations where the layer depth is greater than 50 mm, the maximum surface temperature of equipment may be marked with the maximum surface temperature T_L as reference to the permitted layer depth. Where the equipment is marked T_L for a layer depth, the ignition temperature of the dust, at layer depth L , shall be applied in place of $T_{5\text{ mm}}$. The maximum surface temperature of the equipment T_L shall be at least 75 °C lower than the ignition temperature of the dust, at layer depth L . Examples of excessively thick dust layers can be found in Annex L.

5.7 Selection of radiating equipment

5.7.1 General

The output parameters of lasers or other continuous wave sources of electrical equipment of EPL “Ga”, “Da”, “Gb” or “Db” shall not exceed the following values:

- 5 mW/mm² or 35 mW for continuous wave lasers and other continuous wave sources, and
- 0,1 mJ/mm² for pulse lasers or pulse light sources with pulse intervals of at least 5 s.

The output parameters of lasers or other continuous wave sources of electrical equipment of EPL “Gc” or “Dc” shall not exceed the following values:

- 10 mW/mm² or 35 mW for continuous wave lasers and other continuous wave sources, and
- 0,5 mJ/mm² for pulse lasers or pulse light sources.

NOTE 1 Radiation sources with pulse intervals of less than 5 s are regarded as continuous wave sources.

NOTE 2 These values are from IEC 60079-0.

For equipment installed outside, but radiating into the hazardous area, the requirements of 5.7.1 shall be applied.

For equipment located outside of a hazardous area, or certified to an edition of IEC 60079-0 or IEC 60079-28 where this requirement is not specified, these values may be confirmed by the equipment manufacturer.

5.7.2 Ignition process

Radiation in the optical spectral range, especially in the case of focusing, can become a source of ignition.

Sunlight, for example, may initiate an ignition if objects concentrate the radiation (for example, concave mirror, lenses, etc.).

The radiation from high intensity light sources, e.g. photo flash lamps or some LEDs is, in certain circumstances, absorbed by particles, such that these particles may become an ignition source.

NOTE Lighting equipment with divergent continuous light sources is normally considered to be not a hazard.

In the case of laser radiation (for example, signalling, telemeters, surveying, range-finders) the energy or power density even of the unfocused beam at long distances may be so great that ignition is possible. Here, too, the heating is mainly caused by the effect of the laser beam on dust layers or by absorption in particles in the atmosphere. Particularly intense focusing may cause temperatures far in excess of 1 000 °C at the focal point.

Consideration shall be given to the possibility that the equipment itself producing the radiation (for example, lamps, electric arcs, lasers, etc.) may be an ignition source.

5.8 Selection of ultrasonic equipment

5.8.1 General

For equipment installed in hazardous area, or installed outside, but radiating into the hazardous area, the output parameters from ultrasonic sources of electrical equipment of EPL “Ga”, “Gb”, “Gc”, “Da”, “Db”, or “Dc” shall not exceed the following values:

- 0,1 W/cm² and 10 MHz for continuous sources,
- average power density 0,1 W/cm² and 2 mJ/cm² for pulse sources.

NOTE These values are from IEC 60079-0.

For equipment located outside of a hazardous area, or certified to an edition of IEC 60079-0 where this requirement is not specified, these values may be confirmed by the equipment manufacturer.

5.8.2 Ignition process

When ultrasonics are applied, large proportions of the energy released by the sound transducer are absorbed by solid or liquid materials. Heating can occur in the material affected and, in extreme cases, may heat the material beyond the minimum ignition temperature.

5.9 Selection to cover external influences

Electrical equipment shall be selected and/or installed so that it is protected against external influences which could adversely affect the explosion protection. Some examples are:

- extremely low or high temperatures;
- solar radiation;
- pressure conditions;
- corrosive atmosphere;
- vibrations, mechanical impacts, friction or abrasion;
- wind;
- painting processes;
- chemicals;
- water and moisture;
- dust;
- plants, animals, insects.

External influences shall be identified as part of the installation design and selection of equipment for the installation and measures applied for control shall be documented and included in the verification dossier.

NOTE 1 Further information can be found in IEC 60364-5-51.

Where equipment is subject to prolonged humidity and wide temperature variations that may lead to condensation affecting the type of protection the equipment should be provided with suitable measures to ensure satisfactory prevention of condensation or draining of any condensate.

Precautions shall be taken, without affecting designed ventilation conditions, to prevent foreign bodies falling vertically into the ventilation openings of vertical rotating electrical machines.

The integrity of electrical equipment may be affected if it is operated under temperature or pressure conditions outside those for which the equipment has been constructed. In these circumstances, further advice shall be sought (see also 5.6).

Where risks can arise from high pressure process fluids entering equipment, (e.g. pressure switches or canned electric motor pumps) under fault conditions, (e.g. a diaphragm or can failure), the fluid may cause any or all of the following to occur:

- rupture of the equipment enclosure;
- risk of immediate ignition;
- transmission of the fluid along the inside of the cable or conduit.

Where equipment is at risk it should be selected so that process fluid containment is reliably separated from the electrical equipment (e.g. by use of a primary seal for the main process interface and a secondary seal internal to the equipment in case of primary seal failure). Where this is not achieved, the equipment should be vented (via a suitably explosion protected vent, drain or breather) and/or the wiring system shall be sealed to prevent the transmission of any fluid. Failure of the primary seal should also be annunciated e.g. by visible leak, self-revealing failure of the equipment, audible sound or electronic detection.

Potential wiring system sealing methods include: the use of a special sealing joint, or a cable gland incorporating a seal around the individual conductors, or a length of mineral-insulated metal-sheathed (MIMS) cable, or an “epoxy” joint should be introduced into the cable run. It should be noted that the application of a cable sealing device may only mitigate the rate of vapour transmission and additional attenuation measures may be necessary. Venting systems should be arranged so that the occurrence of any leaks will become apparent.

In the absence of IEC standards on process sealing for electrical equipment, national or other applicable standards such as IEC 61010-1 should be followed. IEC 61010-1 includes some information relative to process connections.

NOTE 2 IEC TS 60079-40 for process sealing is under consideration

When selecting enclosures with a higher degree of ingress protection (IP) than required by the type of protection (perhaps to make it suitable for an adverse environment), the IP rating of the enclosure should be maintained to the IP rating requirement of the location or that required by the type of protection whichever is the higher. Where the IP rating assigned to the equipment is not maintained, this should be identified in the verification dossier.

5.10 Selection of transportable, portable and personal equipment

5.10.1 General

Due to the demand of the application and enhanced flexibility for use, transportable, portable or personal equipment may be required to be used in differing areas. Equipment of a lower EPL shall not be taken into an area requiring a higher EPL, unless it is otherwise protected.

In practice, however, such a limitation may be difficult to enforce – particularly with portable or personal equipment. It is recommended, therefore, that all equipment meet the requirements of the location to which the equipment will be exposed which requires the highest EPL. Similarly, the equipment group and temperature classification should be appropriate for all the gases, vapours and dusts in which the equipment may be used.

Unless suitable precautions are taken, spare batteries shall not be taken into the hazardous area.

Where the equipment contains cells or batteries, the user shall verify with the manufacturer that the concentration of hydrogen in the free volume of the battery container or housing cannot exceed 2 % by volume, or the degassing apertures of all cells shall be so arranged that the escaping gases are not vented into any enclosure of the equipment containing electrical or electronic components or connections. Alternatively, where the equipment meets the requirements for Equipment Group IIC, the requirement of degassing apertures or limitation of hydrogen concentration does not apply.

NOTE 1 Due to the risk of gassing producing hydrogen from all cell types, provision for adequate venting is applied as the gassing can create an explosive condition in small enclosures. This condition would apply to torches, multi meters, pocket gas sensors and similar items.

NOTE 2 These details are derived from the requirements in IEC 60079-11.

5.10.2 Transportable and portable equipment

Unlike equipment which is permanently installed, transportable or portable equipment may occupy the hazardous area on a temporary basis. Such equipment may include, for example, emergency generators, electrical arc welders, industrial lift (fork) trucks, air compressors, powered ventilation fans or blowers, portable electrically powered hand-tools, certain types of test and inspection equipment.

Equipment that may be transported or carried into a hazardous area shall be to the appropriate equipment protection level. Where there is a need to use transportable or portable equipment in a hazardous area for which the normally required EPL is not obtainable, a documented program for risk management shall be implemented. This program shall include appropriate training, procedures and controls. A safe work permit shall be issued appropriate to the potential ignition risk created by the use of the equipment (see Annex B).

If plugs and sockets are present in a hazardous area, they shall be to the required EPL for the area. Alternately, they shall only be energized or connections made under a safe work procedure (see Annex B).

5.10.3 Personal equipment

Items of personal equipment which are battery or solar operated are sometimes carried by personnel and inadvertently taken into a hazardous area.

A basic electronic wrist watch is an example of a low voltage, electronic device which has been independently evaluated and found to be acceptable for use in a hazardous area under both historic and current EPL requirements.

All other personal battery or solar operated equipment (including electronic wrist watches incorporating other devices) shall:

- a) conform to a recognised type of protection appropriate to EPL, gas/dust group and temperature class requirements, or
- b) be subjected to a risk assessment, or
- c) be taken into the hazardous area under a safe work procedure.

NOTE An increased risk is associated with lithium batteries which may be used to power personal electronic equipment.

5.11 Rotating electrical machines

5.11.1 General

In selecting rotating electrical machines, in addition to the requirements of 5.1 to 5.10, the following shall, as a minimum, be considered:

- duty type (S1 to S10 as defined in IEC 60034-1);
- supply voltage and frequency range;
- heat transfer from driven equipment (e.g. pump);
- bearing and lubricant life;
- insulation class

Motors which are subject to vibration and other factors which may affect cable connections and cable entry integrity should have additional care taken for:

- terminal screws and nuts which should be checked as securely tight to avoid excessive heat due to poor connections;
- glands and the parts used for the cable strain relief are tight to avoid stress on cable connections and maintain integrity of the gland.

5.11.2 Environmental Factors for “Ex” machine installation

Motors and generators require large volumes of clean air for cooling and the environmental factors which affect cooling shall be considered. These environmental factors include:

- a clean, well-ventilated location;
- the machine enclosure should be consistent with the location, environment and ambient conditions;
- if the location is not relatively free of dust and particles, the machine should have air filters or, in more severe cases, the machine should be enclosed;
- other equipment, walls, buildings, etc. should not restrict machine ventilation or allow ventilating air to recirculate:
 - adequate space around the machine for normal maintenance;
 - adequate overhead space for removal of the top cover;
 - an environment free of corrosive gases and liquids (both acids and bases).

Extreme care is required for machines supplied with a dust-ignition-proof collector-ring housing, accessory device, or conduit box since any nicks or burrs during disassembly and reassembly may destroy the explosion-proof or dust-ignition-proof features.

5.11.3 Power and accessory connections, grounding

The relevant installation and operating instructions as well as national and international rules have to be observed. Connection shall only be made by an expert and in accordance with the valid safety regulations. The power connections shall be in accordance with the manufacturer instructions with respect to:

- the electrical power: observe data on the rating plate; compare type of current, mains voltage and frequency; observe rated current for setting of the protective switch; connect motor in accordance with the wiring diagram provided in the terminal box; cable size dimensioned depending on the nominal current, cable length and ambient temperature;
- The type of protection of the cable gland, compliance with the allowable maximum temperature of the cable;
- the grounding conditions of the net. For earthing the motor is provided with an earthing terminal, which depending on the mounting arrangement is either located on the frame respectively on the flange end shield. In addition all motors have a protective conductor terminal inside the terminal box.

Depending upon the specific electric machine specified, according the outline nameplate, the machine may include any of the following accessories:

- stator winding resistance temperature detectors (slot detectors, HV);
- embedded temperature sensors in the winding system (LV);
- bearing temperature detectors, options: resistance or thermocouples, readout capability, alarm and shutdown contact capability;
- space heaters with their own temperature class;
- vibration sensors;
- tachometer;
- additional heaters for the bearing oil reservoir;
- controls for excess pressure drop across air filters.

The additional equipment has to fulfil its own requirements with possibly different types of protections, temperature classes or gas/dust groups.

As protection against dust and humidity, unused cable entries in the terminal box shall be sealed with a blanking element in accordance with the IEC 60079 series and shall have a torsion proof seal. All terminal screws and nuts have to be securely tightened to avoid excessive transition resistances. After entry of the cable into the terminal box the glands and the parts used for the strain relief are to be tightened with the corresponding torque in accordance with the data of the cable gland manufacturer.

5.11.4 Motors fed from a converter supply

Selection and installation of motors supplied at varying frequency and voltage by a converter shall take into account items that may reduce the voltage at the motor terminals. Also other hazards shall be taken into account.

NOTE 1 A filter at the output of the converter can cause a voltage drop at the terminals of the motor. The reduced voltage increases the motor current and slip, and therewith increases the temperature of the motor in the stator and rotor. Such temperature rise is most notable at constant rated load conditions.

NOTE 2 Additional information on the application of motors with a converter supply can be found in IEC/TS 60034-17 and IEC/TS 60034-25. Major concerns include frequency spectrums of the voltage and current plus their additional losses, over-voltage effects, bearing currents and high frequency earthing.

5.11.5 Switching motors above 1kV

5.11.5.1 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 incensive 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.

The peak voltages which arise as a result can damage the winding insulation, which can lead to insulation deterioration and incensive sparks. If vacuum circuit breakers or vacuum contactors are used for motor switching, the motor installation design should consider using an appropriate surge suppressor, such as a zinc oxide varistor with spark gap.

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

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

5.11.5.2 Overvoltages resulting from switching operations

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

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

5.12 Luminaires

Selection of luminaires shall take into account the possibility of changes of the temperature class, if lamps with different wattages can be used.

Some luminaires will have different temperature classes according to the type or rating of the lamp used. The type or rating of the lamp used shall be selected according to the temperature class required.

If luminaires with replaceable lamps are selected, those shall be of a type using only unmodified standard lamps without supplemental fittings.

Low-pressure sodium lamps shall not be transported unprotected through a hazardous area owing to the risk of ignition due to free sodium from a broken lamp.

NOTE During the aging process some lamps can create hotspots (e.g. fluorescent lamps type HO), becoming a source of ignition.

5.13 Plugs and socket outlets

5.13.1 General

Plugs and socket outlets are not permitted in locations requiring EPL “Ga” and “Da”.

NOTE Connectors used for Ex “i” protection are not classified as plugs and socket outlets.

5.13.2 Specific requirements for explosive dust atmospheres

Socket outlets in areas requiring EPL “Db” and “Dc” shall be installed so that dust will not enter the socket outlet with or without a plug in place. To minimize the ingress of dust in the event of a dust cap being accidentally left off, socket outlets shall be positioned at an angle, which is not more than 60° to the vertical, and the opening facing downwards.

If couplers are used in areas endangered by explosive dust atmospheres, care should be taken that no dust will enter the coupler when disconnected.

5.13.3 Location

Socket outlets shall be installed in locations so that the flexible cord required shall be as short as possible in order to fulfil the disconnection time in the event of a fault as required in IEC 60364-4-41.

5.14 Cells and batteries

5.14.1 Charging of secondary cells and batteries

Cells and batteries shall only be recharged in a non-hazardous area, unless this is covered by the certificate and manufacturer’s instructions permit charging in a hazardous area.

NOTE 1 This includes charging of cells inside Ex “d” enclosures.

Before equipment is taken back into the hazardous area it shall be ensured that:

- the temperature is below the marked temperature class, and,

- no gas produced during charging is still in the container.

NOTE 2 Battery rooms are normally considered to be a safe area if in compliance with the relevant national or regional standards, (e.g. IEC 62485-2).

5.14.2 Ventilation

If there are openings in the enclosure required for ventilation of batteries, it shall be ensured that openings are not affected by the installation.

5.15 RFID tags

5.15.1 General

RFID tags shall not be used in environments with high electromagnetic fields exceeding RMS values of 1 A/m or 3 V/m e.g. in high current electrolysis plants.

5.15.2 Passive RFID tags

Passive RFID tags, i.e. tags, which are not battery powered and derive power from the RF reader only, need not be certified if their construction meets the requirements for simple apparatus.

Passive RFID tags shall be considered to have a temperature class T6 at an ambient temperature $T_{amb} \leq 40\text{ °C}$, or temperature class T5 at an ambient temperature $T_{amb} \leq 60\text{ °C}$, if not specified by the manufacturer.

5.15.3 Mounting RFID tags

The tag housing shall comply with the requirements in 6.5.

In locations requiring EPL “Ga” or “Da”, RFIDs shall only be used if certified together with the equipment.

In locations requiring EPL “Gb” or “Db” a special precaution shall be applied to prevent foreseeable failures (e.g. dropping the tag), to avoid reducing creepage and clearance distances of other devices.

Mounting of a tag shall not impair the properties of the tag itself, nor shall the type of protection of the equipment, on which it is attached, be affected negatively.

When using adhesives the maximum operating temperature has to be considered.

Creepage and clearance distances shall not be affected by mounting. Damaged RFID tags shall not be taken into a hazardous area.

5.16 Gas detection equipment

Gas detection may be used as a part of control measures to enable the use of electrical equipment in hazardous areas where that equipment might not meet other requirements of this standard. (see 4.1)

For gas detection equipment, all relevant requirements in IEC 60079-29-1 to IEC 60079-29-4 shall be applied.

6 Protection from dangerous (incendive) sparking

6.1 Light metals as construction materials

The material composition of metallic installation materials (e.g. cable trays, mounting plates, weather protection and enclosures) shall comply with the following requirements. 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, and
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.

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”
no requirements

Particular consideration shall be given to the location of items that incorporate light metals in the external construction as it has been well established that such materials give rise to sparking that is incendive under conditions of frictional contact.

NOTE These values are taken from IEC 60079-0 for equipment.

6.2 Danger from live parts

In order to avoid the formation of sparks liable to ignite the explosive atmosphere, the possible inadvertent contact with bare live parts other than single intrinsically safe or energy-limited parts shall be prevented.

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

6.3 Danger from exposed and extraneous conductive parts

6.3.1 General

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

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