

Non-electrical equipment for use in potentially explosive atmospheres

Part 1: Basic method and requirements

ICS 13.230

National foreword

This British Standard is the UK implementation of EN 13463-1:2009. It supersedes BS EN 13463-1:2001 which is withdrawn.

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Foreword

This document (EN 13463-1:2009) has been prepared by Technical Committee CEN/TC 305 “Potentially explosive atmospheres - Explosion prevention and protection”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2009, and conflicting national standards shall be withdrawn at the latest by July 2009.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13463-1:2001.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EC Directive(s).

For relationship with EC Directive(s), see informative Annex ZA, which is an integral part of this document.

Annex H provides details of significant technical changes between this European Standard and the previous edition: EN 13463-1:2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

Non-electrical equipment in accordance with this European Standard means mainly mechanical equipment. The extent of explosion protection and prevention measures applied to mechanical equipment differ from those applied to electrical equipment.

Whereas common electrical equipment working within its design parameters often contains effective ignition sources, this is not true for most mechanical equipment. In most cases, the normal operation of mechanical equipment within its design parameters will not lead to ignition of an explosive atmosphere. In other words, most mechanical equipment performing its designed duty without malfunctions and with proper maintenance will not produce ignition sources in normal operation. Thus, additional protective measures that are commonly used for electrical explosion protected equipment (e.g. enclosures) are not needed.

Even where malfunctions have to be considered, much mechanical equipment can meet the requirements for category 2 equipment by a proper choice of well-tried constructional measures that would reduce failures causing ignition sources to an acceptably low level.

Essential to this decision is the use of the ignition hazard assessment to evaluate the potential ignition sources of mechanical equipment and under which conditions they will become effective. This is the fundamental difference to standards for electrical equipment.

1 Scope

This European Standard specifies the basic method and requirements for design, construction, testing and marking of non-electrical equipment intended for use in potentially explosive atmospheres in air of gas, vapour, mist and dusts. Such atmospheres can also exist inside the equipment. In addition, the external atmosphere can be drawn inside the equipment by natural breathing produced as a result of fluctuations in the equipment's internal operating pressure, and/or temperature.

This European Standard is valid for atmospheres having pressures ranging from 0,8 bar to 1,1 bar and temperatures ranging from - 20 °C to + 60 °C., i.e. equipment built to this European Standard will be satisfactory to any service conditions within this range unless otherwise specified.

NOTE 1 The requirements of this European Standard can also be helpful for the design, construction, testing and marking of equipment intended for use in atmospheres outside the validity range stated above. In this case however, the ignition hazard assessment, ignition protection provided, additional testing (if necessary), manufacturer's technical documentation and instructions to the user, should clearly demonstrate and indicate the equipment's suitability for the conditions it may encounter. It should also be recognized that changes in temperature and pressure can have a significant influence on ignitability.

This European Standard does not cover additional marking for equipment intended for use outside the scope of its validity such as an oxygen-enriched atmosphere.

This European Standard is also applicable for the design, construction, testing and marking of components, protective systems, devices and assemblies of these products which have possible ignition sources and are intended for use in potentially explosive atmospheres.

It specifies the requirements for the design and construction of equipment, intended for use in potentially explosive atmospheres in conformity with all categories of Group I and II. This European Standard can be supplemented by European Standards concerning the specific types of ignition protection.

NOTE 2 These are given below:

EN 13463-2,	Non-electrical equipment for use in potentially explosive atmospheres – Protection by flow restricting enclosure (fr)
EN 13463-3,	Non-electrical equipment for use in potentially explosive atmospheres – Protection by flameproof enclosure (d)
EN 13463-5,	Non-electrical equipment for use in potentially explosive atmospheres – Protection by constructional safety (c)
EN 13463-6,	Non-electrical equipment for use in potentially explosive atmospheres – Protection by control of ignition sources (b)
EN 60079-2,	Electrical apparatus for explosive gas atmospheres – Pressurised enclosures "p" (Protection by pressurization described in EN 60079-2 can also be used for non-electrical equipment.)
EN 13463-8,	Non-electrical equipment for use in potentially explosive atmospheres – Protection by liquid immersion (k)
EN 50303,	Group I, category M1 equipment intended to remain functional in atmospheres endangered by firedamp and/or coal dust.

NOTE 3 Equipment designed and constructed in accordance with this European Standard for a particular category may be used in areas requiring a category with a higher level of safety by the application of additional explosion prevention and/or protection methods. Such applications are not covered in this standard.

NOTE 4 Such explosion prevention and/or protection measures include for example inerting, suppression, venting or containment as described in EN 1127-1, for Group II equipment or for example by dilution, drainage, monitoring and shut-down as described in EN 1127-2 for Group I equipment. Such explosion protection methods are outside the scope of this European Standard.

NOTE 5 Although the normal atmospheric conditions above give a temperature range for the atmosphere of - 20 °C to + 60 °C the ambient temperature range for the equipment is - 20 °C to + 40 °C unless otherwise specified and marked, see 6.2.2.

2 Normative references

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

EN 582, *Thermal spraying - Determination of tensile adhesive strength*

EN 1127-1:2007, *Explosive atmospheres – Explosion prevention and protection – Part 1: Basic concepts and methodology*

EN 1127-2, *Explosive atmospheres – Explosion prevention and protection – Part 2: Basic concepts and methodology for mining*

EN 13237:2003, *Potentially explosive atmospheres – Terms and definitions for equipment and protective systems intended for use in potentially explosive atmospheres*

EN 13463-6:2005, *Non-electrical equipment for use in potentially explosive atmospheres – Part 6: Protection by control of ignition source 'b'*

EN 14986, *Design of fans working in potentially explosive atmospheres*

EN 50303:2001, *Group I, category M1 equipment intended to remain functional in atmospheres endangered by firedamp and/or coal dust*

EN 60079-0:2006, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements (IEC 60079-0:2004, modified)*

ISO 1817:2005, *Rubber, vulcanized – Determination of the effect of liquids*

CLC/TR 50404:2003, *Electrostatics – Code of practice for the avoidance of hazards due to static electricity*

"Seventh Report on the Specifications and Testing Conditions relating to Fire-resistant Hydraulic Fluids Used for Power Transmission (Hydrostatic and Hydrokinetic) in Mines", Commission of the European Communities Safety and Health Commission for Mining and Extractive Industries, Luxembourg 1994

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13237:2003 and the following apply.

3.1 equipment

machines, apparatus, fixed or mobile devices, control components and instrumentation thereof and detection or prevention systems which, separately or jointly are intended for the generation, transfer, storage, measurement, control and conversion of energy and/or the processing of material and which are capable of causing an explosion through their own potential sources of ignition

[EN 1127-1:2007]

NOTE 1 If equipment supplied to the user contains any interconnecting parts e.g. fastenings, pipes, etc. these form part of the equipment.

NOTE 2 Simple apparatus with no moving parts, containers and pipes on their own are not considered as equipment under the scope of this European Standard.

3.2 equipment category

3.2.1 equipment Group I category M 1

equipment designed and, where necessary, equipped with additional special means of protection to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a very high level of protection

NOTE 1 Equipment of this category is intended for use in underground parts of mines as well as those parts of surface installations of such mines endangered by firedamp and/or combustible dust.

NOTE 2 Equipment of this category is required to remain functional even in the event of rare incidents relating to equipment, with an explosive atmosphere present, and is characterised by means of protection such that:

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

3.2.2 equipment Group I category M 2

equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection

NOTE 1 Equipment of this category is intended for use in underground parts of mines as well as those parts of surface installations of such mines likely to be endangered by firedamp and/or combustible dust.

NOTE 2 This equipment is intended to be de-energised in the presence of an explosive atmosphere.

NOTE 3 The means of protection relating to equipment in this category assure the requisite level of protection during normal operation and also in the case of more severe operating conditions, in particular, those arising from rough handling and changing environmental conditions.

3.2.3 equipment Group II category 1

equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a very high level of protection

NOTE 1 Equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours or mists or by air/dusts mixtures are present continuously, for long periods or frequently.

NOTE 2 Equipment of this category ensures the requisite level of protection, even in the event of rare malfunctions relating to equipment, and is characterised by means of protection such that:

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

3.2.4 equipment Group II category 2

equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a high level of protection

NOTE 1 Equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours or mists or by air/dusts mixtures are likely to occur.

NOTE 2 The means of protection relating to equipment in this category ensures the requisite level of protection, even in the event of frequently occurring disturbances or equipment faults which are normally taken into account.

3.2.5

equipment Group II category 3

equipment designed to be capable of functioning in conformity with the operational parameters established by the manufacturer and ensuring a normal level of protection

NOTE 1 Equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours or mists or by air/dusts mixtures are unlikely to occur or, if they do occur, are likely to do so only infrequently and for a short period only.

NOTE 2 Equipment of this category ensures the requisite level of protection during normal operation.

3.3

possible ignition source

any kind of ignition source

NOTE 1 See EN 1127-1 for a list of all possible ignition sources.

NOTE 2 See Figure 1

3.4

equipment related ignition source

any possible ignition source, which is caused by the equipment under consideration regardless of its ignition capability

NOTE 1 These are sometimes called "relevant ignition sources", however this can lead to misunderstanding as to whether the ignition source is relevant in terms of it being present, in terms of its ignition capability or in terms of whether it is present in the equipment or not.

NOTE 2 All equipment related ignition sources are considered in the ignition hazard assessment to determine whether they are potential ignition sources.

NOTE 3 See Figure 1

3.5

potential ignition source

equipment related ignition source which has the capability to ignite an explosive atmosphere (i.e. to become effective)

NOTE 1 The probability of becoming effective determines the equipment category (they may arise in normal operation, expected malfunction, rare malfunction).

NOTE 2 See Figure 1

3.6

effective ignition source

potential ignition source which is able to ignite an explosive atmosphere when consideration is taken of when it occurs (i.e. in normal operation, expected malfunction or rare malfunction) which determines the intended category

NOTE 1 An effective ignition source is a potential ignition source which can ignite the explosive atmosphere if preventive or protective measures are not used.

NOTE 2 For example the frictional heat which may be produced by a bearing is a possible ignition source. This is an equipment related ignition source if the piece of equipment contains a bearing. If the energy which may be produced by the friction in the bearing is capable of igniting an explosive atmosphere then this is a potential ignition source. Whether this potential ignition source is effective depends on the probability that it will occur in a particular situation (e.g. following loss of lubrication).

NOTE 3 See Figure 1

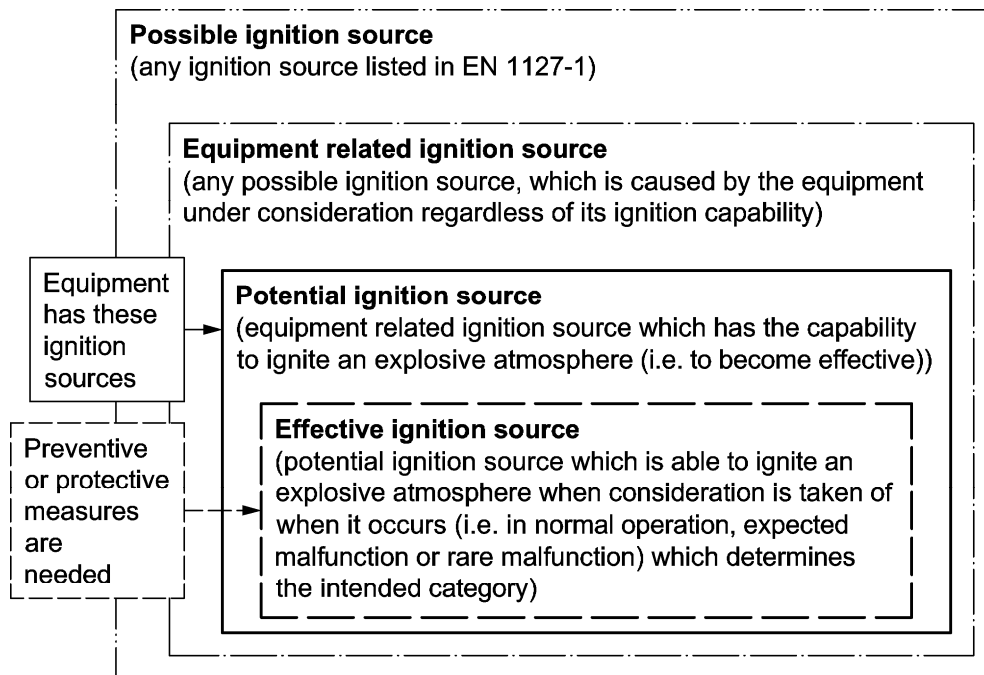


Figure 1 — Relationship between ignition source definitions

3.7 normal operation
situation when the equipment, protective systems, and components are operating for their intended use within their design parameters

NOTE 1 Failures (such as a breakdown of pump seals, flange gaskets or releases of substances caused by accidents) which involve repair or shut-down are not considered to be part of normal operation

NOTE 2 Minor releases of flammable material may be part of normal operation. For example, releases of substances from seals which rely on wetting by the fluid which is being pumped are considered to be minor releases.

[EN 13237:2003]

3.8 malfunction
equipment, protective systems and components do not perform the intended function

NOTE 1 See also EN ISO 12100-1:2003, 5.3 b) 2)

NOTE 2 For the purposes of this standard this can happen due to a variety of reasons, including

- variation of a property or of a dimension of the processed material or of the workpiece;
- failure of one (or more) of the component parts of the equipment, protective systems and components;
- external disturbances (e.g. shocks, vibration, electromagnetic fields);
- design error or deficiency (e.g. software errors);
- disturbance of the power supply or other services;
- loss of control by the operator (especially for hand-held machines).

3.8.1 expected malfunction
disturbances or equipment faults which are known to occur in practice

3.8.2

rare malfunction

type of malfunction which may happen only in rare instances

NOTE For example, this includes two independent expected malfunctions which, separately, would not create an ignition hazard but which, in combination, do create an ignition hazard, are regarded as a single rare malfunction.

3.9

maximum surface temperature

temperature used for marking of the equipment which is the highest temperature that can be attained in service under the most adverse operating conditions (but within the recognised tolerance) by any part or surface of equipment, protective system or component which can produce an ignition of the surrounding explosive atmosphere with an appropriate safety margin

NOTE 1 The maximum surface temperature is determined according to 8.2 and includes safety margins depending on the category of the equipment. As a result of the application of safety margins according to 8.2, the maximum surface temperature, in most cases, will be in excess of the highest measured surface temperature.

NOTE 2 The surface temperature which is relevant can be internal or external depending upon the type of ignition protection concerned.

NOTE 3 For equipment intended for use in explosible dust atmospheres, the surface temperature is determined without any deposited dust on the equipment, see 6.2.3.

3.10

maximum possible potential energy

maximum amount of energy which can be stored in an equipment or in parts of an equipment and can dissipate into kinetic energy during release

3.11

type of ignition protection

types of protection covered by specific standards

NOTE For information see list in the scope.

3.12

non-electrical equipment

equipment which can achieve its intended function mechanically

4 Equipment categories and explosion groups

4.1 Equipment category

Equipment for potentially explosive atmospheres is divided into:

- a) Group I equipment for mines susceptible to firedamp; this group comprises two categories according to the level of safety provided:
 - i. Category M1;
 - ii. Category M2.
- b) Group II Equipment for places with a potentially explosive atmosphere, other than mines susceptible to firedamp; this group comprises three categories according to the level of safety provided:
 - i. Category 1;
 - ii. Category 2;

iii. Category 3.

Equipment intended for mines where the atmosphere, in addition to firedamp, may contain significant proportions of other flammable gases and/or combustible dusts (i.e. other than methane or coal dust), shall be constructed and tested in accordance with the requirements relating to Group I and also to the subdivision of Group II corresponding to the other significant flammable gases. This equipment shall then be marked appropriately.

NOTE Group I equipment tested in a firedamp air mixture does not need any additional testing to demonstrate its suitability for use in an explosive coal dust atmosphere.

This European Standard may be used in conjunction with one or more types of protection described in the standards listed in Clause 1, depending on the ignition hazard assessment in 5.2, to provide the protection required.

4.2 Explosion groups

Equipment of Group II intended for use in explosive gas atmospheres may also be classified according to the nature of the potentially explosive atmosphere for which it is intended. This equipment is classified according to the explosion groups IIA, IIB and IIC.

NOTE 1 This classification is based on the maximum experimental safe gap and the minimum ignition current of the gas mixture, see IEC/TR 60079-12 and IEC/TR 60079-20.

NOTE 2 The explosion groups also may be used to classify equipment with respect to ignitability.

NOTE 3 Equipment explosion sub-groups are shown in Table 1.

Table 1 — Equipment explosion groups

Explosion group of explosive atmosphere	Equipment with explosion group markings that can be used in these atmospheres
IIA	IIA, IIB, IIC
IIB	IIB, IIC
IIC	IIC

Equipment without any explosion group marking can be used for explosive atmospheres of explosion group IIA, IIB and IIC provided the equipment is not marked for specific atmospheres.

For equipment incorporating flame arresters the classification is extended as shown in Table 2 (see EN 12874).

Table 2 — Explosion groups for equipment incorporating flame arresters (subdivisions)

Explosion group	Maximum experimental safe gap (MESG) of gas/air-mixture mm
IIA1 ^a	≥ 1,14
IIA	> 0,90
IIB1	≥ 0,85
IIB2	≥ 0,75
IIB3	≥ 0,65
IIB	≥ 0,50
IIC	< 0,50
^a IIA1 does not include natural gas and is not applicable for detonation arresters.	

For general use with explosive atmospheres containing hydrogen, explosion group IIC is required.

4.3 Specific explosive atmospheres

The equipment may be tested for a specific explosive atmosphere. In this case it shall be marked accordingly, see 9.3.2 e).

5 Ignition hazard assessment

5.1 General requirements

Non-electrical equipment for use in potentially explosive atmospheres shall comply with the requirements of this part of EN 13463 and if relevant modified by the specific parts of EN 13463 for other types of ignition protection.

All intended service conditions for the equipment (e.g. rough handling, humidity effects, ambient temperature and pressure variations, effects of chemical agents, corrosion, vibration) shall be specified by the manufacturer and included in the required instructions for use (see Clause 9).

If equipment is designed and constructed according to good engineering practice and the ignition hazard assessment ensures that the equipment does not contain any effective ignition sources in normal operation, the equipment can be classified as category 3 equipment.

Similarly where the ignition hazard assessment confirms that the equipment does not contain any effective

ignition sources during
 expected malfunctions or
 rare malfunctions,
 the equipment can be classified as
 category 2 or
 category 1 equipment
 respectively.

To confirm the category of the equipment, Annex A shall be applied.

5.2 Procedure of ignition hazard assessment

5.2.1 Formal analysis

All equipment and all parts of it shall be subjected to a formal documented hazard analysis. This assessment shall be made to determine which possible ignition sources arise in the equipment under consideration and are therefore equipment related ignition sources and whether these may be potential ignition sources. The assessment shall also list the measures to be applied to prevent potential ignition sources from becoming effective. All ignition sources dealt with in EN 1127-1 are to be considered. Examples of such sources include hot surfaces, naked flames, hot gases/liquids, mechanically generated sparks, adiabatic compression, shock waves, exothermic chemical reaction, thermite reactions, self-ignition of dust, electrical arcing and static electricity discharges.

NOTE 1 This assessment is often best carried out using a table listing all the ignition sources from EN 1127-1 with the decision noted against each, see example in Annex B.

NOTE 2 For the general principles see EN 15198.

Protective measures/types of protection shall be considered and/or applied in the following order:

- ensure that ignition sources cannot arise;
- ensure that ignition sources cannot become effective;
- prevent explosive atmosphere reaching the ignition source;
- contain the explosion and prevent flame propagation.

Depending on the intended equipment category all ignition sources caused in the case of normal operation, expected malfunction and rare malfunction shall be considered.

Ignition sources caused by misuse which can reasonably be anticipated shall also be considered. See Annex G.

5.2.2 Assessment for equipment-group I

5.2.2.1 Group I, category M1

In the case of Group I, category M1 equipment the assessment shall list all of the potential ignition sources that are either effective or likely to become effective, taking account of the need to have a very high level of protection and the fact that category M1 equipment is required to be either safe with two faults applied, or protected by two independent means of protection. The assessment shall indicate this by showing either a type of ignition protection that prevents ignition under two fault conditions, or identifying the two independent measures to prevent the ignition used according to this European Standard and to the ignition protection standards listed in the scope of this European Standard which have been applied.

5.2.2.2 Group I, category M2

In the case of Group I, category M2 equipment, the assessment shall list all of the potential ignition sources that are either effective or likely to become effective, in normal operation and expected malfunctions. It shall also list those sources where the risk of them becoming effective cannot be disregarded by virtue of the equipment being designed to be de-energised in the event of an explosive atmosphere occurring. The assessment shall indicate the measures to prevent the ignition used according to this European Standard and to the ignition protection standards listed in the scope of this European Standard which have been applied to render such ignition sources ineffective during the period from the occurrence of the explosive atmosphere, its detection and the de-energisation of the equipment.

5.2.3 Assessment for equipment-group II

5.2.3.1 For category 1 equipment

In the case of category 1 equipment, the listed ignition sources shall include all potential ignition sources that are effective or may become effective during normal operation, expected malfunction and rare malfunction. It shall also indicate the measures which have been applied to prevent the ignition source from becoming effective. These measures may either be according to this European Standard or to the ignition protection standards listed in the scope of this European Standard.

5.2.3.2 For category 2 equipment

In the case of category 2 equipment, the listed ignition sources shall include all potential ignition sources that are effective or may become effective during normal operation and expected malfunction. It shall also indicate the measures to prevent the ignition used according to this European Standard and to the ignition protection standards listed in the scope of this European Standard which have been applied.

5.2.3.3 For category 3 equipment

In the case of category 3 equipment, the listed ignition sources shall include all potential ignition sources that are effective or may become effective during normal operation. It shall also indicate the measures to prevent the ignition used according to this standard and to the ignition protection standards listed in the scope of this European Standard which have been applied.

5.2.4 Assessment with faults

Where the category requires assessment to include expected malfunctions and/or rare malfunctions, the assessment shall also consider those parts which if they failed could:

- ignite any flammable substance contained within the equipment (e.g. lubricating oil); and/or
- consequently become or create an ignition source.

5.2.5 Basic information necessary for the ignition hazard assessments

The ignition hazard assessment shall be based on the following information where appropriate:

- description of the equipment;
 - intended use;
 - materials and their characteristics;
- design drawings and specifications;
- any relevant assumptions which have been made (e.g. loads, strengths, safety factors);
 - results of design calculations made;
 - results of examinations carried out;
 - requirements for installation, operation and maintenance.

NOTE Examples of some ignition hazard assessments performed for equipment are given in Annex C.

5.2.6 Ignition hazard assessment report

The results of an ignition hazard assessment shall be reported completely in a clearly arranged and comprehensible way. For this purpose the report shall contain as a minimum the following information content:

- basic information as described in 5.2.5;
- hazards identified and their causes;
- measures implemented to eliminate or reduce identified ignition hazards (e.g. from standards or other specifications);
- result of the final ignition hazard evaluation;
- reasons for evaluation results if not self-explanatory;
- resulting categorisation and necessary safety-related limitations of the intended use.

NOTE It is recommended to report the ignition hazard assessment results in tabular form. Annex B shows and explains an adequate reporting scheme. Examples are given in this reporting scheme (see Annex C).

The hazard assessment report shall be included in the required technical documentation which demonstrates compliance with this standard (see 9.1).

A summary of the hazards identified and the preventive and/or protective measures used shall be included in the instructions for use.

6 Assessment of possible ignition sources

6.1 General

A description of all possible ignition sources which may occur is given in EN 1127-1. These are further considered in the following.

6.2 Hot surfaces

6.2.1 General

If an explosive atmosphere comes into contact with a heated surface, ignition can occur. Not only can a hot surface itself act as an ignition source, but a dust layer or a combustible solid in contact with a hot surface and ignited by the hot surface can also act as an ignition source for an explosive atmosphere.

The maximum temperature of a surface which can occur determines whether it can act as an ignition source.

The maximum surface temperature shall be specified in relevant documentation according to Clause 9.

6.2.2 Design temperatures

Where equipment is designed for use in a different ambient temperature range than from - 20 °C to + 40 °C it shall be stated in the instructions for use provided by the manufacturer and marked according to 9.3.2 g).

NOTE Although the normal atmospheric conditions in the scope give a temperature range for the atmosphere of - 20 °C to + 60 °C the ambient temperature range for the equipment is - 20 °C to + 40 °C unless otherwise specified and marked.

6.2.3 Establishing the maximum surface temperature

As part of the ignition hazard assessment, the maximum surface temperature of the equipment shall be established. Basically, this is the highest surface temperature, corrected by safety margins given in 8.2, of any part of the equipment that could be exposed to the potentially explosive atmosphere, or where a dust layer could form, taking account of its size and ability to become an ignition source. The assessment shall also take account of any integral device(s) fitted to limit the highest surface temperature (e.g. the use of a low melting point fusible drain plug in a fluid coupling). Where a temperature limiting device is used it shall fulfil the

requirements according to EN 13463-6. The maximum surface temperature shall be assessed at the maximum ambient temperature for which the equipment is designed.

The measurement, or determination by calculation, of the highest surface temperature shall be made with the equipment at full load, but with those failures tolerated by the applied type of ignition protection. In the case of Group II equipment the measurement, or determination by calculation of the highest surface temperature shall include the conditions of operation of expected malfunction for category 2 equipment and of rare malfunction for category 1 equipment for which no additional protective measures are used.

NOTE 1 The maximum surface temperature of the equipment is used – as determined according to 8.2 including safety margins given here – for marking of the equipment with a defined temperature, a temperature class of the equipment or an appropriate explosive atmosphere. The actually measured highest surface temperature may differ from the assigned maximum surface temperature as a result of the application of safety margins.

Where the equipment is intended and marked for use only with one or more specific gas or vapour explosive atmospheres, then the maximum surface temperature shall not exceed the lowest ignition temperature of those explosive atmospheres.

NOTE 2 Equipment cannot be marked as suitable for use for a specific explosive dust atmosphere as the ignition temperature depends on the application.

6.2.4 Group I equipment

The maximum surface temperature shall not exceed:

- a) 150 °C on any surface where coal dust can form a layer;
- b) or 450 °C where coal dust is not expected to form a layer (for example inside an IP 5X enclosure), in which case:
 - i. the actual maximum surface temperature is marked on the equipment, and
 - ii. the symbol "X" is placed on the equipment and the special conditions for safe use shall be given in the instruction for use.

NOTE When choosing equipment of Group I, the user should take account of the influence on the smouldering temperature of coal dusts if they are likely to be deposited in a layer on surfaces which may reach a temperature above 150 °C.

6.2.5 Group IIG equipment

Group IIG equipment shall be:

- classified in a temperature class depending on the maximum surface temperature as given in Table 3. In this case the maximum surface temperature shall not exceed the temperature class limits according to Table 3;
- or, defined by the actual maximum surface temperature of the equipment,
- or if appropriate, restricted to the specific gas, vapour or mist for which it is intended; in this case the maximum surface temperature shall not exceed the ignition temperature of the specific gas, vapour or mist for which it is intended;

and shall be marked accordingly, see also 9.3.

Table 3 — Classification of maximum surface temperatures for Group IIG equipment

Temperature class	Maximum surface temperature °C
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Where the maximum surface temperature depends not on the equipment itself, but mainly on operating conditions (like a heated fluid in a pump), the relevant information shall be given in the instructions for use and the equipment shall be marked with TX in order to inform the user about this special situation (see Clause 9 on marking).

NOTE 1 The maximum surface temperature of the equipment includes the safety margin to the minimum ignition temperature of the potentially explosive atmosphere as required in EN 1127-1:2007, 6.4.2, see also 8.2 for further details.

NOTE 2 The inclusion of the required safety margin in the marked maximum surface temperature of the equipment aligns it to that used for marking electrical equipment.

6.2.6 Special cases for Group IIG equipment

6.2.6.1 Small surface areas

Small surface areas, whose temperature exceed that permitted for the temperature classification, shall be acceptable providing that they conform to one of the following:

- a) for Group II with T4 classification, small surface areas shall conform to Table 4, or
- b) for T5 classification, the surface temperature of a surface area smaller than 1000 mm² shall not exceed 150 °C.

Table 4 — Assessment for T4 classification according to component size

Total surface area excluding	Requirement for T4 classification
< 20 mm ²	Surface temperature ≤ 275 °C
≥ 20 mm ² and ≤ 1 000 mm ²	Surface temperature ≤ 200 °C

NOTE These data do not apply for very small parts like mechanically generated sparks or radiatively heated parts like glass fibre tips etc. with surfaces much smaller than 1 mm². In the latter case these temperatures may be exceeded, information can be found in EN 60079-28.

6.2.6.2 Enclosed volumes

The minimum ignition temperature of large volumes of an explosive atmosphere enclosed by the equipment (see EN 14522) can be below the standard ignition temperature and shall be taken into account in these cases in the course of the ignition hazard assessment according to 5.2 if these volumes are part of the equipment.

NOTE This effect occurs mainly where the walls enclosing the mixture are of a uniform temperature.

For category 1 equipment this effect is taken into account by the safety margin used to determine the maximum surface temperature according to 8.2. For category 2 equipment a safety margin depending on the enclosed volume shall be applied where the enclosed volume of gas or vapour can be heated up to the temperature of the surface. For a number of combustible materials EN 14522 provides useful data on larger volumes.

6.2.7 Group IID equipment

Group IID equipment shall be defined by the actual maximum surface temperature and shall be marked accordingly.

NOTE 1 The relationship of the maximum surface temperature of the equipment and the minimum ignition temperature of dust layers and dust clouds is given in EN 1127-1.

NOTE 2 The maximum surface temperature is determined without any deposited dust on the equipment.

NOTE 3 The possible insulation effects of a dust layer on the surface temperatures are taken into account by the safety margin to the dust layer ignition temperature specified in EN 1127-1 (75 °C for a 5 mm layer).

Where the actual maximum surface temperature depends not on the equipment itself, but mainly on operating conditions (like a heated fluid in a pump), the relevant information shall be given in the instructions for use and the equipment shall be marked with TX in order to inform the user about this special situation (see Clause 9 on marking).

6.3 Flames and hot gases (including hot particles)

The requirements according to EN 1127-1 shall apply.

Where the ignition hazard assessment shows that the overheating of non metallic materials can lead to smouldering and then burning appropriate measures shall be taken (see 8.3).

6.4 Mechanically generated sparks

6.4.1 General

As a result of friction, impact or abrasion processes such as grinding, particles can become separated from solid materials and become hot owing to the energy used in the separation process. If these particles consist of oxidizable substances, for example iron or steel, they can undergo an oxidation process, thus reaching even higher temperatures. These particles (sparks) can ignite combustible gases and vapours and certain dust/air-mixtures (especially metal dust/air mixtures). In deposited dust, smouldering can be caused by the sparks, and this can be a source of ignition for an explosive atmosphere.

For further details EN 1127-1 applies.

6.4.2 Assessment of sparks generated by single impacts

6.4.2.1 Assessment of single impact sparks as Potential Ignition Sources

Single impacts between metal parts need not to be considered as potential ignition sources if the following conditions are met.

This assessment does not apply to ignition sources originating from grinding and friction (see 6.4.3).

Either

- a) the impact velocity is less than 1 m/s and the maximum potential impact energy is less than 500 J and
 - 1) aluminium, titanium and magnesium in combination with ferritic steel is not used, or

- 2) aluminium in combination with stainless steel ($\geq 16,5\%$ Cr) is only be used if the steel cannot corrode and no iron oxide and/or rusty particles can be deposited on the surface (appropriate reference to the properties of the stainless steel shall be given in the technical documentation and instructions for use), or
- 3) hard steel in combination with hard steel is not used, or
- 4) hard steel is not used where it can impact in granite, or
- 5) aluminium in combination with aluminium is only used if no iron oxide and/or rusty particles can be deposited on the surface.

NOTE 1 Hard steel is understood as being either all kinds of hardened steel (surface hardened or heat treated in an other way to improve surface hardness) or other steel types with $HV \geq 2300$ (see EN ISO 6507-4).

or

- b) where a combination of non-sparking metals is used the impact velocity is less than or equal to 15 m/s and the maximum potential energy is less than 60 J for gas/vapour-atmospheres or less than 125 J for dust-atmospheres.

NOTE 2 Non-sparking metals are e.g. copper (Cu), zinc (Zn), tin (Sn), lead (Pb), some brasses (CuZn) and bronze (CuSn), which are non-ferrous metals of high heat conductivity and are difficult to oxidize. Sparks can only be generated by these materials when they are used in combination with materials of extremely high hardness.

6.4.2.2 Assessment of single impact sparks as effective ignition sources

6.4.2.2.1 General

The following Tables should support a manufacturer in his decision whether a potential ignition source can become effective or not. If an impact to be assumed in the course of the ignition hazard assessment might have lower energies than given in the tables, the risk is low enough that the ignition source is not considered to become effective.

If on the other hand the energies exceed the values in the Tables, this does not necessarily mean that the ignition source will become effective. In this case, the ignition hazard assessment needs to assess all aspects and may show that the risk is low enough to be acceptable.

NOTE 1 Such situations may typically arise with equipment or materials of well known properties described in specific product standards (like fans EN 14986 or industrial trucks EN 1755) where proven experience leads to the conclusion that an ignition source under these circumstances will not become effective.

Ignition sources generated by impact need not be considered as effective ignition sources if the impact velocity is less than 15 m/s and the maximum possible potential energy is less than the values given in the following Tables.

If the impact energies are larger than those given in the following tables then they need to be considered as potential ignition sources and assessed accordingly. In this case consideration shall be taken of when they occur and whether they are able to ignite the explosive atmosphere (i.e. in normal operation, expected malfunction or rare malfunction) which determines the intended category.

NOTE 2 In some cases stainless steel may be a solution to avoid single impact sparking.

6.4.2.2.2 Category 1G equipment

For category 1G equipment see Table 5.

Table 5 — Single impact energy limits for category 1G equipment

Explosion group	Single impact energy limits	
	Non-sparking metals :	Other materials, excluding materials specified in 6.4.2.1 a):
IIC	60 Nm	5 Nm (Hydrogen) 3 Nm (Hydrocarbons incl. acetylene)
IIB	125 Nm	10 Nm
IIA	125 Nm	20 Nm

NOTE These criteria do not apply for atmospheres with fuel gases such as carbon sulphide, carbon monoxide and ethylene oxide

6.4.2.2.3 Category 2G equipment

For category 2G equipment see Table 6.

Table 6 — Single impact energy limits for category 2G equipment

Explosion group	Single impact energy limits	
	Non-sparking metals:	Other materials, excluding materials specified in 6.4.2.1 a):
IIC	125 Nm	10 Nm
IIB	250 Nm	20 Nm
IIA	500 Nm	40 Nm

NOTE These criteria do not apply for atmospheres with fuel gases such as carbon sulphide, carbon monoxide and ethylene oxide

6.4.2.2.4 Category 3G equipment

For category 3G equipment see Table 7.

Table 7 — Single impact energy limits for category 3G equipment

Explosion group	Single impact energy limits	
	Non-sparking metals:	Other materials, excluding materials specified in 6.4.2.1 a):
IIC	250 Nm	20 Nm
IIB	500 Nm	40 Nm
IIA	500 Nm	80 Nm

NOTE These criteria do not apply for atmospheres with fuel gases such as carbon sulphide, carbon monoxide and ethylene oxide.

6.4.2.2.5 Equipment of category 1D, 2D or 3D

For equipment of category 1D, 2D or 3D see Table 8.

Table 8 — Single impact energy limits for categories 1D, 2D and 3D equipment

Equipment category	Single impact energy limits	
	Non-sparking metals:	Other materials, excluding materials specified in 6.4.2.1 a):
1D	125 Nm	20 Nm
2D and 3D	500 Nm	80 Nm

NOTE These values do not apply to explosive pyrotechnic or self reactive dusts which do not come under the scope of this European Standard.

6.4.3 Assessment of sparks and hot surfaces generated by friction

Friction can lead to sparks as well as to hot surfaces. For hot surfaces see 6.2.

A relative contact speed of 1 m/s is often used as the limit value below which friction ignition sources are not capable to ignite an explosive atmosphere. Experimental tests have confirmed this for many situations.

There are a few exceptions for example with extremely ignition-sensitive dusts such as sulphur and explosive gas atmospheres for example hydrogen and ethylene where there is a high contact load. Other ignition sensitive gas/air mixtures for example acetylene, carbon disulfide, carbon monoxide, ethylene oxide are also likely to be ignited.

Whether a potential frictional ignition source should be considered as effective depends on when it occurs i.e. during normal operation, expected malfunctions or under rare malfunctions.

6.4.4 External equipment parts containing light metals

6.4.4.1 Equipment-group I

Where the ignition hazard assessment shows that there is a risk of ignition from incendive friction, impact or abrasion sparks (see EN 1127-2) then the limitations given below shall apply.

Materials used in the construction of external parts of Group I equipment shall contain, by mass:

for category M1 and M2:

- not more than 15 % in total of aluminium, magnesium, titanium and zirconium and
- not more than 7,5 % in total of magnesium, titanium and zirconium.

For mining hand-held tools (e.g. pneumatic hammer) category M2 the hazard of impact sparks can be eliminated to an acceptable level by application of protective coating (layer) on the surface of light alloy parts. The effectiveness of protection against impact sparks shall be verified for combination of certain material and protective coating by tests. One of the accepted methods is given in 8.4.4.

6.4.4.2 Equipment-group II

Where the ignition hazard assessment shows that there is a risk of ignition from incendive friction, impact or abrasion sparks (see EN 1127-1) then the limitations given below shall apply.

Materials used in the construction of external parts of Group II equipment shall contain, by mass:

- a) for category 1
 - i. not more than 10 % in total of aluminium, magnesium, titanium and zirconium and
 - ii. not more than 7,5 % in total of magnesium, titanium and zirconium.
- b) for category 2
 - i. not more than 7,5 % of magnesium.
- c) for category 3
 - i. no special requirements.

6.5 Electrical ignition sources

Electrical ignition sources do not come under the scope of this European Standard. For electrical ignition sources see standards series EN 60079.

6.6 Stray electric currents, cathodic corrosion protection

6.6.1 Internal sources

Where this ignition source is created by the equipment itself it shall be considered accordingly, (e.g. induction driven processes such as a slipping permanent magnet coupling).

6.6.2 Other sources

These ignition sources are not significant for the manufacturer of mechanical equipment, see EN 1127-1.

NOTE 1 These should be considered by the user.

NOTE 2 Stray currents can flow in electrically conductive systems or parts of systems

- as return currents in power generating systems – especially in the vicinity of electric railways and large welding systems – when, for example, conductive electrical system components such as rails and cable sheathing laid underground lower the resistance of this return current path;
- as a result of a short-circuit or of a short-circuit to earth owing to faults in the electrical installations;
- as a result of external magnetic induction (e.g. near electrical installations with high currents or radio frequencies, see also 6.9); and
- as a result of lightning (see appropriate national standards).

6.7 Static electricity

6.7.1 General

Incendive discharges of static electricity can occur under certain conditions. The discharge of charged, insulated conductive parts can easily lead to incendive sparks. With charged parts made of non-conductive materials, and these include most plastics as well as some other materials, brush discharges and, in special cases, during fast separation processes (e.g. films moving over rollers, drive belts), or by combination of conductive and non-conductive materials), propagating brush discharges are also possible. Cone discharges from bulk material can also occur.

Spark discharges, propagating brush discharges and cone discharges can ignite all types of explosive gas, vapour, mist and dust atmospheres, depending on their discharge energy.

Brush discharges can ignite almost all explosive gas and vapour atmospheres. For explosive dust atmospheres they only need to be considered if the minimum ignition energy is less than 1 mJ.

The requirements for non-conductive parts of equipment and non-conductive layers on metal parts only apply if they are exposed to the explosive atmosphere and if there is a foreseeable electrostatic charging mechanism.

NOTE For further information on hazards from static electricity see CLC/TR 50404.

6.7.2 Connection facilities for earthing conducting parts

All conducting parts of equipment shall be arranged such that a dangerous potential difference cannot exist between them. If there is a possibility of isolated metal parts becoming charged and acting as an ignition source then earthing terminals shall be provided.

6.7.3 Prevention of highly efficient charge generating mechanisms (leading to propagating brush discharges on non-conductive layers and coatings)

Propagating brush discharges are considered to be an effective ignition source for gas, vapour, mist and dust air mixtures. They can arise following highly efficient charging of non-conductive layers and coatings on metal surfaces. Propagating brush discharges can be prevented in both Group I and Group II equipment from occurring by ensuring that the breakdown voltage across the layers is less than 4 kV or exclude any charging mechanism stronger than manual rubbing of surfaces.

For Group IID equipment incendive propagating brush discharges can also be prevented by ensuring that the thickness of the non-conducting layer is greater than 10 mm.

NOTE 1 Under these conditions brush discharges can occur, but for equipment of category IID they are considered not to be an ignition source, as they are not incendive for dust atmospheres with a minimum ignition energy of more than 1 mJ.

NOTE 2 Where hybrid mixtures can occur, prevention of brush discharges may be necessary.

NOTE 3 Processing of liquids or suspensions (mixing or stirring, filling or draining) can give rise to ignition risks due to static electricity.

6.7.4 Equipment group I

Equipment with non-conducting surface areas projected in any direction of more than 100 cm² (for category M1 and M2) shall be so designed that under normal conditions of use, maintenance and cleaning, danger of ignition due to electrostatic charges is avoided.

NOTE Measures according to b) and c) can prevent only brush discharges, not propagating brush discharges.

This requirement shall be satisfied by one of the following

- a) by suitable selection of the material so that the surface resistance, measured according to the method given in 8.5.8 does not exceed 1 GΩ at (23 ± 2) °C and (50 ± 5) % relative humidity; or
- b) by virtue of the size, shape and layout, or other protective methods, such that dangerous electrostatic charges are not likely to occur. This requirement can be satisfied by using the test in annex E provided propagating brush discharges cannot occur (see 6.7.3);
- c) when the non-conductive material is a coating on an earthed metal (conducting surface) the thickness is limited to less than 2 mm provided propagating brush discharges cannot occur (see 6.7.3).

6.7.5 Equipment-group II

Group II equipment where parts are susceptible to become electrostatically charged shall be so designed that under conditions of use, maintenance and cleaning, danger of ignition due to electrostatic charges is avoided.

This requirement shall be satisfied by one of the following:

- a) by suitable selection of the material so that the surface resistance of the enclosure, measured according to 8.5.8 does not exceed 1 GΩ at (23 ± 2) °C and (50 ± 5) % relative humidity;
- b) or by virtue of the size, shape and lay-out, or other protective methods, such that dangerous electrostatic charges are not likely to occur. For category 2G equipment this requirement can be satisfied by using the test in Annex D provided propagating brush discharges cannot occur (see 6.7.3);
- c) or by limitation of the surface area projected in any direction of non-conductive parts of equipment liable to become electrostatically charged as follows, see Table 9, provided propagating brush discharges cannot occur;

Table 9 — Permitted maximum projected areas for non-conductive parts of equipment liable to become electrostatically charged

Category	Permitted projected area ^c cm ²		
	IIA	IIB	IIC
1	50	25	4
2	100 ^a	100 ^a	20 ^a
3	no limit ^b	no limit ^b	no limit ^b

^a where the intended use of the equipment can result in frequent incendive discharges occurring in normal operation, the criteria for Category 1 equipment shall apply.

^b where the intended use of the equipment can result in frequent incendive discharges occurring in normal operation, the criteria for Category 2 equipment shall apply.

^c Projected area: For sheet materials the area is defined by the exposed (chargeable) area. For curved and projecting objects the area is the projection of the object giving the maximum area i.e. the shadow image. For long narrow materials such as cable, sheaths or pipes the maximum size is defined by the transverse dimension (i.e. the diameter for cable, sheaths or pipes) when it is coiled it should be treated as a sheath.

NOTE These values may be multiplied by 4 if the exposed flat areas of plastics are surrounded by conductive earthed frames.

- d) or when the non-conductive material in Group IIG equipment is a coating on an earthed metal or conducting surface which can become charged, the thickness is limited to not more than 2 mm in the case of gases and vapours of Group IIA and IIB, or not more than 0,2 mm in the case of gases and vapours of Group IIC provided in both cases propagating brush discharges cannot occur (see 6.7.3).

NOTE 1 Measures according to b), c) and d) can prevent only brush discharges but not propagating brush discharges.

NOTE 2 For group IID-equipment brush discharges will not ignite the potentially explosive dust atmosphere, and therefore there is no restriction on the thickness or surface area of such coatings provided propagating brush discharges cannot occur. Where propagating brush discharges can occur the requirements given in 6.7.3 shall apply.

NOTE 3 Further information on this topic is given in the CENELEC Technical Report CLC/TR 50404.

Where the danger of ignition by electrostatic discharges cannot be avoided by the design of the equipment a warning label shall indicate the safety measures to be applied in service. This shall be included in the information for use, see 9.2.

6.8 Lightning

This ignition source is not significant for the manufacturer of mechanical equipment and is the responsibility of the user, see EN 1127-1.

6.9 Radio frequency (RF) electromagnetic waves from 10^4 Hz to 3×10^{12} Hz

This ignition source is not significant for the manufacturer of mechanical equipment and is the responsibility of the user, see EN 1127-1.

6.10 Electromagnetic waves from 3×10^{11} Hz to 3×10^{15} Hz

This ignition source is not significant for the manufacturer of mechanical equipment and is of the responsibility of the user, see EN 1127-1.

6.11 Ionizing radiation

The requirements according to EN 1127-1 shall apply.

6.12 Ultrasonics

The requirements according to EN 1127-1 shall apply.

6.13 Adiabatic compression and shock waves

The requirements according to EN 1127-1 and EN 14986 shall apply.

6.14 Exothermic reactions, including self-ignition of dusts

The requirements according to EN 1127-1 shall apply.

7 Additional considerations

7.1 Dust deposits and other material in the gap of moving parts

The ignition hazard assessment shall consider the ignition risk that arises from dust or other material trapped between two moving parts or a moving part and a fixed part. If dust or other material remains in contact with the same moving part for a long period, it can heat up and can cause a burning deposit of dust or other material which can later ignite an explosive atmosphere. Even slow moving parts can cause a large rise in temperature.

NOTE In certain types of powder handling equipment, this type of ignition risk cannot be avoided. In this case, one or more of the protective measures described in EN 1127-1 can be used.

7.2 Opening times of enclosures

Enclosures which can be opened more quickly than the time necessary for an ignition source to become non-effective, (e.g. to allow the cooling of enclosed hot parts to a surface temperature below the temperature class limit or the marked temperature of the equipment) shall be marked with the warning:

"AFTER STOPPING, DELAY X MINUTES BEFORE OPENING"

"X" being the value in minutes of the delay required.

Alternatively the equipment may be marked with the warning:

"DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT"

This information shall be included in the instructions for use.

7.3 Non metallic parts of the equipment

7.3.1 General

The following requirements, and also those of 8.5, apply to all non-metallic parts of the equipment which are relevant for the explosion prevention and protection, e.g. plastic parts, glass windows, etc. and to non-conductive layers on metal parts.

7.3.2 Specification of the materials

Materials shall be specified and documented according to 9.1, this specification shall include:

- the complete reference of the material;
- the applied surface treatments, such as varnishes, etc.

7.3.3 Thermal endurance

The endurance to heat and to cold shall be such that the level of explosion prevention and protection is not reduced.

Plastic materials shall have a temperature index TI corresponding to the 20 000 h point (see EN 60079-0:2006, 7.1.3) of at least 20 K greater than the local maximum surface temperature having regard to the maximum ambient temperature.

7.4 Removable parts

It shall be ensured that parts necessary for the level of explosion prevention and protection cannot be unintentionally or inadvertently removed. This may be achieved by for example the use of fasteners that need a tool or key to remove them.

7.5 Materials used for cementing

The manufacturer's technical documentation submitted according to 9.1 shall verify that for the intended operating conditions, the materials used for cementing, and on which safety depends, have a thermal stability adequate for the maximum temperature to which they will be subjected, within the rating of the equipment. The thermal stability is considered adequate if the limiting value for the material exceeds this maximum temperature by at least 20 K.

NOTE If the cementing has to withstand adverse service conditions, appropriate measures should be agreed between user and manufacturer (see 5.1).

7.6 Light transmitting parts

For equipment group I and equipment group II category 1 and 2:

Light transmitting parts, whose integrity is of relevance for the ignition protection shall be capable of passing the relevant tests according to 8.4.1 or provided with a cover or permanent guard that is capable of passing the relevant test.

NOTE Sight glasses are commonly used to check the status (e.g. level, quality) of lubricating agents used for equipment with rotating parts.

Before a decision on testing is made it shall be checked whether the damage of a sight glass can occur, depending on its location and mounting position, and whether the damage can result in

- a) a loss of liquids that can lead to spontaneous dry run and cannot be detected within routine maintenance cycle or
- b) an auto-ignition of the leaking product because it comes into contact with hot surfaces and thus can act as an ignition source for the flammable atmosphere.

If a loss of liquid is not dangerous according to a) or auto-ignition is not relevant according to b) a damaged sight glass is not deemed to be critical for the type of explosion protection and an impact test according to 8.4.1 need not to be applied.

8 Verification and tests

8.1 General

The verifications and tests are intended to verify that the equipment complies with the relevant requirements of this standard and with the relevant requirements of the European Standard for the specific type of ignition protection concerned. These may be used as type tests or routine tests as appropriate.

Those parts of the equipment which are relevant for the explosion prevention and protection shall be subjected to the appropriate tests. Each test shall be made in that configuration of the equipment which is considered the most unfavourable, relevant to explosion prevention and protection. A test may be omitted if it is judged to be unnecessary, in which case the justification for its omission shall be recorded in the ignition hazard assessment.

8.2 Determination of the maximum surface temperature

8.2.1 General

The maximum surface temperature shall be determined under the most adverse conditions at the most unfavourable load defined by the manufacturer and according to the category. The determination of the maximum surface temperature shall take account of normal operation for category 3 equipment, of expected malfunctions for category 2 equipment, rare malfunctions for category 1 equipment and any additional measures to control or limit the temperature.

Similarly for Group I, category M2 equipment the determination of the maximum surface temperature shall take account of those faults that cannot be disregarded by virtue of the equipment being designed to be de-energised in the event of an explosive atmosphere. For Group I M1 see the requirements of EN 50303.

The measurement of the surface temperatures and temperatures of other parts as prescribed in this European Standard and the specific European Standards for the types of protection concerned shall be made in still ambient air, with the equipment mounted in its normal service position. Air movement due to the function of the equipment is permitted. The temperature of the hottest point of the equipment in contact with the explosive atmosphere shall be determined resulting in the highest surface temperature.

For equipment which can be normally used in different positions, the temperature in each position is to be determined and the highest temperature is to be considered. When the temperature is determined for certain positions only, this shall be specified in the test report and the equipment shall be marked either by the symbol "X" marking or by a label.

The measuring devices (thermometers, thermocouples, contactless temperature measuring device, etc.) and the connecting cables shall be selected and so arranged that they do not significantly affect the thermal

behaviour of the equipment. The accuracy of the measuring devices shall be at least 2% of the measured value in °C or ± 2 K which ever is the greater.

The final temperature is considered to have been reached when the rate of rise of temperature does not exceed 2 K/h or after operation of any temperature limiting device forming part of the equipment.

Where there is no temperature limiting device the result shall be corrected for the maximum ambient temperature specified in the rating by adding the difference between the ambient temperature used in the test and the ambient temperature during the rating to the measured temperature.

The highest surface temperature measured shall not exceed:

- a) for Group I equipment, those values as given in 6.2;
- b) for Group II Category 1G equipment:
 - i. 80 % of the marked maximum surface temperature or 80 % of the lower limit of the marked temperature class or 80 % of the ignition temperature in °C of the substance used for marking;
- c) for Group II Category 2G- and Category 3G-equipment:
 - i. where each manufactured sample is routinely submitted to the thermal test, the temperature as marked on the equipment;
 - ii. where the equipment is subjected to type testing, the marked maximum surface temperature, or the temperature class limit,
 - less 5 K for temperature classes T6, T5, T4 and T3 (or marked maximum surface temperatures ≤ 200 °C), and
 - less 10 K for temperature classes T2 and T1 (or marked maximum surface temperatures > 200 °C).
- d) for Group IID-equipment:
 - i. the marked maximum surface temperature on the equipment, which shall be the actual maximum surface temperature, or, if appropriate,
 - ii. the temperature restricted to the specific combustible dust for which it is intended.

NOTE Where direct measurement of surface temperature is not possible, other methods can be applied, e.g. calculation.

8.2.2 Maximum surface temperature in special cases

In special cases the above temperature limits may be exceeded, if there is proven evidence, that the explosive atmosphere cannot be ignited by the hot surface under consideration.

The assessment shall include conditions according to the category required as given in 8.2.1, paragraphs one and two.

Special ignition tests are carried out to determine the temperature at which ignition/non-ignition occurs or to determine the maximum temperature at which no ignition occurs. The following safety margins are then applied to this temperature:

- a) 25 K for T4, T5 and T6 and Group I;
- b) 50 K for T1, T2 and T3.

These safety margins shall be ensured by experience of similar parts or by tests of the equipment itself in representative explosive atmospheres.

8.3 Flammability test

If the ignition hazard assessment has shown that the overheating of non metallic materials could lead to smouldering and then burning the material shall be tested.

Examples of suitable tests are given in IEC 60695 and EN 13501-1.

8.4 Mechanical tests

8.4.1 Test for resistance to impact

The equipment shall be submitted to the effect of a test mass of 1 kg falling vertically from a height (h) into the outer enclosure. The height (h) is dependent on the impact energy (E) which is specified in Table 10 according to the application of the equipment ($h = E/10$; h in metres and E in Nm). The weight shall be fitted with an impact head in hardened steel in the form of a hemisphere of 25 mm diameter.

Before each test, it is necessary to check that the surface of the impact head is in good condition.

The test for resistance to impact shall be made on equipment which is completely assembled and ready for use; however, if this is not possible (e.g. for light-transmitting parts) the test is made with the relevant parts removed but fixed in their mounting or an equivalent frame. Tests on an empty enclosure are permitted only if appropriate in which case the justification shall be recorded in the technical documentation.

For light-transmitting parts made of glass, the test shall be made on three samples but only once on each. In all other cases the test shall be made on two samples, at two separate places on each sample.

The points of impact shall be the places considered to be the weakest. The test shall be restricted to those parts of the equipment where impacts from the outside can occur during the use of the equipment. The equipment shall be mounted on a steel base so that the direction of the impact is normal to the surface being tested if it is flat, or normal to the tangent to the surface at the point of impact if it is not flat. The base shall have a mass of at least 20 kg or be rigidly fixed or inserted in the floor (secured in concrete, for example). Annex E shows a suitable test rig.

Table 10 — Tests of resistance to impact

Group	Impact Energy Nm			
	I		II	
Risk of mechanical danger	High	Low	High	Low
1. Guards, protective covers, hoods, entries	20	7	7	4
2. Plastics equipment	20	7	7	4
3. Light metal or cast metal enclosures	20	7	7	4
4. Enclosures of other materials than in 3 with wall thickness	20	7	7	4
– less than 3mm for Group I – less than 1mm for Group II				
5. Light-transmitting parts without guard	7	4	4	2
6. Light-transmitting parts with guard(tested without guard)	4	2	2	1

When an equipment is submitted to tests corresponding to the low risk of mechanical danger, it shall be marked with the symbol "X" according to 9.3.2 i).

Normally the test is carried out at an ambient temperature of $(20 \pm 5) ^\circ\text{C}$, except where the material data shows it to have a reduction in resistance to impact at lower temperatures within the specified ambient range, in which case the test shall be performed at the lowest temperature within the specified range.

When the equipment has an enclosure or a part of an enclosure in plastics material, including plastic hoods and ventilation screens in rotating equipment, the test shall be carried out at the upper and lower temperatures according to 8.5.1.

8.4.2 Drop test

In addition to being submitted to the resistance to impact test according to 8.4.1, handheld equipment or equipment carried on the person, ready for use, shall be dropped four times from a height of 1 m on to a horizontal concrete surface. The position of the sample for the drop test shall be stated in the report.

For equipment with an enclosure in other than plastics material the test shall be carried out at a temperature of $(20 \pm 5) ^\circ\text{C}$, except where the material data shows it to have a reduction in resistance to impact at lower temperatures within the specified ambient range, in which case the test shall be performed at the lowest temperature within the specified range.

For equipment which has enclosures or parts of enclosures made of plastics material the tests shall be carried out at the lower ambient temperature according to 8.5.1.

8.4.3 Required results

The resistance to impact and drop tests shall not produce damage which degrades the level of protection of the equipment.

External fanhoods and ventilation screens shall not be displaced or deformed causing rubbing of the moving parts.

8.4.4 Tests for surface protective coating for group I category M2 equipment

8.4.4.1 General

The light alloy parts, protected by protective coating shall pass both following tests (impact test in explosive atmospheres and adhesion tests).

8.4.4.2 Impact ignition tests in explosive mixture

8.4.4.2.1 Verification of ignition of the raw light alloy material

The subject of the test is the evaluation of spark ignition hazard of material used by the manufacturer for the production of equipment.

The test shall be carried out on a series of at least 3 different samples, manufactured from the tested raw material.

One test series is represented by the 20 impact tests. For each test series one sample is used.

The impact test shall be done in an explosive atmosphere containing the 6,5 % to 7 % CH₄ V/V, 25 % to 26 % of oxygen in nitrogen. The tests shall be done in a test rig – see Figure F.1, with impact energy 400 Nm.

The angle between the falling test sample and the corroded steel plate shall be 55° to 60° measured from the horizontal plane. The corrosion of the steel plate in the impact point shall be in form of the continuous layer containing the corrosion particle at least 0,1 mm in dimension.

NOTE For preparation of corroded steel plate the following method should be used:

degreasing of the plate, wetted in 15 % solution of HCl, rinsing in water, drying and 5 days exposition in vapour of 15 % to 20 % HCl solution at room temperature.

The test mixture shall be refreshed after a series of 10 impact tests. After each of 10th impact the mixture shall be ignited by the electrical spark plug located inside on the upper wall of chamber.

The maximum number of ignitions during the test series is only 1 ignition.

8.4.4.2.2 Estimation of protective coating efficiency

The light alloy raw material with the content of minimum 90% w/w Mg is used for the purpose of tests.

This raw material is coated by the protective coating by using the technology identical to the technology used by manufacturer. The test shall be carried out on at least 3 different samples, manufactured of the tested raw material.

One test series is represented by the 20 impact experiment. For each test series one sample is used.

The impact test shall be done in explosive atmosphere containing the 6,5 % to 7 % CH₄ V/V, 25 % to 26 % of oxygen in nitrogen. The tests shall be done in a test rig – see Figure F.1, with impact energy 400 Nm.

The angle between the falling test sample and the corroded steel plate shall be 55° to 60° measured from the horizontal plane. The corrosion of the steel plate in the impact point shall be in form of the continuous layer containing the corrosion particle at least 0,1 mm in dimension.

The test mixture shall be refreshed after a series of 10 impact tests. After each of 10th impact the mixture shall be ignited by the electrical spark plug located inside on the upper wall of chamber.

The maximum number of ignitions is only 1 for each of the test series.

8.4.4.2.3 Interpretation

If the number of ignitions is not higher than the accepted values mentioned in 8.4.4.2.1 and 8.4.4.2.2, the equipment manufactured of the tested material and additionally coated by the approved protective coating, can be assessed as the equipment of category M2. This methodology is applicable only for the non-electrical mining hand tool equipment.

8.4.4.3 Adhesion test of the protective coating

The aim of the test is the determination of adhesive properties of the protective coating, on the raw material.

The same raw material as being used for the manufacturing of equipment and the same coating technology shall be used for the preparation of samples. The samples shall be prepared without the final layer of paint, which is not considered to protect against mechanically generated sparks.

The protective coating adhesion test shall be tested on the 6 test samples according to EN 582.

The tensile adhesive strength of all tested samples shall not be less than 20 MPa.

8.5 Additional tests of non-metallic parts of the equipment relevant for explosion protection

8.5.1 Ambient temperatures during tests

When, according to this European Standard or to the specific European Standards listed in Clause 1, tests shall be made as a function of the permissible upper and lower design temperature values, the ambient temperatures used during the tests shall be:

- for the upper design temperature, the maximum design temperature (see 6.2.2) increased by at least 10 K but at most 15 K;
- for the lower design temperature, the minimum design temperature (see 6.2.2) reduced by at least 5 K but at most 10 K.

8.5.2 Tests for equipment-group I

The tests shall be made as follows:

- 2 samples shall be submitted to the tests of thermal endurance to heat (see 8.5.4), then the tests of thermal endurance to cold (see 8.5.5), then the mechanical tests (see 8.5.7) and finally to the tests specific to the type of ignition protection concerned.
- 2 samples shall be submitted to the tests of resistance to oils and greases (see 8.5.6) then to the mechanical tests (see 8.5.7) and finally to the tests specific to the type of ignition protection concerned.
- 2 samples shall be submitted to the tests of resistance to hydraulic liquids for mining applications (see 8.5.6) then to the mechanical tests (see 8.5.7) and finally to the tests specific to the type of ignition protection concerned.

NOTE In the procedures and test sequences described above, the objective is to demonstrate the performance of the non-conductive material relevant to the level of protection or the type of ignition protection listed in Clause 1 after exposure to extremes of temperature and harmful substances likely to be met in use. In an attempt to keep the number of tests to a minimum it is not necessary to perform all of the tests specific to the type of ignition protection on every sample if it is obvious that a sample has not been damaged in such a way as to impair the type of ignition protection offered. Similarly, the number of samples can be reduced if it is possible for the exposure tests and protection proving tests to be performed in parallel on the same two samples.

8.5.3 Tests for equipment-group II

The tests shall be made on 2 samples which shall be submitted to the tests of thermal endurance to heat (see 8.5.4) then to tests of thermal endurance to cold (see 8.5.5) then to the mechanical tests (see 8.5.7) and finally to the tests specific to the type of ignition protection concerned.

8.5.4 Thermal endurance to heat

The thermal endurance to heat is determined by submitting the non-metallic parts of the equipment relevant to the level of protection to continuous storage for four weeks in ambient conditions of (90 ± 5) % relative humidity and at a temperature of (20 ± 2) K above the maximum design temperature but at least 80 °C.

In the case of a maximum service temperature above 75 °C the period of four weeks specified above will be replaced by a period of two weeks at (95 ± 2) °C and (90 ± 5) % relative humidity followed by a period of two weeks at a temperature of (20 ± 2) K higher than the maximum design temperature.

8.5.5 Thermal endurance to cold

The thermal endurance to cold is determined by submitting the non-conductive parts of the equipment relevant to the level of protection to storage for 24 h in ambient conditions corresponding to the minimum design temperature reduced according to 8.5.1.

8.5.6 Resistance to chemical substances for Group I equipment

The plastics enclosures and plastics parts of enclosures shall be submitted to tests of resistance to the following substances:

- oils and greases,
- hydraulic liquids for mining applications,

if they can come into contact with these substances.

The relevant tests shall be made on four samples of enclosure sealed against the intrusion of test liquids into the interior of the enclosure:

- two samples shall remain for (24 ± 2) h in oil No 2 according to Annex A "Reference immersion liquids" of ISO 1817:2005, at a temperature of 50 °C.
- the two other samples shall remain for (24 ± 2) h in an hydraulic liquid of Group HFC (aqueous solution of polymer in 35 % water) at a temperature of 50 °C, according to "Seventh Report on the Specifications and Testing Conditions relating to Fire-resistant Hydraulic Fluids Used for Power Transmission (Hydrostatic and Hydrokinetic) in Mines", Commission of the European Communities Safety and Health Commission for Mining and Extractive Industries, Luxembourg 1994,

At the end of the test, the enclosure samples concerned shall be removed from the liquid bath, carefully wiped and then stored for (24 ± 2) h in the laboratory atmosphere. Subsequently, each of the enclosure samples shall pass the mechanical tests according to 8.5.7.

8.5.7 Mechanical resistance tests

In the case of non-metallic parts of the equipment relevant to the level of protection mechanical tests according to 8.4 shall be carried out.

The following detailed conditions shall be observed:

a) Test for resistance to impact

- The places of impact shall be on the external parts exposed to impact. If the enclosure of non-metallic material is protected by another enclosure, only the external parts of the assembly shall be subjected to the resistance to impact tests.
- The test shall first be made at the highest temperature, then at the lowest temperature, according to 8.5.1.

b) Drop test

The drop test for equipment which is held in the hand or carried on the person, shall be made at the lowest temperature, according to 8.5.1.

8.5.8 Surface resistivity test of non-conductive parts of the equipment relevant for explosion prevention and protection

The test shall be made in accordance with CLC/TR 50404.

8.5.9 Thermal shock test

Glass parts and windows of equipment shall withstand, without degrading the level of protection, a thermal shock caused by a jet of water of about 1 mm diameter at a temperature (10 ± 5) °C sprayed on them when they are at maximum service temperature.

9 Documentation and information for use

9.1 Technical documentation of the manufacturer

The manufacturer's technical file shall give a full and correct specification of the explosion safety aspects of the equipment including the results of relevant tests.

It shall also show that the requirements of this European Standard and of the specific European Standards for the types of ignition protection concerned have been observed for the design and construction of the equipment.

This documentation shall include at least:

- ignition hazard assessment report;
- description of the equipment;
- design and manufacturing drawings;
- all descriptions and explanations necessary for the understanding of drawings;
- material certificates if necessary;
- test reports of tests described in Clause 8;
- documents specified in 9.2.

9.2 Information for use

All equipment shall be accompanied by instructions including at least the following particulars:

- a) a recapitulation of the information with which the equipment is marked, except for the serial number, together with any appropriate additional information to facilitate maintenance (e.g. address of the importer, repairer, etc);
- b) description of the intended use of the equipment;
- c) a summary of the hazards identified and the preventive and/or protective measures used;
- d) instructions for safe use:
 - i. all parts of the instructions relevant for explosion protection including for example procedures to be carried out before start up and during lifetime use to ensure the safe use of the equipment;
 - ii. putting into service;
 - iii. use;
 - iv. assembling and dismantling;
 - v. maintenance (servicing and emergency repair);
 - vi. installation;
 - vii. adjustment;
- e) where necessary, an indication of any special hazard arising from the use of the equipment e.g. danger areas in front of pressure-relief devices;
- f) where necessary training instructions;
- g) details which allow a decision to be taken beyond any doubt as to whether an item of equipment in a specific category can be used safely in the intended area under the expected operating conditions;

NOTE This information is generated as a consequence of carrying out the ignition hazard assessment. Sometimes a manufacturer will be aware of ignition risks that come from the process, that cannot be controlled by the design of the equipment. In this case the manufacturer should inform the user that additional precautions will be needed.

- h) pressure parameters, maximum surface temperatures and other limit values;
- i) where necessary, special conditions of use, including particulars of possible misuse which experience has shown might occur;
- j) where necessary, the essential characteristics of accessories which may be fitted to the equipment.

The instructions shall contain text, drawings and diagrams necessary for the putting into service, maintenance, inspection, checking of correct operation and, where appropriate, repair of the equipment, together with all useful instructions, in particular with regard to safety.

9.3 Marking

9.3.1 General

The equipment shall be marked on the main part in a visible place. This marking shall be legible and durable taking into account possible chemical corrosion.

The equipment shall be marked according to the category and protection both inside and outside where appropriate.

9.3.2 Marking according to this standard

The marking shall include:

- a) name and the address of the manufacturer;
- b) manufacturer's type identification;
- c) year in which the equipment was manufactured;
- d) symbol of the equipment group and the category (M1 or M2 for Group I mining equipment, or 1 or 2 or 3 for Group II non-mining equipment),
 - i. additionally for equipment Group II equipment only:
 - 1) the letter "G" where explosive atmospheres caused by gases, vapours or mists are concerned;
and/or
 - 2) the letter "D" where explosive atmospheres caused by dusts are concerned;
- e) if a type of protection is used, the symbol for each type of ignition protection, which indicates that the equipment corresponds to one or more of the types of protection listed in Clause 1 of this European Standard.

NOTE The following symbols are used:

- 'fr': for a flow restricting enclosure
- 'd': for a flameproof enclosure
- 'c': for constructional safety
- 'b': for control of ignition source
- 'p': for pressurised equipment
- 'k': for liquid immersion

where appropriate, the symbol of the explosion group of the equipment according to 4.2, Table 1. When the equipment is designed for use only in a particular gas or dust, the symbol "II" shall be followed by the chemical formula, or name of the gas or dust.

- f) for Group II equipment, the symbol indicating the temperature class or the maximum surface temperature in °C, or both. When the marking includes both, the temperature class shall be given last in parentheses. Accessories used for connecting equipment parts need not be marked with the temperature class.

EXAMPLE T1 or 350 °C or 350 °C (T1).

Equipment for Group II, having a maximum surface temperature greater than 450 °C, shall bear only the inscription of the temperature. Example: 600 °C.

Equipment for Group II, designed and marked for use in a particular gas, need not have a temperature reference.

Where the actual maximum surface temperature depends not on the equipment itself, but mainly on operating conditions (like a heated fluid in a pump), a single temperature class or temperature cannot be marked by the manufacturer. A reference to this situation shall be included in the marking by using a TX marking and the relevant information shall be given in the instructions for use.

- g) where appropriate, for both Group I and Group II equipment, the ambient temperature marking as shown in Table 11 below:

Table 11 — Ambient temperature marking

Equipment	Ambient temperature in service	Additional marking
Normal	Maximum : + 40 °C Minimum: - 20 °C	None
Special	Stated by the manufacturer and specified in the instructions for use.	T_a or T_{amb} with the special range. For example "0 °C < T_a ≤ 60 °C" Or the symbol "X"

- h) a serial number, except for:
- i. accessories (entries, blanking plates, adapter plates)
 - ii. very small equipment on which there is limited space. (The batch number can be considered to be an alternative to the serial number.)
- i) if special conditions for safe use apply, the symbol "X" shall be used. The use of a warning marking giving appropriate instructions can be used as an alternative to the requirement for the "X" marking;

The manufacturer shall ensure that the requirements of the special conditions for safe use are passed to the user together with any other relevant information in the instructions for use.

- j) any additional marking prescribed in the specific European Standards for the types of ignition protection concerned, as listed in Clause 1; and
- k) any marking normally required by the standards of construction of the equipment.

Where the equipment is suitable for use in explosive atmospheres containing gas, vapour mists and dusts, both of the relevant categories shall be included. Where different types of protection are used on different parts of non-electrical apparatus, each respective part shall bear the symbol for the type of protection concerned.

Where more than one type of protection is used, the symbol for the main type of protection shall appear first and be followed by the symbols of the other types of protection used.

9.3.3 Marking on very small equipment

On very small equipment where there is limited space, a reduction in the marking is permitted and all other marking may be given on the packaging and the accompanying documents, but at least the following information is required on the equipment itself:

- a) name or registered trade mark of the manufacturer;
- b) symbol of the type of protection;
- c) symbol "X" if appropriate.

9.4 Examples of the full marking (informative)

NOTE The symbols given below are under discussion for the standards on ignition protection under preparation.

9.4.1 Example showing an item of Group II, non-electrical equipment certified to this standard

Category 1, with type of ignition protection constructional safety 'c' and liquid immersion 'k', suitable for IIB-gases, vapours and mists with an auto ignition temperature > 135 °C (T4):

BEDELLE , FR - Paris, Rue Napoleon.	=	name and address of manufacturer
Type A B 5 – 2001	=	type of equipment and year of production
II 1G IIB T4 c / k	=	marking according to Group II, Cat 1, Gas and type of ignition protection
Ser. No. 32567	=	serial number

NOTE Attention is drawn to the "/" between the two independent types of ignition protection applied to the same ignition source.

9.4.2 Example showing an item of Group II, category 2 equipment

Category 2, with type of ignition protection constructional safety 'c' and liquid immersion 'k' for different parts of the equipment, suitable for IIB-gases, vapours and mists with an auto ignition temperature > 135 °C (T4):

BEDELLE , FR - Paris, Rue Napoleon.	=	name and address of manufacturer
Type A B 6 – 2001	=	type of equipment and year of production
II 2G IIB c k T4	=	marking according to Group II, Cat 2, Gas and type of ignition protection
Ser. No. 32567	=	serial number

NOTE There is no "/" between the two combined types of ignition protection applied to different ignition sources.

9.4.3 Further examples of the ignition protection marking (only informative)

9.4.3.1 Example of equipment Group II, category 2 for gas ignition protection flameproof suitable for IIB-gases, vapours and mists with an auto ignition temperature > 135 °C (T4)

II 2G d IIB T4

9.4.3.2 Example of equipment Group II, category 3 suitable for gases, vapours and mists with an auto ignition temperature > 135 °C (T4) without specified type of ignition protection

II 3G T4

9.4.3.3 Example for equipment Group II, category 2 suitable for dusts with ignition protection constructional safety and a maximum surface temperature of 110 °C

II 2D c T110°C

9.4.3.4 Example for marking for gas and dust atmospheres suitable for gases, vapours and mists with an auto ignition temperature of 230 °C and for dusts with a maximum surface temperature of 230 °C

II 2GD c T230 °C

9.4.3.5 Example for marking of equipment having two categories e.g. for different parts of the equipment

II 2G d T3 / 1G c T2 X

Annex A (normative)

Methodology for confirming the category

A.1 Methodology for confirming the category of Equipment-group I

A.1.1 Category M1 Equipment

Apply the appropriate requirements for Category M1 of EN 50303:2001 which refers to the standards for the specific types of protection listed in Clause 1 and to the requirements of this European Standard. If no single type of protection is suitable to provide protection for Category M1, it will be necessary to employ simultaneously two types of protection as provided for in EN 50303:2001.

A.1.2 Category M2 Equipment

Identify potential ignition sources which are effective or can become effective in normal operation and expected malfunctions in the event of severe operating conditions such as those arising from rough handling and changing environmental conditions.

If no effective ignition sources are identified, apply the requirements of this European Standard.

If ignition sources are identified, apply the appropriate requirements for at least Category M2 of one of the standards for the specific types of ignition protection listed in Clause 1 in addition to the requirements of this European Standard.

A.2 Methodology for confirming the Category of Equipment-group II

A.2.1 Category 1 Equipment

Identify potential ignition sources which are effective or can become effective in normal operation, in the case of expected malfunctions and in the case of rare malfunctions.

If no effective ignition sources are identified, apply the appropriate requirements of this European Standard.

If effective ignition sources are identified, apply the appropriate requirements for at least Category 1 of one of the standards for the specific types of ignition protection listed in Clause 1 of this European Standard in addition to the requirements of this European Standard. If no single type of ignition protection is suitable to provide protection for Category 1, it will be necessary to employ simultaneously two independent types of protection, each of them suitable for Category 2 in accordance with Clause 5..

The ignition protection flow restricting enclosure, "fr", is not suitable for category 1 equipment.

A.2.2 Category 2 Equipment

Identify potential ignition sources which are effective or can become effective in normal operation and in the case of expected malfunctions.

If no effective ignition sources are identified, apply the appropriate requirements of this European Standard.

If effective ignition sources are identified, apply the appropriate requirements for at least category 2 of one of the standards for the specific types of ignition protection listed in Clause 1 in addition to the requirements of this European Standard.

The ignition protection flow restricting enclosure is not suitable for category 2 equipment.

A.2.3 Category 3 Equipment

Identify potential ignition sources which are effective or can become effective in normal operation.

If no effective ignition sources are identified, apply the appropriate requirements of this European Standard.

If effective ignition sources are identified, apply the appropriate requirements for at least category 3 of one of the standards for the specific types of ignition protection listed in Clause 1 in addition to the requirements of this European Standard.

Annex B (informative)

Explanation of the ignition hazard assessment procedure

B.1 General

It is intended to provide assistance for implementing the assessment procedure and the individual assessment steps. A special way of reporting is explained guiding systematically through the assessment procedure and resulting in well directed and traceable statements. For manufacturers the report offers additional support for the preparation of the essential technical documentation. Further explanation of the general procedure is given in EN 15198. Technical examples for the implementation of the procedure are shown in Annex C.

NOTE In any case, the Directive 94/9/EC requires a technical documentation (in its Appendix III, VIII and IX; one of these is mandatory). The necessary evidence should be determined for each protective measure because of the ATEX requirements for the technical documentation: "The technical documentation shall enable the conformity of the product with the requirements of the Directive to be assessed. It shall, to the extent necessary for such assessment, cover the design, manufacture and operation of the product ..."

B.2 Reporting with the help of a table

It is not essential to report about the ignition hazard assessment in a specific manner. But it is useful to report in a well-structured way in order to ensure clearness and comprehensibility. Therefore, the use of a table is recommended representing the structure of the assessment procedure and, thus, allowing for easy reassessment and supporting the compilation of the technical documentation.

Annex C shows different examples of an ignition hazard assessment report using an adequate reporting scheme cited as an example in EN 15198. Therewith, it is possible to proceed in a clear way, to structure methodically and to identify necessary statements, measures and evidence i.e. essential parts of the technical documentation. Therefore, it should ease a well directed fulfilment of the requirements by the manufacturers. This reporting scheme provides for assimilating all necessary information and should not require additional statements beyond the table.

NOTE The reporting scheme presented in Annex C and cited as an example in EN 15198 is only one of the alternatives. Different ways of reporting are possible provided the required content is completely covered (see 5.2.6). Unused parts of the table can be left blank or can be deleted.

B.3 Assessment Procedure

The ignition hazard assessment procedure can be divided into the following steps:

- 1) Identification of ignition hazards (analysis of the ignition hazards and their causes),
- 2) Preliminary ignition hazard estimation and evaluation (estimation of the ignition hazards determined in step 1 regarding the frequency of their occurrence and comparison with the target category),
- 3) Determination of measures (determination of preventive and/or protective measures, if necessary, to reduce the probability of an ignition hazard according to step 2),
- 4) Finally ignition hazard estimation and categorisation (estimation of the ignition hazards regarding the frequency of occurrence after including preventive and/or protective measures determined in step 3),
- 5) Determination of the equipment category.

If modifications are made to the design to incorporate additional protective or preventative measures, the assessment process should be reviewed to check for new potential faults or ignition hazards. Particularly, attention should be paid to new interdependencies or combinations of malfunctions, if applicable for the equipment category.

B.4 Assessment Steps

B.4.1 Identification of Ignition Hazards

This step will result in a complete list of all ignition hazards applicable to the equipment (see Clause 4, 5.2.1 and Clause 6). At first, the known list of potential ignition sources representing different physical ignition mechanisms (given e.g. in 5.2.1 and in EN 1127-1) should be examined (see Table B.1). It should be determined which types of ignition sources are possible (see Table B.2, Column 1 a).

Table B.1 —Table showing recommended documentation of initial assessment of equipment related ignition sources

Possible Ignition Sources (List from EN 1127-1)	Equipment Related Yes/No	Reason
Hot surfaces	Yes	Inside and Outside - Gas compression, Vane friction, Particle ingress
Mechanical sparks	Yes	Particles could produce hot-spots
Flames, hot gases	Outside No Inside Yes	inside Compression temperature To be measured - gas temperature directly at exhaust
Electrical sparks	No	Not Present
Stray electric currents and cathodic corrosion protection	No	Not present
Static electricity	Yes	Vanes, Lipseal, Exhaust filter, float valve
Lightning	No	Not present
Electromagnetic waves	No	Not present
Ionising radiation	No	Not present
High frequency radiation	No	Not present
Ultrasonics	No	Not present
Adiabatic compression	Yes	Inside chamber
Chemical reaction	Yes	Possible with process fluid/gas

Subsequently these ignition sources should be considered separately with regard to differences in

- intended use or possible application,
- constructional variants,
- operating conditions or working cycles including their variations (start, stop, load alternations etc.),
- influences of the ambience (temperature, pressure, humidity, energy supply etc.),

- material parameters or their interdependencies (metallic, non metallic, electrostatic chargeable liquids etc.),
- interdependencies with components or other pieces of equipment,
- interdependencies with persons (including foreseeable misuse),
- if required, combinations of malfunctions (category 1).

Table B.2 — Example for reporting of the identification of ignition hazards (step 1) and the first assessment (step 2)

	1		2				
	Ignition hazard analysis		Assessment of the frequency of occurrence without application of an additional measure				
	a	b	a	b	c	d	e
No.	Potential ignition source	Description of the basic cause (Which conditions originate the ignition hazard?)	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	Reasons for assessment
1	electrostatic discharge	parts of non metallic material with a surface resistance exceeding 1 GΩ		x			no charging during normal operation; material is an outer part of the casing; charging could be done by a person (operator)

Constructive features (e.g. non-conductive material with a resistance below 1 GΩ) may be assumed provided that they will not be changed because they are necessary for other reasons. (see Table B.2, Column 1 b). Types of protection like Flameproof Enclosure (see EN 13463-3) or Control of Ignition Sources (see EN 13463-6) should not be considered in this first step. Otherwise it could be ignored that those measures are not necessary or that other measures are more effective or may save costs. For the analysis of the ignition hazards, all utilizable information sources should be used (discussions with experts from test houses, universities, users, other manufactures etc.) and all accessible examples should be examined. In the case of very complex equipment, ignition hazard analysis should be supplemented by one or more systematic methods like FMEA or fault tree analysis.

B.4.2 Preliminary Ignition Hazard Estimation and Evaluation

In this step the individual ignition hazards are evaluated to determine, how often an individual ignition source may become effective (see Table B.2, Column 2). In doing so the ignition sources are considered exactly in the form, in which they are laid down in column 1, i.e. under inclusion of the constructive features that will be applied in any case. From the result of the preliminary ignition hazard estimation (see Table B.2, Column 2 a to d) it is clear whether additional measures are necessary in step 3 in order to meet the target category (ignition hazard evaluation; see EN 15198). In Table B.2, Column 2 e the reasons for the results of the evaluation can be reported if not self-explanatory (see 5.2.6).

The individual estimation results and decisions can be never of general validity, e.g. for a complete group of products like pumps, brakes or gears. As a general rule, they depend on the special design of the type or even of the individual piece of equipment. Thus, in this step – in contrast to the prior step 1 (hazard analysis) –

all criteria shown as an example (including those from standards) should be treated carefully and with extreme reserve. The estimation should be based ultimately on a certain design and could differ even within the variants of a type design (size, alternative assembly etc.). Typical ignition hazards, which are accessible to general consideration, are usually given in (harmonized) standards along with special constructive requirements and test procedures. Such valuations given in the normative parts of standards (e.g. electrostatic requirements) meaning the appropriateness for a certain equipment category, can be adopted without special analysis.

B.4.3 Determination of Measures

If the evaluation shows the application is required to meet the target category adequate preventive and/or protective measures are determined in this step (see Table B.3, Column 3). It is necessary to define these measures in such a way that possible ignition sources cannot become effective or the probability of the ignition source becoming effective is sufficiently low. These measures should not be confused with types of protection according the list in Clause 1. The term preventive and protective measures is meant in a broader sense: measures with the purpose of explosion protection. Therefore, the term contains also all measures during putting into service, maintenance and repair, operation, warning notices, experimental investigations providing for evidence etc. which will decrease the probability of the ignition source becoming effective. Types of protection are only a subset of the measures.

Table B.3 — Example for reporting of the determination of preventive or protective measures (step 3) and the concluding estimation and categorisation (step 4)

3			4					
Measures applied to prevent the ignition source becoming effective			Frequency of occurrence incl. all measures					
a	b	c	a	b	c	d	e	f
Description of the measure	References (standards, technical rules, experimental results known from literature)	Technical documentation (evidence including relevant features listed in column 3 a)	during normal operation	during anticipated malfunction	during rare malfunction	not relevant	resulting equipment category in respect of this ignition hazard	necessary restrictions
largest area less than 25 mm ²	EN 13463-1:2008, clause 6.7.5 c), 7.3.2, 7.3.3	<ul style="list-style-type: none"> – specifications of the material (clause 7.3.2.); – parts list, pos. Z; – drawing No. Y 				x	1G	IIB

Table B.3 includes the description of the measure (see Table B.3, Column 3 a), the reference showing the capability of the measure to avoid or reduce the ignition hazard (see Table B.3, Column 3 b) and the link to the necessary specifications or evidence for inclusion in the technical documentation (see Table B.3, Column 3 c). The link to the necessary specifications or evidence should be given for each measure in order to meet the requirements for the technical documentation. During compilation of the technical documentation attention should be paid to the following aspects:

- completeness of the manufacturers specifications (technical descriptions, drawings, parts lists, results of calculations etc.),
- provision of evidence about all required experimental test results and certificates,

- recognition and determination of necessary specifications for manufacturing (e.g. tolerances or test specifications for quality assurance) and safe operation of the equipment (e.g. for installation, maintenance and repair).

B.4.4 Concluding ignition hazard estimation and categorisation

In this step a concluding estimation of an individual ignition hazard (only a single row of the assessment table) is performed regarding the frequency of its occurrence considering the information reported in step 1 and 2 and the measures determined in step 3 (see Table B.3, Column 4 a to d). From this follows directly the resultant categorisation regarding the individual ignition hazard (see Table B.3, Column 4 e). Moreover, in addition to the category determined, restrictions of the intended use are often necessary. These restrictions could refer to the temperature class or the maximum surface temperature, to a specific explosion group (see Table B.3, Column 4 f) or possibly to a single substance in whose explosive atmospheres the product may be used or is not allowed to be used. Besides this, attention should be paid to other limitations of the intended use arising from the ambient temperature, ambient pressure, supply sources etc.

B.4.5 Determination of the equipment category

The resultant equipment category is finally the worst case of all individual categorisations summarised from all lines in the reporting table.

Annex C (informative)

Examples of ignition hazard assessment

C.1 General remarks

The following examples are not definitive. Alternative measures can normally be applied. The most important ignition sources of non-electrical equipment are electrostatic discharges, hot surfaces and mechanical sparks. Real equipment may have different and/or further ignition sources.

It is expressly pointed out that an ignition hazard assessment is always depending on the individual design and the specific intended use of a product. Therefore, the following ignition hazard assessment examples are neither complete nor directly applicable to real products without detailed analysis.

C.2 Examples for common cases demonstrating the use of the scheme

The examples in Table C.1 show a few common cases for typical parts of non-electrical equipment to explain the use of the reporting scheme described in Annex B. The examples should be read row by row and stand alone.

A resulting equipment category cannot be indicated in this case.

The examples alert to typical potential ignition hazards and their assessment. Specific importance is attached to measures applied to prevent the ignition source becoming effective. For purpose of evidence, the identification and specification of the parts causing ignition hazards and the description of the measures applied form part of the essential technical documentation.

Table C.1 — Common cases demonstrating the use of the scheme – Electrostatic discharge

No.	1		2					3			4					
	ignition hazard		assessment of the frequency of occurrence without application of an additional measure					measures applied to prevent the ignition source becoming effective			frequency of occurrence incl. measures applied					
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f
	potential ignition source	description/basic cause <i>(Which conditions originate which ignition hazard?)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis <i>(citation of standards, technical rules, experimental results)</i>	technical documentation <i>(evidence including relevant features listed in column 1)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting equipment category in respect of this ignition hazard	necessary restrictions
1	electrostatic discharge	parts of non metallic material with a surface resistance not exceeding 1 GΩ				X	assessment is provided for by a (harmonised) standard; highly efficient charge generating mechanisms can be excluded	limiting the surface resistance; verification of the surface resistance of the individual materials used	7.3.2; 7.3.3; 6.7.5 a);	– specifications of the material (7.3.2; 7.3.3); – parts list, pos: ... – test report according to 8.4.8				X	1	
2	electrostatic discharge	parts of non metallic material with a surface resistance not exceeding 1 GΩ		X			no charging during normal operation; material is an outer part of the casing; charging could be done by a person (operator)	largest area less than 25 mm ²	7.3.2; 7.3.3; 6.7.5 c)	– specifications of the material (clauses 7.3.2; 7.3.3); – parts list, pos: ... – drawing no: ...				X	1G	IIB
3	electrostatic discharge	examples of processes where charging can give rise to significant amount of electrostatic charging: Filling and draining of vessels, transfer of liquid, agitation	X				acknowledged rule of technology	limitation of the intended use: Only liquids with a high conductivity (> 1000 pS/m) can be used	CLC/TR 50404:2003, 5.7	– special conditions for safe use (X) – specification of the liquid in the users manual, chapter ..., clause ...				X	1G	yes ^a
4	electrostatic discharge	circumferential speed of a traction drive	X				acknowledged rule of technology	conductivity criteria and conditions of use for belts: limitation of the maximum speed because of the type of construction of the drive, e.g. exclusion of frequency converters to avoid overspeed	CLC/TR 50404:2003, 4.5	– users manual, chapter ..., clause ...			X		2G	IIB
Resulting equipment category including all existing ignition hazards:															b	b
^a	Limitation of the intended use required															
^b	A resulting equipment category cannot be indicated in this case.															

Table C.2 — Common cases demonstrating the use of the scheme – Hot surface

No.	1		2					3			4						
	ignition hazard		assessment of the frequency of occurrence without application of an additional measure					measures applied to prevent the ignition source becoming effective			frequency of occurrence incl. measures applied						
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f	
	potential ignition source	description/basic cause <i>(Which conditions originate which ignition hazard?)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis <i>(citation of standards, technical rules, experimental results)</i>	technical documentation <i>(evidence including relevant features listed in column 1)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting equipment category in respect of this ignition hazard	necessary restrictions	
1	hot surface	hot surface of a frictional wheel drive	X				drive has critical heating during normal operation	The maximum surface temperature under the most adverse conditions. A temperature monitoring and limiting system (IPL 1; type of protection "b1") is mounted. Limiting temperature is 120 °C.	8.2, EN 13463-5 and EN 13463-6:2005, 8.1	– test report no. ... about the thermal type test – EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)			X		2G	T4 ^a	
2	hot surface	hot surface of a ball bearing		X			bearing has negligible heating during normal operation	The bearing is calculated according to ISO 281 for a specified lifetime. A malfunction is generally agreed as a rare incident under these conditions. The maximum surface temperature is determined under the most adverse conditions (110 °C)	8.2 and EN 13463-5:2003, 6.1	– test report no. ... about the thermal type test			X		2G	T4	
3	hot surface	heating of a viscosity meter (stirrer system)				X	mechanical input energy can cause heating The maximum surface temperature under the most adverse conditions. Maximum temperature rising ΔT 3 K		8.2	– test report no. ... about the thermal type test				X	1G	T6	
Resulting equipment category including all existing ignition hazards:															b	b	
^a	The conformity assessment procedure for a monitoring system according to control of ignition source "b" is variational and depends on the equipment category																
^b	A resulting equipment category cannot be indicated in this case.																

Table C.3 — Common cases demonstrating the use of the scheme – Mechanical spark

No.	1		2					3			4						
	ignition hazard		assessment of the frequency of occurrence without application of an additional measure					measures applied to prevent the ignition source becoming effective			frequency of occurrence incl. measures applied						
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f	
	potential ignition source	description/basic cause <i>(Which conditions originate which ignition hazard?)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis <i>(citation of standards, technical rules, experimental results)</i>	technical documentation <i>(evidence including relevant features listed in column 1)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting equipment category in respect of this ignition hazard	necessary restrictions	
1	mechanical spark	breakdown of the bearing of an ATEX category 2 equipment (gear) could cause grinding of a stirrer in a vessel (zone 0); the distance between the stirrer and the vessel may be unacceptably reduced			X		A breakdown of the bearing shall be considered as a rare malfunction (for category 1 equipment), because this is not considered in ATEX category 2 equipment. Therefore, mechanical grinding can not be excluded inside the vessel.	The shaft feed through is designed with an additional emergency bearing to avoid contact between stirrer and vessel (sleeve bearing in category 2 part; category of the gear remains unchanged) In addition the failure of the bearing will be kept under surveillance by a temperature monitoring and limiting system (IPL 1; type of protection "b1"). Limiting temperature < 155 °C.	Clause 5, EN 13463-5:2003, 6.1 and EN 13463-6:2005, 8.1	– test report no. ... about the thermal type test – EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)				X	1G	T3 ^a	
2	mechanical spark	mechanical generated sparks due to a grinding fan		X			mechanical grinding can not be excluded. Assessment is provided for a (<i>harmonised</i>) standard.	The minimum clearance between rotating elements and the casing is defined.	EN 14986:2005, 4.15	– constructional measures design according to drawing no. ...			X		2G		
3	mechanical spark	mechanical generated sparks due to a grinding roots pump rotor at dry run conditions			X		mechanical grinding of a the rotor and particulate material	A shock pressure resistant casing and mounting of an autonomous protective system (flame arresters to avoid flame transmission into the inlet and outlet)	Clause 5 and EN 12874	– test report no. ... about the thermal type test – EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)				X	1G		
Resulting equipment category including all existing ignition hazards:															b	b	
^a	The conformity assessment procedure for a monitoring system according to control of ignition source "b" is variational and depends on the equipment category.																
^b	A resulting equipment category cannot be indicated in this case.																

C.3 Example of an ignition hazard assessment for a pump

Table C.4 gives an (incomplete) example of how a manufacturer could record the ignition hazard assessment for a pump. This example is not definitive and alternative measures could be applied. The category of the pump is the outcome at the end of the assessment table. It is assumed that the pump is located in zone 1 and is intended to pump flammable liquid from a storage tank to a reactor.

Aspects of normal operation (category 3) are heating during continuous operation with maximum load at the highest ambient temperature. The fluid pressure at the inlet and the outlet should be considered as well as corrosion and the temperature of the fluid conveyed. If the maximum surface temperature depends not on the pump itself, but mainly on the heated fluid conveyed, the temperature class cannot be determined by the manufacturer. It shall be determined by the user in accordance to the information provided by the manufacturer in the instructions (marking with TX; see 9.3).

In the event of frequently occurring disturbances or equipment faults which normally have to be taken into account (category 2) attention should be paid to: continues operation at maximum pressure with low feed rate, failure of parts and components because of the operating conditions and the dimensioning, suction of contaminants, loosening of mechanical fasteners or stress because of impacts or friction.

Rare malfunctions (category 1; not dealt with in Table C.5) may be the operation with closed pressure line (closed outlet), the failure of an ignition control device or a newly-created ignition hazard in consequence of any combination of two frequently occurring malfunctions.

Table C.4 — Ignition hazard assessment report for a pump

No.	1		2					3			4					
	ignition hazard		assessment of the frequency of occurrence without application of an additional measure					measures applied to prevent the ignition source becoming effective			frequency of occurrence incl. measures applied					
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f
	potential ignition source	description/basic cause <i>(Which conditions originate which ignition hazard?)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis <i>(citation of standards, technical rules, experimental results)</i>	technical documentation <i>(evidence including relevant features listed in column 1)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting equipment category in respect of this ignition hazard	necessary restrictions
1	hot surface	losses dissipate into heat	X				The pump has a maximum temperature during normal operation	The maximum surface temperature is determined under the most adverse conditions (ΔT 45 K). A bypass (overflow) is installed to insure the minimum flow rate. The minimum residual volume of the storage tank is specified	8.2	– test report no. ... about the thermal type test			X		2G	T4
2	hot surface	dissipation of mechanical energy into heat		X			external valve closed upstream	The maximum surface temperature is determined under the most adverse conditions. A temperature monitoring and limiting system (IPL 1; type of protection "b1") is mounted. Limiting temperature is 100 °C.	8.2 and EN 13463-6:2005, 8.1	– test report no. ... about the thermal type test – EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)			X		2G	T4 ^a
3	hot surface	friction of the clutch plate		X			The clutch starts to slip and generates heat.	The maximum surface temperature (ΔT 30K) is determined under the most adverse conditions. The coupling time and max. torque is specified. An overload safety device (fusible plug) is mounted.	EN 13463-5:2003, 8.2	– test report no. ... about the thermal type test			X		2G	T5
4	electrical spark	electric motor inside the assembly		X			Electrical equipment is a possible ignition source.	Only electrical equipment with declaration of conformity (ATEX) is used.	EN 60079 series	– EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)			X		2G	IIA T2
5	mechanical spark	a grinding rotor at dry run conditions		X			Mechanical grinding of the rotor can not be	The bearing is calculated according to ISO 281 for a specified lifetime. A	Clause 5 and EN 13463-5:2003, 6.1	– description and calculation no.			X		2G	

						excluded. A breakdown of a bearing shall be considered.	malfunction is generally agreed as a rare incident under these conditions.		drawing no. ... about the design								
6	electrostatic discharge	transfer of non-conductive liquid causes electrostatic charge	X			The conductivity of the liquid is not defined	limitation of the intended use: Only liquids with a high conductivity (> 1000 pS/m) can be used. Only a conductive liquid is foreseen. Ethanol is a conductive liquid. Proper earthing of the equipment is required.	CLC/TR 50404:2003	- users manual chapter ..., clause ...: limitation of the intended use				X	1G			
7	...	further ignition sources				...											
Resulting equipment category including all existing ignition hazards:														2G	200 °C		
^a Limitation of the intended use required.																	

C.4 Example of an ignition hazard assessment for an agitator

Table C.5 gives an (incomplete) example of how a manufacturer could record the ignition hazard assessment for an agitator which is assumed to be inside of category 1 and outside of category 2. This example is only for the category 1 part of the agitator. It is not definitive and alternative measures could be applied.

In general potential ignition hazards by hot surfaces, mechanical sparks and electrostatic charging, e.g. in the stirrer vessel, shall be regarded by the manufacturer. Mechanical sparks can be generated by collisions of the organs of an agitator or the organs and the vessel or contacts with contaminants or cut of pieces of the agitator. Other possibilities for grinding contact are vibrations of the stirrer shaft because of critical revolution speed, external oscillation or in consequence of a bearing failure.

The agitator shall be planned and manufactured so that it fulfils its safe function within the limits of the operating conditions stipulated by the manufacturer. If a stirrer is combined with a not stationary vessel it can not only be expected by the operating instructions that the mould alignment is satisfactory. The safe centring between the moving parts shall be considered by the conceptual design. This could be carried out by a mechanical clamping unit and a safety circuit. Constructions supporting misuse shall be avoided as well. Stirrers must not be mountable on vessels where it is not intended (e.g. Intermediate Bulk Containers).

Category 3 equipment must not create effective ignition sources during normal operation. Exemplary the charging due to agitation of chargeable suspensions and fluids shall be mentioned. This ignition hazard cannot be avoided by the equipment design. It shall be prevented by avoiding the explosive atmosphere. Therefore, such an assessment result must lead to a restriction of the intended use. The choice of materials, an adequate dimensioning and e.g. the consideration of minimum distances between moving parts and fixed parts shall also be regarded to avoid mechanical sparks and hot surfaces.

To meet the requirements of category 2 apparatus expected malfunctions, e.g. defect of a fluid lubricated slide ring seal because of the absence of lubrication, must be avoided. A monitoring of the fluid level including an actuation switch-off is regarded as adequate. Further examples are mechanical wear, exceeded service life of the lubrication or corrosion.

For category 1 apparatus rare malfunctions as well as ignition hazards in consequence of two expected malfunctions shall be considered. Exemplary the failure of a rolling contact bearing of the shaft guiding shall be mentioned. The bearings are used in zone 1 and can be assessed with category 2 requirements, but in case of a failure it may create an ignition hazard in zone 0. Because of this an appropriate action is indispensable, e.g. a continuous monitoring device for the bearing including an actuator switch-off. Other examples are insufficient stability, impermissible operation at the critical rotary frequency, losing of parts, failures of safety devices or the intrusion of explosive mixtures into not adequate protected parts of the equipment because of defective separation elements, e.g. gaskets or rotating mechanical seals.

For category 1 combinations of two rare malfunctions or a rare malfunction in combination with an expected malfunction can be disregarded. In these cases an ignition hazard is regarded as sufficiently improbable. Examples are on the one hand the grinding between shaft and vessel even though an adequate strength is chosen for the parts that exert influence on the move of the shaft or, on the other hand, the operation at the critical rotary frequency even though this speed shall not be possible because of the agitator's design.

Table C.5 — Ignition hazard assessment report for an agitator

No.	1		2					3			4					
	ignition hazard		assessment of the frequency of occurrence without application of an additional measure					measures applied to prevent the ignition source becoming effective			frequency of occurrence incl. measures applied					
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f
	potential ignition source	description/basic cause <i>(Which conditions originate which ignition hazard?)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis <i>(citation of standards, technical rules, experimental results)</i>	technical documentation <i>(evidence including relevant features listed in column 1)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting equipment category in respect of this ignition hazard	necessary restrictions
1	electrostatic discharge	isolated electrical conductive parts	X				isolated conductive parts creates a capacitor, which e.g. can be charged by electrostatic induction to a hazardous static	equipotential bonding between the parts, earthing of the housing, information for installation	6.7.2	– specification of the material (7.3.2) – parts list, pos: ... (or drawing no: ...)				X	1G	
2	electrostatic discharge	isolating parts e.g. of non metallic material		X			no charging during normal operation; material is an outer part of the casing; charging could be done by a person (operation)	surface resistance < 1 GΩ at 50 % relative humidity	6.7.5 a, 8.5.8	– specification of the material (6.7, 7.3.2, 7.3.3) – parts list, pos: ... – drawing no: ...				X	1G	
3	electrostatic discharge	isolating parts e.g. of non metallic material		X			no charging during normal operation; materials is an outer part of the casing; charging could be done by a person (operator)	surface resistance < 1 GΩ at 50 % relative humidity; area < 25 cm ²	6.7.5 and Table 8	– specification of the material (6.7, 7.3.2, 7.3.3) – parts list, pos: ... – drawing no: ...				X	1G	IIB
4	electrostatic discharge	electrostatic charging of the liquid during agitation	X				use of chargeable liquids tends to static under normal operation	limitation of the intended use: Only liquids with a high conductivity (> 1000 pS/m) can be used (alternative inertisation is required)	CLC/TR 50404:2003, 5.7	– specific conditions for safe use – alert in the users manual, chapter ..., clause ...				X	1G	yes ³
5	hot surface	grinding of the shaft in range of the casing				X	design according to the state of the art, safety factor > 3 for all parts effective the deflection	no additional measures required	This European Standard and EN 13463-5:2003, Clause 5	– constructional measures, design according to drawing no. ...				X	1G	

Table C.5 (continued)

No.	1		2					3			4					
	ignition hazard		assessment of the frequency of occurrence without application of an additional measure					measures applied to prevent the ignition source becoming effective			frequency of occurrence incl. measures applied					
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f
	potential ignition source	description/basic cause <i>(Which conditions originate which ignition hazard?)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis <i>(citation of standards, technical rules, experimental results)</i>	technical documentation <i>(evidence including relevant features listed in column 1)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting equipment category in respect of this ignition hazard	necessary restrictions
6	hot surface	breakdown of the bearing with influence to zone 0; (the bearing is located in zone 1 near the separating plate of the vessel)			X		A breakdown of the bearing shall be considered as a rare malfunction (for category 1 equipment)	The malfunction of the bearing will be detected by a thermal sensor. Maximum temperature < 150 °C (IPL 1; type of protection "b1")	Clause 5, EN 13463-5:2003, 6.1 and EN 13463-6:2005, 8.1	– test report no. ... about the thermal type test – EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)				X	1G	T3
7	hot surface	breakdown of the bearing of an ATEX category 2 equipment (gear) with influence to zone 0; (the bearing is located in zone 1 near the separating plate of the vessel)			X		frictional losses could heat up the separating plate	The failure of the bearing will be detected by a thermal sensor. Maximum temperature < 155 °C (IPL 1; type of protection "b1")	Clause 5, EN 13463-5:2003, 6.1 and EN 13463-6:2005, 8.1	– test report no. ... about the thermal type test – EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)				X	1G	T3
8	hot surface	frictional heat at the wiper; relative motion of the rotating mechanical seal			X		heating < 80 % of the temperature class T4 during normal operation	The maximum surface temperature is determined under the most adverse conditions. Alternatively a temperature monitoring and limiting system (IPL 1; type of protection "b1") can be mounted. Limiting maximum temperature is 100 °C	8.2 and EN 13463-6:2005, 8.1	– test report no. ... about the thermal type test – EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)				X	1G	T4
9	mechanical spark	mechanical generated sparks due to a breaking shaft due to unacceptable vibration			X		equipment is not designed for liquid surface passage under motion, foreseeable misuse can not be exclude	liquid level monitoring system (IPL 1; type of protection "b1") to avoid liquid surface passage	EN 13463-6:2005, 8.1	EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)				X	1G	

Table C.5 (continued)

No	1		2					3			4					
	ignition hazard		assessment of the frequency of occurrence without application of an additional measure					measures applied to prevent the ignition source becoming effective			frequency of occurrence incl. measures applied					
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f
potential ignition source	description/basic cause <i>(Which conditions originate which ignition hazard?)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis <i>(citation of standards, technical rules, experimental results)</i>	technical documentation <i>(evidence including relevant features listed in column 1)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting equipment category in respect of this ignition hazard	necessary restrictions	
10	mechanical spark	grinding on the shaft or the stirrer in the range of the case		X			mechanical grinding can not be excluded, if the vessel is not centered	The minimum clearance between rotating elements and the vessel is defined. The vessel clamping unit an interlock.	Clause 5 and EN 13463-6:2005, 8.1	- constructional measures, design according to drawing no. ... EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)				X	1G	
11	mechanical spark	grinding of the wiper in the vessel	X				grinding of the wiper under load during normal operation	use of capable material, static spring loaded	Clause 5, EN 13463-5:2003, Clause 10	- constructional measures, design according to drawing no. ...				X	1G	
12	mechanical spark	breakdown of the bearing of the shaft guidance could cause grinding of a stirrer in a vessel (zone 0); the distance between the stirrer and the vessel may be unacceptably reduced			X		A breakdown of the bearing shall be considered as a rare malfunction (for category 1 equipment).	failure of the bearing will be detected by a vibration monitoring system (IPL 1; type of protection "b1")	Clause 5 and EN 13463-6:2005, 8.1	EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)				X	1G	
13	mechanical spark	loosening of the shaft			X		unsecured joints	force locked joints secured with an additional measure e.g. screw retention	EN 13463-5:2003, 4.2	- test report no. ... about the thermal type test - EC conformity declaration (ATEX) and instructions of the monitoring system (purchased from an external supplier)				X	1G	
14	mechanical spark	unacceptable durability of parts e.g. the shaft			X		possible corrosion	adequate material selection	EN 13463-5:2003, 4.2	- constructional measures, design according to drawing no. ...				X	1G	
15	mechanical spark	breakdown of a clutch (clutch in zone 0)			X		design according to the state of the art, safety factor > 3	only stiff in the rotational senses clutches are used	EN 13463-5:2003, 4.2	- constructional measures, design according to drawing no. ...				X	1G	

Table C.5 (continued)

No	1		2					3			4							
	ignition hazard		assessment of the frequency of occurrence without application of an additional measure					measures applied to prevent the ignition source becoming effective			frequency of occurrence incl. measures applied							
	a	b	a	b	c	d	e	a	b	c	a	b	c	d	e	f		
	potential ignition source	description/basic cause <i>(Which conditions originate which ignition hazard?)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	reasons for assessment	description of the measure applied	basis <i>(citation of standards, technical rules, experimental results)</i>	technical documentation <i>(evidence including relevant features listed in column 1)</i>	during normal operation	during foreseeable malfunction	during rare malfunction	not relevant	resulting equipment category in respect of this ignition hazard	necessary restrictions		
16	mechanical spark	unacceptable vibration of the vessel causes damage of the agitator			X		internal and external sources of vibration can not be excluded.	experimental determination and exclusion of the critical speed, limitation of the intended use	EN 13463-5:2003, Clause 5	<ul style="list-style-type: none"> - test report no. ... about the determination of the critical speed - special conditions for safe use - alert in the users manual, chapter ..., clause ... - marking of the range of the critical speed on the name plate 					X	1G	yes ^a	
17	mechanical spark	accidental entry of metal items like tools through the manway			X		Multiple sparks formed if no liquid present	Information to user to prevent loose metal items from falling into the vessel	-	- instructions for use					X	1G		
18	electrical spark	electrical equipment (category 2) in contact with zone 0			X		shift of zone 0 in consequence of an undetected leakage	natural ventilation, constructional measures	EN 60079-26	<ul style="list-style-type: none"> - constructional measures, design according to drawing no. ... 					X	1G		
19	...	further ignition access					...											
															Resulting equipment category including all existing ignition hazards:		1G	IIB T3 ^a
^a Limitation of the intended use required																		

Annex D (informative)

Charging tests with non conductive materials

D.1 Introduction

This Annex describes one test to decide whether a non-conductive material is capable of being charged to produce brush discharges and therefore can act as an ignition source for an explosive gas/air or vapour/air mixture. This test is performed with the part itself, or a 225 cm² flat sample of the material from which the equipment is constructed.

The size of the flat sample is relevant because experimental evidence shows that 225 cm² is an optimum value for the surface area in terms of charge distribution density. Other factors influencing the validity of the test results are the humidity of the test environment, which shall be kept to 30 % RH or less at 23 °C ± 2 K to minimize leakage of the electrostatic charge. Also, the size of the spark discharge electrode to produce a single spark is important. Too small electrodes can lead to multiple discharge sparks and/or corona discharging of lower energy. Therefore a spherical electrode with a diameter of 15 mm (see Figure D.2) shall be used to produce a single point discharge spark. Furthermore, the extent of the person's perspiration is also of influence.

D.2 Principle of the test

Either the actual sample, or if it is not possible because of its size or shape, a 150 mm x 150 mm x 6 mm plate shaped sample of the material shall be conditioned for 24 hours at 23 °C ± 2 K and a relative humidity not higher than 30 %. Its surface is then electrically charged, under the same environmental conditions as it was conditioned, by three separate methods. The first method involves rubbing the surface with a polyamide material (e.g. a polyamide cloth). The second, rubbing the same surface with a cotton cloth and the third exposing the same surface to a high voltage spray electrode.

After completion of each of the charging methods, the charge Q from a typical surface discharge is measured. This is done by discharging the sample by a spherical electrode (15 mm diameter) into a known value fixed capacitor C and measuring the voltage V across it. The charge Q is given by the formula $Q = C V$, where C is the value of the fixed capacitor in Farads and V is the highest voltage. This procedure is used to find the method that produces the highest measured charge to assess of the incendivity of the discharge according to D.4.2.4.

Where there is a general trend of decreasing stored charges during these tests, new samples shall be used for the following tests. The highest value shall be used for the assessment procedure according to D.4.2.4.

NOTE In some cases the properties of the charged material could be changed due to the discharges so that the transferred charge decreases in subsequent tests. Due to possible multiple discharges of textile clothes such samples are assessed conservative by this method.

As this kind of experiment can be influenced by e.g. the persons perspiration, it shall be demonstrated by a calibration experiment with a reference material of PTFE that the transferred charge is at least 60 nC.

D.3 Samples and apparatus

The test sample comprises either the actual sample, or if it is not practical because of its size or shape, a 150 mm x 150 mm x 6 mm flat plate of the non conductive material. The test apparatus comprises:

- a) DC high voltage power supply capable of delivering at least 30 kV;
- b) electrostatic voltmeter (0 V to 10 V) with a measuring uncertainty of 10 % or better and an input resistance higher than 10^9 Ohm;
- c) 0,10 μ F capacitor for at least 400 Volt (0,01 μ F is also suitable if the input resistance of the voltmeter is greater than 10^{10} Ohm);
- d) cotton cloth large enough to avoid contact between the test sample and the operator's fingers during the rubbing process;
- e) polyamide cloth large enough to avoid contact between the test sample and the operator's fingers during the rubbing process;
- f) PTFE handle, or tongs, able to move the test sample without discharging its charged surface;
- g) flat disk made of PTFE with an area of 100 cm² as a highly chargeable reference;
- h) earthed table made of wood or an earthed metal plate;
- i) single pointed electrode, or array of pointed electrodes mounted on a common plate, connected to the minus pole of a dc high voltage power supply.

D.4 Procedure

D.4.1 Conditioning

All the tests are conducted in a room with a temperature of (23 ± 2) °C and no more than 30 % relative humidity.

Clean the test piece with isopropyl alcohol, rinse with distilled water and dry it e.g. in a drying oven at no more than 50 °C. Store in the room for 24 h at $23 \text{ °C} \pm 2 \text{ K}$ and a relative humidity of no more than 30 %.

D.4.2 Determination of the most efficient charging method

D.4.2.1 Rubbing with a pure polyamide cloth (Figure D.1)

Lay the sample on the wooden or earthed metal table plate (thickness at least 10 mm) with its surface upwards. Charge the surface by rubbing it 10 times with the polyamide cloth. The last rub shall finish on the edge of the sample. Move the sample carefully away from the table plate without discharging it. If such a procedure is not possible fasten the sample between ceiling and floor far away from any wall and charge it. Discharge the sample by slowly approaching the spherical electrode into a 0,1 μ F or 0,01 μ F capacitor (Figure D.2) until a discharge occurs and measure the voltage on the voltmeter immediately after removing the spherical electrode from the sample (the voltage decreases with time due to the non infinity input resistance of the voltmeter). The surface charge is given by the formula: $Q = C V$ where V is the voltage across the capacitor at $t = 0$. The test shall be repeated 10 times. Make sure that only a single discharge is recorded and that the spark gap is at least 1,5 mm in the case of I and IIA, 1 mm in the case of IIB and 0,5 mm in the case of IIC. In any case of doubt use a field mill to check the voltage before discharging (should be $> 6 \text{ kV}$ for I and IIA, $> 4 \text{ kV}$ for IIB and $> 2 \text{ kV}$ for IIC). If too low voltages occur they result in a too conservative result.

NOTE Due to possible charge binding effects of table surfaces it is recommended to raise the sample in the air and provoke a discharge there. Discharges occurring at gaps less than 2 mm for IIA, 1 mm for IIB and 0,5 mm for IIC are less incendive than expected by their transferred charge due to quenching effects at the electrodes.

D.4.2.2 Rubbing with a cotton cloth

Repeat the procedure of D.4.2.1 using a pure cotton cloth instead of the polyamide cloth. The test shall be repeated 10 times. The highest value shall be used for the assessment procedure according to D.4.2.4.

D.4.2.3 Charging with a DC high voltage power supply (Figure D.3)

Position the spray electrode above the test sample 3 cm from the center of the exposed surface and charge it with a voltage of at least 30 kV between the negative electrode and ground. Move the sample for 1 min in order to charge the whole surface and discharge the sample according to D.4.2.1. The test shall be repeated 10 times. The highest value shall be used for the assessment procedure according to D.4.2.4. If the electrode according to Figure D.3, Key, Item 4, is used, the 100 needle electrodes are put on the surface of the sample, high voltage is applied for some seconds, and then the electrodes are removed. The high voltage must be only be switched off when the electrodes have been removed far away from the sample to avoid discharges from the charged sample back to the electrode.

In the following cases charging by influence with a DC high voltage power supply is not suitable and should not be used:

- a) the test sample is made of conducting material which is not earthed;
- b) the test sample is backed with metal if, according to 6.7.3, propagating brush discharges may occur;
- c) the test sample is concavely shaped. In this case use D.4.2.1.

WARNING — In the cases of 1) to 3) strong discharges may occur which are hazardous to the health of the testing person and which may destroy the measuring instrument.

D.4.2.4 Assessment of discharge

If the transferred charge of the reference material lies clearly above 60 nC and the maximum transferred charge Q measured in any of the above tests is less than

- 60 nC the non conductive material is suitable for use with explosion group I or IIA;
- 30 nC the non conductive material is suitable for use with explosion group I or IIB;
- 10 nC the non conductive material is suitable for use with explosion group I or IIC.

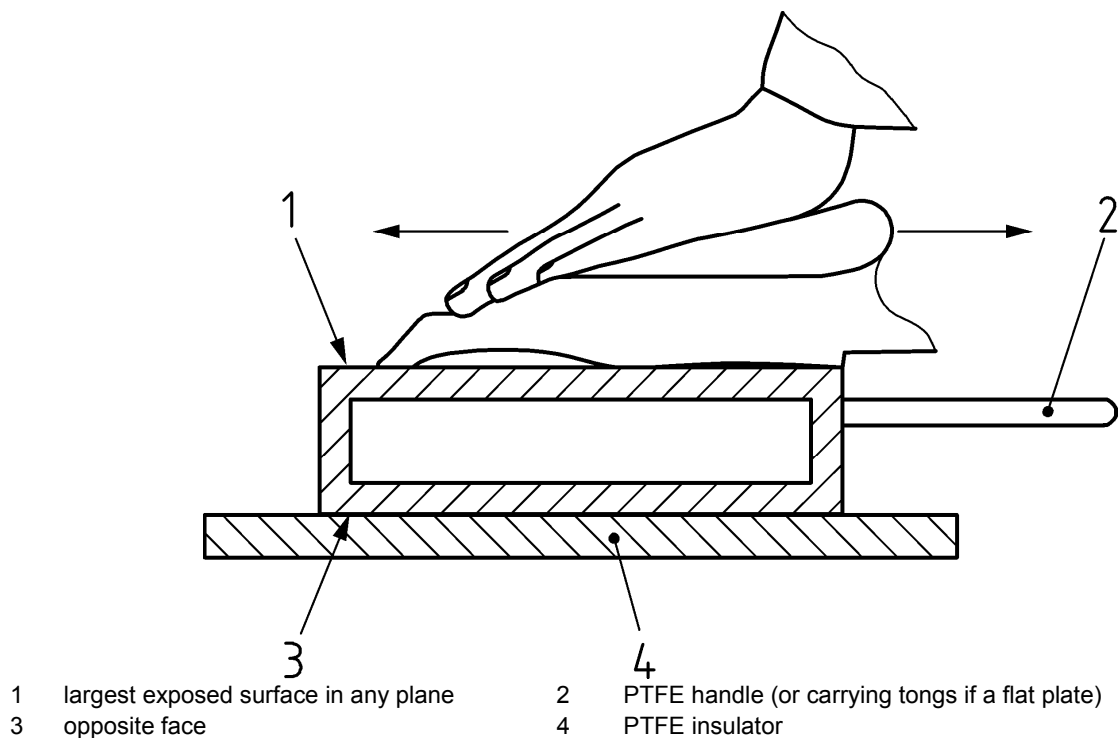


Figure D.1 — Rubbing with a pure polyamide cloth

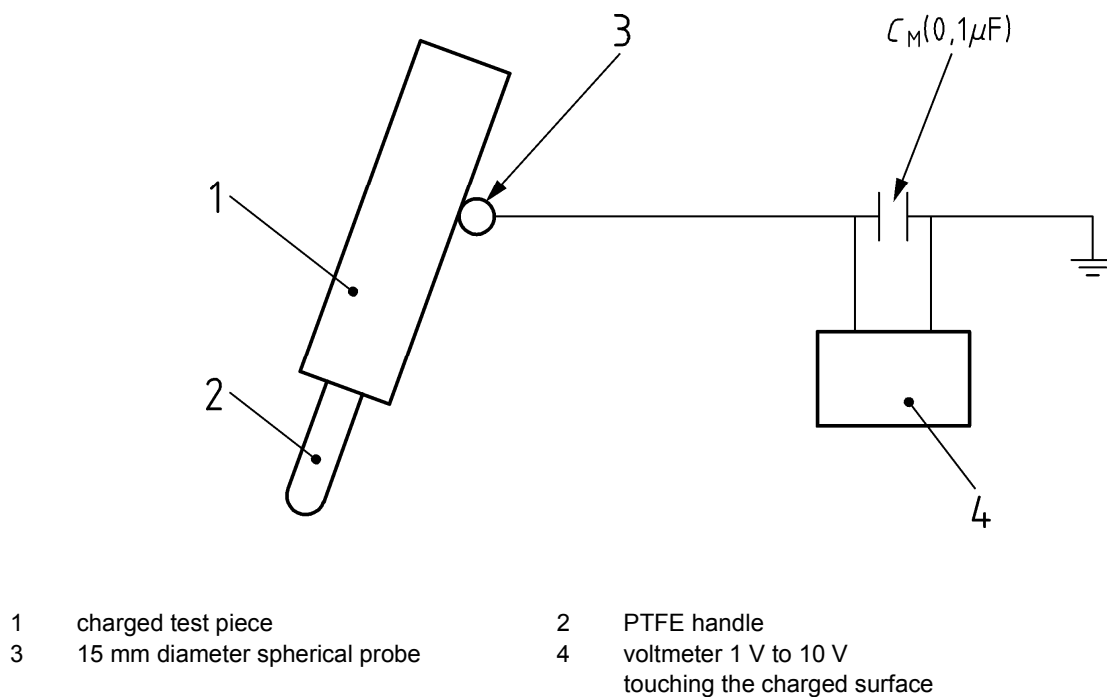
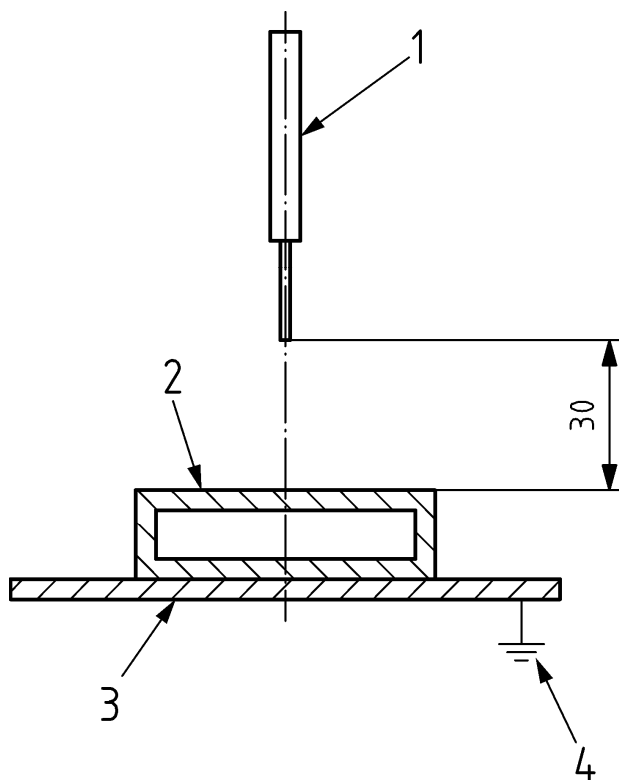


Figure D.2 — Discharging the charged surface of the test piece with a probe connected to earth via a 0,1 μF capacitor

Dimensions in millimetres



Key

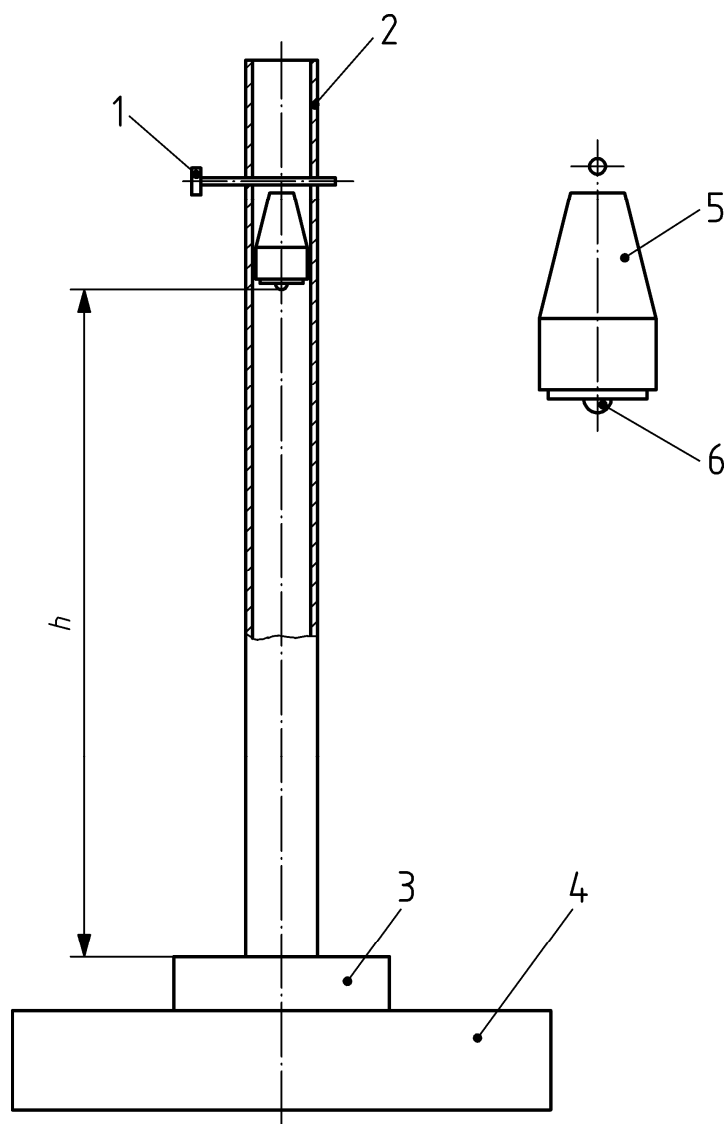
- | | | | |
|---|----------------------------------|---|--|
| 1 | negative charge needle electrode | 2 | largest exposed surface in any plane |
| 3 | opposite face | 4 | earthed conducting plate (brass); positive electrode |

Figure D.3 — Charging by the influence of a DC high voltage power

Annex E (informative)

Example of rig for resistance to impact test

Figure E.1 shows an example of a rig used for a resistance to impact test.



Key

- | | | | |
|---|-------------------------|---|--|
| 1 | adjustment pin | 2 | plastics guide tube |
| 3 | test piece | 4 | steel base (mass $\geq 20\text{kg}$) |
| 5 | steel mass of 1 kg | 6 | impact head 25 mm diameter in hardened steel |
| h | drop height (see 8.4.1) | | |

Figure E.1 — Example of rig for resistance to impact test

Annex F (normative)

Rig for impact ignition test

Figure F.1 shows a rig used for impact ignition test.

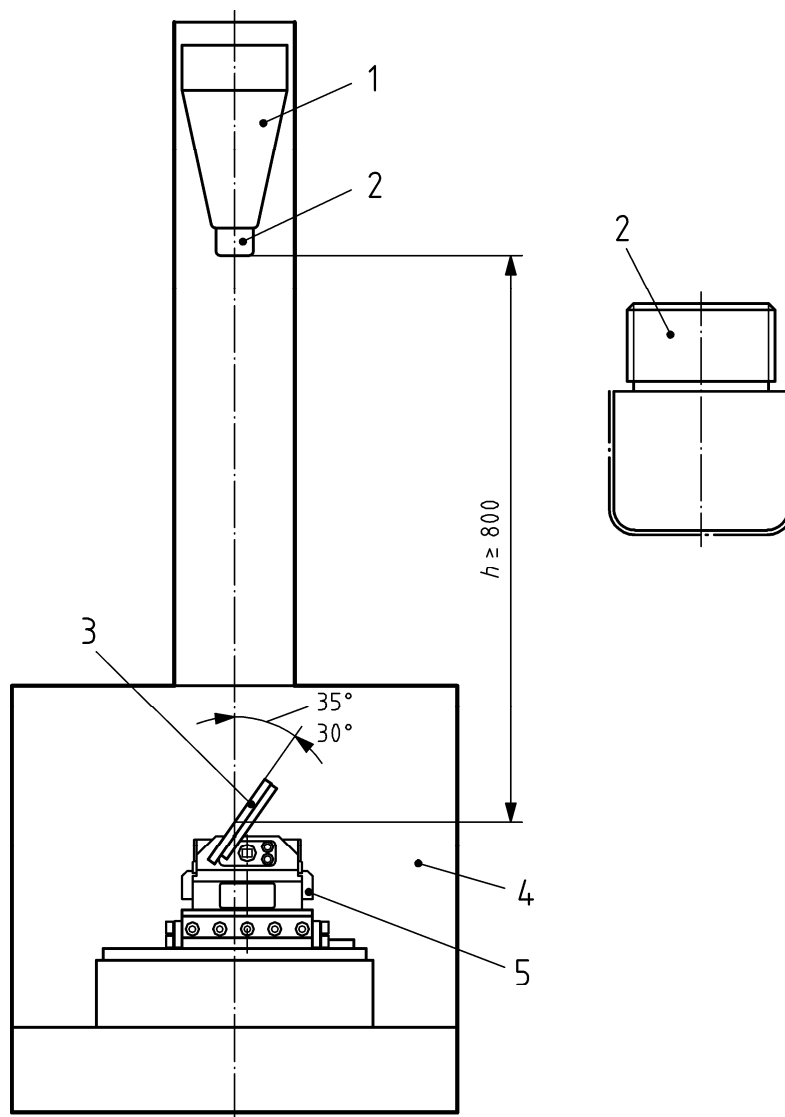


Figure F.1 — Rig for impact ignition test

Key

- 1 mass of 50 kg or impact energy 400 J
- 2 coated test sample
- 3 rusted steel plate
- 4 explosion chamber (the side wall is opened and covered by the plastic foil for the purpose of explosion pressure release)
- 5 device for the cross and longitudinal motion of the rusted plate
- h drop height

Annex G (informative)

Consideration of misuse which can reasonably be anticipated during ignition hazard assessment procedure

G.1 Introduction

The following explanations are designated to assist the manufacturer during accomplishment of the ignition hazard assessment. An approach is explained how misuse which can reasonably be anticipated could be considered and could form part of the tabular assessment report explained in Annex B.

G.2 Identification and analysis of the ignition hazards

In this step the potential ignition sources caused by misuse, e.g. possible mistakes during installation, maintenance and operation of the equipment should be reported. A good source of information could be customers practice as can be obtained in the course of repair orders or reported in other ways. Some questions to identify misuse which can reasonably be anticipated:

- What interventions by individuals are necessary or can be assumed during intended use of the equipment considering transport, storage, installation, operation, maintenance and repair?
- Which typical abnormal handling due to carelessness is well-known during these interventions?
- Which non intended operation by people who could come into contact with the equipment (the aforementioned persons but also other persons e.g. cleaning staff, craftsman, fire fighters etc.) can be anticipated?

G.3 First assessment of the ignition hazards

Misuse which can reasonably be anticipated shall be taken into account independently of the equipment category. Therefore, an assessment of the frequency of its occurrence is dispensable. Column 2d (if applicable) and Column 2e of the reporting scheme (see Annex B) could be used. Furthermore, it could be helpful to ask, which of the listed misuses are not to be expected in the case of well-trained staff (well-trained with respect to work in hazardous areas) or due to safeguards against unwanted access to hazardous areas.

G.4 Determination of safety measures

Appropriate design measures should be used to avoid misuse or to limit the effects of the misuse. In case this is not possible, warning notices in the instructions and/or labels e.g. in form of pictograms on the equipment should be adopted. Logical, ergonomic and easy ways of operation of the equipment should be established. In some cases the use of special tools (e.g. for adjustment or mechanical linkage) can assure that only well trained and equipped specialists can be considered to intervene and that unwanted manipulation is avoided. Using warning labels attention should be paid to ensure that they are durable and fixed to an appropriate place on the equipment. The information content should not allow misinterpretation and, if necessary, should be understandable independent of the users language (e.g. by use of symbols or figures).

G.5 Final assessment of the ignition hazards

Misuse which can reasonably be anticipated shall be taken into account independently of the equipment category. Therefore, an assessment of the frequency of its occurrence is dispensable. Only column 4d (not to be considered) of the reporting scheme (see Annex B) should be used to make clear that the measures are deemed to be adequate.

Annex H (informative)

Significant changes between this European Standard and the previous edition

The significant changes with respect to the previous edition are listed in Table H.1.

Table H.1 — Significant changes

Clauses of this European Standard	TYPE		
	Minor and formal changes	Extensions	Substantial change regarding ESRs
Clause 3 Introduction of new definitions and slight redefinitions concerning ignition sources to improve ignition hazard assessment	X	X	
Clause 4 Introduction of Table 1 and Table 2 on explosion groups to give additional information to user without changing requirements		X	
Clause 5 – Consideration of ignition sources caused by misuse – Some text additions to support user of standard – Reduction of requirements for cat. 1 equipment to be in line with electrical standards (as this is a reduction in requirements no safety gap is caused by this change)		X X	X
Clause 6 – Additional text about hot surfaces to support user of this standard and introduction of requirements for small surface areas (to be inline with electrical standards) and enclosed volumes – Introduction of TX marking – Additional information concerning flames and hot gases – Additional technical information (energy limits for potential ignition sources as a technical support to user on request of Standing Committee) and test methods for mining equipment – Complete listing of ignition sources and additional text concerning electrostatic phenomena to support user in the course of the ignition hazard assessment – Deletion of requirements for dusts from table 9, resulting in lower requirements	X	X X X X	
– additional requirements for frequent discharges, can result in very special cases in higher requirements		X	

Table H.1 (Continued)

Clauses of this European Standard	TYPE		
	Minor and formal changes	Extensions	Substantial change regarding ESRs
Clause 7.6 Additional information about light transmitting parts to support decisions on necessary tests		X	
Clause 8 Additional information on surface temperature determination, flammability testing and test for surface coating to allow different technical solutions		X	
Clause 9 Documentation and information for use: Additional information to support user		X	
Annex C (informative) on examples of ignition hazard assessment was added to support user of this standard		X	

Annex ZA

(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 94/9/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive 94/9/EC of 23 March 1994 concerning equipment and protective systems intended for use in potentially explosive atmospheres.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard given in table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and Directive 94/9/EC

Clauses/sub-clauses of this EN	Essential Requirements (ERs) of EU Directive 94/9/EC	Qualifying remarks/Notes
4	1.0.1 Principles of integrated explosion safety 1.0.2 Design considerations	
5.1	1.0.1 Principles of integrated explosion safety 1.0.2 Design considerations 1.0.3 Special checking and maintenance conditions	
5.2	1.0.2 Design considerations 1.3 Potential ignition sources	
6.1	1.3 Potential ignition sources	
6.2.1, 6.2.2, 6.2.3	1.2.8 Overloading of equipment 1.3.1 Hazards arising from different ignition sources 1.4.1 Hazards arising from external effects	
6.2.4	2.0.1 Requirements applicable to equipment in category M1 of equipment group 1 2.0.2 Requirements applicable to equipment in category M2 of equipment group I	
6.2.5, 6.2.6	2.1.1 Explosive atmospheres caused by gases, vapours or hazes 2.2.1 Explosive atmospheres caused by gases, vapours or mists 2.3.1 Explosive atmospheres caused by gases, vapours or mists	
6.2.7	2.1.2 Explosive atmospheres caused by air/dust mixtures 2.2.2 Explosive atmospheres caused by air/dust mixtures 2.3.2 Explosive atmospheres caused by air/dust mixtures	

Table ZA.1 (Continued)

Clauses/sub-clauses of this EN	Essential Requirements (ERs) of EU Directive 94/9/EC	Qualifying remarks/Notes
6.3	1.3.1 Hazards arising from different ignition sources	reference to EN 1127-1
6.4	1.3.4 Hazards arising from overheating	
6.5	1.0.1 Principles of integrated explosion safety 1.3.1 Hazards arising from different ignition sources	reference to EN 60079
6.6	1.3.3 Hazards arising from stray electric and leakage currents	
6.7	1.3.2 Hazards arising from static electricity	
6.8 - 6.14	1.3.1 Hazards arising from different ignition sources	
7.1	1.3.4 Hazard arising from overheating	
7.2	1.2.6 Safe opening	
7.3	1.1.3 Selection of material 1.4.1 Hazards arising from external effects 1.4.2 Hazards arising from external effects	
7.4	1.2.2 Design and Construction 1.2.6 Safe opening	
7.5	1.1.3 Selection of materials 1.4.2 Hazards arising from external effects	
7.6	1.1.3 Selection of materials 1.4.1 Hazards arising from external effects 1.4.2 Hazards arising from external effects	
8	1.1.3 Selection of materials 1.2.1 Design and Construction 1.2.2 Design and Construction 1.2.5 Additional means of protection	
9.1	1.0.1 Principles of integrated explosion safety 1.0.3 Special checking and maintenance conditions 1.0.4 Surrounding area conditions	
9.2	1.0.6 Instructions	
9.3	1.0.5 Marking	
Annexes A - E	1.0.2 Design considerations 1.3.1 Hazards arising from different ignition sources	
Annex D	1.3.2 Hazards arising from static electricity	
Annex E	1.2.5 Additional means of protection	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

- [1] Beyer, M.: *Ignition Hazard Assessment on Explosion-protected Non-electrical Equipment*, Int. ESMG Symp. On Process Safety and Industrial Explosion Protection, Nürnberg, 2002
- [2] Beyer, M.: *Systematische Zündgefahrbewertung an explosionsgeschützten mechanischen Geräten*, Technische Überwachung 45 (2004) 3, pp. 27 - 31
- [3] Himstedt, M., Beyer, M.: *Explosionsgeschützte Rührwerke – Beispiele für eine Zündgefahrbewertung*, Technische Überwachung 45 (2004) 5, pp. 36 - 41
- [4] Beyer, M.: *On the Method of Ignition Hazard Assessment for Explosion Protected Non-Electrical Equipment*, Ex-Magazine 31 (2005), pp. 78 - 85
- [5] Beyer, M.: *Assessment Method for Ignition Hazards Caused by Mechanical Ignition Sources*, 2nd Petroleum and Chemical Industry Conference (PCIC) Europe, Basle, 2005, pp. 131 - 138
- [6] EN 12874, *Flame arresters – Performance requirements, test methods and limits for use*
- [7] EN 13463-2, *Non-electrical equipment for use in potentially explosive atmospheres - Part 2: Protection by flow restricting enclosure 'fr'*
- [8] EN 13463-3, *Non-electrical equipment for use in potentially explosive atmospheres - Part 3: Protection by flameproof enclosure 'd'*
- [9] EN 13463-5, *Non-electrical equipment intended for use in potentially explosive atmospheres - Part 5: Protection by constructional safety 'c'*
- [10] EN 13463-8, *Non-electrical equipment for potentially explosive atmospheres - Part 8: Protection by liquid immersion 'k'*
- [11] EN 14522, *Determination of the auto ignition temperature of gases and vapours*
- [12] EN 15198, *Methodology for the risk assessment of non-electrical equipment and components for intended use in potentially explosive atmospheres*
- [13] EN 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d" (IEC 60079-1:2007)*
- [14] EN 60079-2, *Explosive atmospheres – Part 2: Equipment protection by pressurized enclosure "p" (IEC 60079-2:2007)*
- [15] EN 60079-26, *Explosive atmospheres – Part 26: Equipment with equipment protection level (EPL) Ga (IEC 60079-26:2006)*
- [16] EN 60079-28, *Explosive atmospheres – Part 28: Protection of equipment and transmission systems using optical radiation (IEC 60079-28:2006)*
- [17] EN 61241-1, *Electrical apparatus for use in the presence of combustible dust – Part 1: Protection by enclosures "tD" (IEC 61241-1:2004)*
- [18] EN ISO 6507-1, *Metallic materials – Vickers hardness test – Part 1: Test method (ISO 6507-1:2005)*
- [19] EN ISO 12100-1:2003, *Safety of machinery – Basic concepts, general principles for design – Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

- [20] ISO 281, *Rolling bearings – Dynamic load ratings and rating life*
- [21] IEC/TR 60079-12, *Electrical apparatus for explosive gas atmospheres – Part 12: Classification of mixtures of gases or vapours with air according to their maximum experimental safe gaps and minimum igniting currents*
- [22] IEC/TR 60079-20, *Electrical apparatus for explosive gas atmospheres - Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus*
- [23] EN 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*
- [24] EN 1755, *Safety of industrial trucks - Operation in potentially explosive atmospheres - Use in flammable gas, vapour, mist and dust*
- [25] EN ISO 6507-4, *Metallic materials - Vickers hardness test - Part 4: Tables and hardness values (ISO 6507-4:2005)*
- [26] EN 13501-1, *Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests*
- [27] IEC 60695 (all parts), *Fire hazard testing*
- [28] Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres

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