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BSI Standards Publication

Explosive atmospheres

Part 37: Non-electrical equipment for explosive atmospheres — Non-electrical type of protection constructional safety "c", control of ignition sources "b", liquid immersion "k"
(ISO 80079-37:2016)

bsi.

National foreword

This British Standard is the UK implementation of EN ISO 80079-37:2016. It supersedes BS EN 13463-5:2011, BS EN 13463-6:2005 and BS EN 13463-8:2003, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EXL/23, Explosion and fire precautions in industrial and chemical plant.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Amendments/corrigenda issued since publication

Date	Text affected
30 June 2016	Annex A page format errors corrected

EUROPEAN STANDARD

NORME EUROPÉENNE

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EN ISO 80079-37

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Supersedes EN 13463-5:2011, EN 13463-6:2005, EN 13463-8:2003

English Version

Explosive atmospheres - Part 37: Non-electrical equipment for explosive atmospheres - Non-electrical type of protection constructional safety ''c'', control of ignition sources ''b'', liquid immersion ''k'' (ISO 80079-37:2016)

Atmosphères explosives - Partie 37: Appareils non électriques destinés à être utilisés en atmosphères explosives - Mode de protection non électrique par sécurité de construction "c", par contrôle de la source d'inflammation "b", par immersion dans un liquide "k" (ISO 80079-37:2016)

Explosionsgefährdete Bereiche - Teil 37: Nicht-elektrische Geräte für den Einsatz in explosionsgefährdeten Bereichen - Schutz durch konstruktive Sicherheit 'c', Zündquellenüberwachung 'b', Flüssigkeitskapselung 'k' (ISO 80079-37:2016)

This European Standard was approved by CEN on 8 February 2016.

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

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European Foreword

This document (EN ISO 80079-37:2016) has been prepared by Technical Committee ISO/TMBG "Technical Management Board - groups" in collaboration with 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 October 2016, and conflicting national standards shall be withdrawn at the latest by October 2016.

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.

The significant changes with respect to EN 13463-5:2011, EN 13463-6:2005 and EN 13463-8:2003 are included in Annex ZB “*Significant changes between this European Standard and* EN 13463-5:2011*,* EN 13463-6:2005 *and* EN 13463-8:2003".

This document supersedes EN 13463-5:2011, EN 13463-6:2005, EN 13463-8:2003.

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 2014/34/EU.

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

Extensions to the marking scheme described in the Directive are found in the ATEX Guidelines published by the European Commission. These are particularly useful for equipment that conforms to more than one category.

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, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 80079-37:2016 has been approved by CEN as EN ISO 80079-37:2016 without any modification.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2014/34/EU

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 2014/34/EU.

Once this standard is cited in the Official Journal of the European Union under that Directive and has been implemented as a national standard in at least one Member State, compliance with the 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

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of 2014/34 EU	Qualifying remarks/Notes
4	1.1.1 1.1.3	
5.1	1.3.4 1.4.1	See also 80079-36 Clause has some limited relevance to ESR 1.2.4
5.2	1.1.1	
5.3.1	1.3.1	See also 80079-36
5.3.2	1.2.3	See also 80079-36
5.4	1.3.1	See also 80079-36
5.6.1	1.0.6a 1.1.3	Not much additional information
5.6.2	1.3.4	See also 80079-36
5.6.3	1.3.1	See also 80079-36
5.7.1	1.0.6a 1.0.6c 1.2.1	
5.7.2	1.3.1	See also 80079-36
5.7.3	1.1.3	
5.8.1	1.1.3 1.3.1 1.3.4	See also 80079-36 Limited information in respect of 1.1.3
5.8.2.1	1.3.1	See also 80079-36
5.8.2.2	1.3.1	See also 80079-36

Clause(s)/sub-clause(s) of this EN	Essential Requirements (ERs) of 2014/34 EU	Qualifying remarks/Notes
	1.3.2	
5.8.2.3	1.3.4	See also 80079-36
5.8.2.4	1.3.4	See also 80079-36
5.8.5.1	1.3.4	See also 80079-36
5.9.3	1.3.4	See also 80079-36
6.1	1.3.1	See also 80079-36
6.2	1.0.6a 1.1.3 1.2.1 1.3.4 1.4.1	See also 80079-36 Clause has some limited relevance to ESR 1.2.4
6.3	1.0.6a 1.2.1	
6.4	1.0.6a 1.2.1	
6.5	1.0.6a 1.2.1	
7.1	1.0.6a 1.2.1 1.3.2 1.3.4 1.4.1	See also 80079-36 Clause has some limited relevance to ESR 1.2.4
7.2	1.0.6a 1.2.1	
7.3	1.0.6a 1.1.3 1.2.1	
7.3.3	1.3.1	
7.3.4	1.2.3 1.3.2	See also 80079-36

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

Annex ZB
(informative)

Significant changes between this European Standard and EN 13463-5:2011, EN 13463-6:2005 and EN 13463-8:2003

This European Standard supersedes EN 13463-5:2011, EN 13463-6:2005 and EN 13463-8:2003.

Table ZB.1 — Significant changes between this European Standard and EN 13463-5:2011, EN 13463-6:2005 and EN 13463-8:2003

Clauses of this European Standard		Type		
		Minor and formal changes	**Extension**	**Substantial change regarding ESRs**
Introduction of new definitions and slight redefinitions concerning ignition sources to improve ignition hazard assessment (EN 13463-5, EN 13463-6, EN 13463-8 Clause 3)	Clause 3	X	X	
Differentiation in requirements for ingress prevention for dust and liquids (EN 13463-5, Clause 4.3.4)	5.2.2	X		
Changing note to normative text (EN 13463-5, Clause 4.4.3)	5.3.3	X	X	
Note 2 deleted and moved to 5.6 (EN 13463-5, Clause 4.6)	5.5	X		
Additional requirement listed (2nd clause) (from EN 13463-5, Clause 4.6)	5.6	X	X	
Additional measure listed (EN 13463-5, Clause 5.3)	5.6.3	X	X	
Changing of wording regarding information for instructions (EN 13463-5, Clause 6.1)	5.7.1	X		
Changing of wording regarding information for instructions (EN 13463-5, Clause 6.2)	5.7.2	X		
Additional requirement New reference regarding electrostatic requirements (EN 13463-5, note in 7.2.2) New note	5.8.2.2	X		
Changing of wording (EN 13463-5, Clause 7.6.5)	5.8.2.5	X		
Changing to clarify dependency of requirements (EN 13463-5, Clause 7.3.2)	5.10	X		
Differentiation to clarify dependency of	5.11.1	X	X	

Clauses of this European Standard		Type		
		Minor and formal changes	**Extension**	**Substantial change regarding ESRs**
requirements (EN 13463-5, Clause 8.1)				
Additional requirement (EN 13463-5, Clause 10.3)	5.13.3	X		
Editorial modification for clarification (EN 13463-6, Clause 6.1)	Clause 6	X	X	
Editorial modification for clarification (EN 13463-8, Clause 5.1)	7.1	X		
Editorial modification for clarification (EN 13463-8, Clause 7.2)	7.3.2	X		
Additional example (EN 13463-8, Clause 7.4)	7.3.4	X		
Editorial modification for clarification (EN 13463-8, Clause 7.8)	7.3.6	X		
Introduction of new definitions for marking	Clause 10	X	X	

NOTE 1 The technical changes referred include the significant technical changes from the EN revised but is not an exhaustive list of all modifications from the previous version.

Explanations:

A) Definitions

Minor and editorial changes clarification
decrease of technical requirements
minor technical change
editorial corrections

Changes in a standard classified as 'Minor and editorial changes' refer to changes regarding the previous standard, which modify requirements in an editorial or a minor technical way. Also changes of the wording to clarify technical requirements without any technical change are classified as 'Minor and editorial changes'.

A reduction in level of existing requirement is also classified as 'Minor and editorial changes'

Extension addition of technical options

Changes in a standard classified as 'extension' refers to changes regarding the previous standard, which add new or modify existing technical requirements, in a way that new options are given, but without increasing requirements for equipment that was fully compliant with the previous standard. Therefore these 'extensions' will not have to be considered for products in conformity with the preceding edition.

Major technical changes	addition of technical requirements
	increase of technical requirements

Changes in a standard classified as 'Major technical change' refer to changes regarding the previous standard, which add new or increase the level of existing technical requirements, in a way that a product in conformity with the preceding standard will not always be able to fulfil the requirements given in the standard. 'Major technical changes' have to be considered for products in conformity with the preceding edition. For every change classified as 'Major Technical Change' additional information is provided in clause B) of the Annex ZB.

NOTE 2 These changes represent current technological knowledge[1]. However, these changes should not normally have an influence on equipment already placed on the market.

B) Information about the background of 'Major Technical Changes'

None

1 see also ATEX Guide 10.3 and Annex ZA.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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EXPLOSIVE ATMOSPHÈRES –

Part 37: Non-electrical equipment for explosive atmospheres – Non electrical type of protection constructional safety “c”, control of ignition source “b”, liquid immersion “k”

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 80079-37 has been prepared by IEC sub-committee 31M: Non-electrical equipment and protective systems for explosive atmospheres, of IEC 31: Equipment for explosive atmospheres.

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

FDIS	Report on voting
31M/104/FDIS	31M/110/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table. In ISO, the standard has been approved by 15 P members out of 20 having cast a vote.

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

"A list of all parts in the IEC 60079 series, under the general title *Explosive atmospheres*, as well as the International Standard 80079 series, can be found on the IEC website."

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

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

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EXPLOSIVE ATMOSPHERES –

Part 37: Non-electrical equipment for explosive atmospheres – Non electrical type of protection constructional safety “c”, control of ignition source “b”, liquid immersion “k”

1 Scope

This part of ISO/IEC 80079 specifies the requirements for the design and construction of non-electrical equipment, intended for use in explosive atmospheres, protected by the types of protection constructional safety “c”, control of ignition source “b” and liquid immersion “k”.

This part of ISO/IEC 80079 supplements and modifies the requirements in ISO 80079-36. Where a requirement of this standard conflicts with the requirement of ISO 80079-36 the requirement of this standard takes precedence.

Types of Protection “c”, “k” and “b” are not applicable for Group I, EPL Ma without additional protective precautions.

The types of ignition protection described in the standard can be used either on their own or in combination with each other to meet the requirements for equipment of Group I, Group II, and Group III depending on the ignition hazard assessment in ISO 80079-36.

2 Normative references

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

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

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

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

ISO 281, *Rolling bearings – Dynamic load ratings and rating life*

ISO 1813, *Belt drives – V-ribbed belts, joined V-belts and V-belts including wide section belts and hexagonal belts – Electrical conductivity of antistatic belts: Characteristics and methods of test*

ISO 9563, *Belt drives – Electrical conductivity of antistatic endless synchronous belts – Characteristics and test method*

ISO 4413, *Hydraulic fluid power – General rules and safety requirements for systems and their components*

ISO 4414, *Pneumatic fluid power – General rules and safety requirements for systems and their components*

ISO 19353, *Safety of machinery – Fire prevention and protection*

ISO 80079-36: 2016, *Explosive atmospheres – Non-electrical equipment for explosive atmospheres – Part 1: Basic method and requirements*[1]

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

EN 13501-1, *Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 80079-36, IEC 60079-0 and the following apply.

3.1
constructional safety "c"
ignition protection where constructional measures are applied so as to protect against the possibility of ignition from hot surfaces, sparks and adiabatic compression generated by moving parts

3.2
mechanically generated sparks
sparks produced by mechanical impact or friction burning particles, as well as showers of particles, produced by impact or friction between two solid materials

3.3
control of ignition source "b"
ignition protection where mechanical or electrical devices are used in conjunction with non-electrical equipment to manually or automatically reduce the likelihood of a potential ignition source from becoming an effective ignition source

Note 1 to entry: This might for example be a level sensor used to indicate loss of oil, a temperature sensor to indicate a hot bearing or a speed sensor to indicate over-speed.

3.3.1
automatic control measure
action taken without manual intervention, to reduce the likelihood of a potential ignition source from becoming an effective ignition source

3.3.2
manual control measure
action taken by a person as a result of a warning, indication, or alarm, to reduce the likelihood of a potential ignition source from becoming an effective ignition source

3.3.3
ignition prevention devices/systems
arrangement that converts signals from one or more sensors into an action, or indication, to reduce the likelihood of a potential ignition source from becoming an effective ignition source

[1] To be published.

3.3.4
safety devices
devices intended for use inside or outside explosive atmospheres but required for or contributing to the safe functioning of equipment and protective systems with respect to the risks of explosion

3.4
liquid immersion "k"
type of protection where potential ignition sources are made ineffective or separated from the explosive atmosphere by either totally immersing them in a protective liquid, or by partially immersing and continuously coating their active surfaces with a protective liquid in such a way that an explosive atmosphere which may be above the liquid, or outside the equipment enclosure, cannot be ignited

3.4.1
protective liquid
a liquid which prevents the explosive atmosphere from making direct contact with potential ignition sources and thereby ensures the explosive atmosphere cannot be ignited

3.4.2
equipment with a sealed enclosure
totally enclosed equipment that limits the ingress of an external atmosphere during the expansion and contraction of the internally contained protective liquid during use in service

Note 1 to entry: Such equipment includes any pipework associated with it and often contains an overpressure relief device.

3.4.3
equipment with a vented enclosure
enclosed equipment that allows the ingress and egress of an external atmosphere through a breathing device or constricted opening during the expansion and contraction of the internally contained protective fluid during normal operation

Note 1 to entry: Such equipment includes any pipework associated with it.

3.4.4
open equipment
equipment that is immersed, or has its components immersed, in a protective liquid that is open to the external atmosphere

Note 1 to entry: For example, an open top vessel with immersed moving components. Such equipment includes any pipework associated with it.

4 Determination of suitability

Before a decision is made to protect equipment or parts of equipment for use as an assembly, including interconnecting parts, by the measures described in this standard, it shall have been subjected to the ignition hazard assessment in accordance with ISO 80079-36.

5 Requirements for equipment with Type of Protection constructional safety "c"

5.1 General requirements

Equipment designed and constructed according to the applicable safety requirements of the relevant industrial standards is intended to be capable of functioning in conformity with the operational parameters established by the manufacturer, including any mechanical and thermal stresses that they are intended to be subjected to.

This also applies to interconnecting parts of equipment including joints (e.g. cemented, soldered, or welded joints).

NOTE This is accomplished by using one or more of the following documents:

- International standards or Technical Specifications
- FDIS of International standards or Technical Specifications
- National Standards or Technical Specifications
- Technical specifications or Test Reports issued by an Ex accredited Test Laboratory
- Technical specifications of industrial associations.

5.2 Ingress protection

5.2.1 General

The degree of ingress protection (IP) as specified in IEC 60529 provided by the outer enclosures of equipment depends upon its intended duty and the type of environment it is designed to be used in. An appropriate rating shall be determined as part of the ignition hazard assessment (see Clause 4) and, if relevant for ignition protection, shall be able to provide that degree of protection.

NOTE IP degrees of protection according to IEC 60529 are not intended to provide protection against the ingress of an explosive gas atmosphere.

5.2.2 Ingress protection in special cases

The following points specify the minimum IP rating for enclosures used in the circumstances described.

a) In the case of equipment intended for use in explosive gas atmospheres, where entry of foreign objects can cause ignition, but entry of dust is harmless, the required degree of protection against the entry of foreign objects shall be determined in the ignition hazard assessment and shall be at least IP20.

b) In the case of equipment intended for use in explosive gas atmospheres, where the entry of dusts or liquids could cause a malfunction leading to an ignition source, the degree of protection shall be at least IP5X for dust and IPX4 for liquids.

c) In the case of equipment intended for use in explosive dust atmospheres, where ingress of dust can result in an ignition source or fire, the degree of protection shall be IP6X.

d) In the case of equipment intended for use in explosive dust atmospheres, where ingress of dust, foreign objects and liquids are not likely to cause an ignition, no specific degree of protection is necessary for the purpose of ignition protection.

NOTE An enclosure is often employed for other safety reasons, e.g. IP2X to prevent parts of the body coming into contact with rotating parts.

5.3 Seals for moving parts

5.3.1 Unlubricated gaskets, seals, sleeves, bellows and diaphragms

Un-lubricated gaskets, seals, sleeves, bellows and diaphragms shall not become an effective ignition source, e.g. if there is a risk of mechanically generated sparks and hot surfaces which can become an effective ignition source. Light metals shall not be used for these parts in this case (see ISO 80079-36).

Non-metallic materials shall be resistant to distortion and degradation which would reduce the effectiveness of explosion protection within the specified lifetime of operation.

5.3.2 Stuffing box seals (packed glands)

Stuffing box seals (packed glands) shall only be used when instructions are provided by the manufacturer to limit the maximum surface temperature during operation of the gland; alternatively an automatic means shall be provided.

5.3.3 Lubricated seals

Seals which normally require the presence of a lubricant which can be replenished to reduce the likelihood of hot surfaces occurring at their interface with equipment parts shall be designed to ensure the sufficient presence of lubricant or shall be protected by one of the following means:

- provision of an effective means to monitor the continued presence of the lubricant; or
- provision of a temperature detection device to warn of increasing temperatures; or
- design of the equipment to be capable of completing the ‘dry run’ type test, as described in Annex B, without exceeding the maximum surface temperature of the equipment and without suffering damage which would reduce the effectiveness of its ignition protection.

Monitoring shall be either continuous or by required appropriate inspection and examination. Where the level of lubricant cannot be easily monitored (e.g. seal containing grease) the relevant information shall be given in the instructions.

The instructions shall include details relating to the correct lubrication, monitoring and maintenance of such seals.

5.4 Equipment lubricants, coolants and fluids

Lubricants and coolants, which are required for the protection against incendive hot surfaces or mechanically generated sparks (see Clause 7) shall have an auto-ignition temperature (see IEC 60079-20-1) at least 50 K above the maximum surface temperature of the equipment where the liquid is being used.

NOTE IEC 60079-20-1 is under revision and is expected to be published as ISO/IEC 80079-20-1.

Any fluid which can be released shall not result in an effective ignition source, e.g. due to high temperature or electrostatic charging.

5.5 Vibration

Effective ignition sources, hot surfaces or mechanically generated sparks or loss of protection, caused by vibration shall be avoided. Vibration can arise from the equipment itself or from the place where it is mounted.

The manufacturer shall prepare any necessary installation, operation and maintenance instructions. In particular, the instructions shall specify the correct operating speed range of the equipment in order to avoid excessive vibration.

5.6 Requirements for moving parts

5.6.1 General

The ignition hazard assessment (see ISO 80079-36) shall identify those moving parts which could lead to the occurrence of unsafe vibration or impact or friction. Such parts shall be constructed in such a way so that they are unlikely to become an effective ignition source during the specified lifetime of operation of the equipment, taking the EPL into consideration in combination with the instructions.

Where the melting point of the material used in the construction of moving parts is below the maximum surface temperature of the equipment, or is not capable of causing incendive hot

surfaces or mechanical sparks, additional protective measures are not normally necessary (e.g. the provision of a low melting point sacrificial wear plate; the use of a plastic fan inside a metal housing, or a metallic fan with sacrificial non-sparking low melting point fan blade-tips).

5.6.2 Clearance

Clearances between un-lubricated moving parts and fixed parts shall be designed such that likelihood of frictional contact, able to produce an effective ignition source in the form of hot surfaces or mechanically generated sparks, is appropriate to the intended EPL.

5.6.3 Lubrication

For moving parts needing lubrication to avoid excessive temperatures or mechanically generated sparks, effective lubrication shall be ensured, e.g. by:

- an oil splash lubricator, or
- a constant oil feed by means of a reservoir, pump and perhaps an oil cooler, or
- an automatic greasing system, or
- an adequate maintenance procedure to provide for routine greasing or oil level verification by manual or visual means.

If the above measures do not achieve the required EPL of the equipment additional measures to monitor adequate lubrication shall be applied, e.g. level, flow, pressure or temperature sensors which operates an alarm or switch function before a critical lubricant condition is reached, see Clause 6.

Where equipment is designed to process liquids and the presence of the process liquid is essential for the purpose of lubrication, cooling, quenching, or ignition protection, or when the safe operation of the equipment (e.g. of a pump) requires special priming considerations, this shall be stated in the instructions.

5.7 Requirements for bearings

5.7.1 General

Bearings are basically divided into three types, sliding plane motion, sliding rotary motion and rolling element. When assessing bearings, as part of the ignition hazard assessment required by ISO 80079-36, at least the following shall be taken into account:

a) the bearing’s suitability for the equipment’s intended duty e.g. speed, temperature, loading and variations of speed and loading;

b) the bearing’s basic rated life as described in ISO 281 for rolling element bearings (see also Note 1);

c) the proper fit of the bearings in their housing and on the shaft (tolerances, roundness and surface quality), taking into consideration the vertical and axial loads on the bearing with respect to shaft and housing;

d) the correct alignment of the bearings;

e) the axial and radial loading of the bearings caused by thermal expansion of the shaft and the housing under the most severe operating conditions;

f) protection of the bearing from ingress of water and solids, if necessary to avoid premature failure;

g) protection of the bearing from electrical currents, including stray circulating currents (which can cause, for example, incendive sparking, or spark erosion leading to premature failure, at the point of contact between the ball and ball race of a ball bearing);

h) the provision of adequate lubrication, according to the lubricating regime necessary for the type of bearing (e.g. for sliding bearings, boundary lubrication, mixed film, or full film hydrodynamic lubrication are the most commonly used regimes);

i) Maintenance checks at recommended intervals (e.g. vibration, temperature);

j) replacement after unacceptable wear or at the end of its recommended life, whichever comes first;

k) protection of the bearing from vibration, especially at standstill;

l) the use of low reliability non-metallic bearing cages in industrial applications.

m) Where a special initial running in period is necessary that could lead to an effective ignition source, information shall be given in the instructions.

NOTE 1 At the present time, no suitable experimental test exists to demonstrate that a given type of bearing has a low risk of becoming an ignition source in service. Ball and roller bearing manufacturers do, however, quote a basic rated life corresponding to a probability of mechanical failure occurring during operation (e.g. failure by deformation of an element, or fatigue flaking or spalling occurring on one of its elements). This basic rating can be used in the ignition hazard assessment in an attempt to determine the risk of bearing malfunction that might lead to the production of an incendive hot surface or sparks. The basic rated life of a ball/roller bearing is based on the amount of radial and axial loading that a ball/roller bearing can theoretically endure for one million revolutions. It is usually expressed as an “L” value in terms of foreseeable lifetime operating revolutions, or foreseeable lifetime hours of service. In an attempt to reduce the risk of malfunction in service to a minimum, it is paramount that the equipment manufacturer pays attention to good design, the ratio of the axial and radial loadings, construction, lubrication, cooling, and maintenance procedures. Regular examination is also recommended during operation, in an attempt to detect impending malfunction. If bearings act as an insulator, constructive measures are taken, so that the isolation of parts of the equipment is avoided (see ISO 80079-36).

NOTE 2 The service life of bearings greatly depends on the service conditions and it is therefore not possible to reliably calculate their service life.

NOTE 3 Bearings without rolling elements are not affected, because it is not possible to calculate their service life. Lubrication is specified in 5.7.2.

5.7.2 Lubrication

Bearings which depend on the presence of a lubricating medium to protect a temperature rise exceeding the maximum surface temperature, or the creation of incendive mechanically generated sparks shall be constructed to ensure the presence of the lubricating medium. This can be achieved by bearings that are sealed for life, an oil splash lubricator, or an automatic greasing system or a manual system of monitoring the oil level, together with suitable instructions about regular servicing and the recommended frequency of inspection.

If the above measures do not achieve the required EPL of the equipment additional measures to monitor adequate lubrication shall be applied, e.g. level, flow, pressure or temperature sensors which operates an alarm or switch function before a critical lubricant condition is reached, see Clause 6.

Where equipment is designed to process liquids and the presence of the process liquid is essential for the purpose of lubrication, cooling, quenching, or ignition protection, or when the safe operation of the equipment (e.g. of a pump) requires special priming considerations, this shall be stated in the instructions.

5.7.3 Chemical compatibility

Bearings shall be made of materials resistant to the liquids, or vapours, in which they are intended to be used. Similarly, the material used in the construction of the bearing, including any bearing cages, shall be resistant to any liquids or solvents which they are intended to come into contact with. Particular attention shall be given to the possibility of swelling of non-metallic parts. Where liquids or vapours can dissolve in the lubricant of the bearings, the lubricant shall remain 'fit for purpose' even in this condition.

NOTE It is not a requirement of this standard that the manufacturer confirm suitability by tests for each combination of fluid and bearing materials.

5.8 Requirements for power transmission systems

5.8.1 Gear drives

Gear drives shall comply with the requirements in 5.1. Where the ignition hazard assessment (see ISO 80079-36) shows there could still be an ignition source, another form of ignition protection shall be used (e.g. protection by liquid immersion, see Clause 7).

Where equipment includes facilities to change the gear ratios (manually, or automatically), the gear changing mechanisms shall be so arranged as to ensure that they are incapable of producing either temperatures exceeding the maximum surface temperature or incendive mechanically generated sparks.

5.8.2 Belt drives

5.8.2.1 Belt drive categories

There are two main categories of belt drives:

a) Friction (flat, V, wedge and V-ribbed) belt drives, where high surface temperatures are foreseeable and may present a hazard.

b) Synchronous (timing) belt drives, with positive interaction between belt teeth and pulley grooves such that friction heat build-up does not normally occur.

5.8.2.2 Electrostatic charging

Power transmission belts shall not be capable of developing an incendive electrostatic discharge during operation.

Belt drives shall not be used in parts of equipment which require construction to EPL Ga or Da. Belts complying with ISO 1813 and ISO 9563 are suitable for equipment constructed to EPL Mb, Gb or Db, except for Group IIC applications. The belt speed shall not exceed 30 m/s. Belts with connectors shall not be used at belt speeds above 5 m/s.

Where the electrical resistance of a belt is known to increase over time in normal service, the manufacturer shall specify, in the instructions, a time period for re-testing or replacement of the belt.

Belts shall not be considered as a suitable earth path between the drive and driven pulleys.

5.8.2.3 Belt tension

Slack drive belts can cause static build up or high surface temperatures; the correct belt tension shall be specified in the manufacturer’s instructions and maintained.

NOTE In cases where a device(s) is used to ensure correct belt tension it shall be determined if the device(s) can serve to detect broken belts.

5.8.2.4 Belt alignment

With drives which could cause surfaces to exceed the maximum surface temperature if they run out of alignment, true alignment shall be maintained (see 5.8.2.6).

NOTE A correctly designed and installed belt drive, operating near the limit of its capability, typically produce surface temperature rise in normal running of up to:

Friction drives	50 K	above ambient temperature
Synchronous drives	25 K	above ambient temperature.

Temperature rises greater than the above will likely reduce the working life of belts.

5.8.2.5 Earthing and bonding

The supporting frame, chassis, or structure, of equipment containing belt(s) shall be constructed of electrically conducting material and shall be so arranged as to provide a leakage path to earth for any static electricity which occurs on the belt(s). The frame, chassis or structure includes the driving pulley or drum and any idler pulleys or rollers associated with the belt drive. Specific electrical bonding between the separate parts and earth shall be provided where the electrical resistance of the leakage path to earth exceeds 1 MΩ.

If the drive pulley or drive roller is powered by a mains fed electrical motor the electrical connection to earth, normally provided for the electric motor, can be taken into account.

NOTE Additional information can be found in IEC/TS 60079-32-1.

The manufacturer shall include in the instructions a requirement for verification of bonding during installation and maintenance periods.

5.8.2.6 Detection of mechanical faults

Drives capable of producing hot surfaces exceeding the maximum surface temperature, as a result of the stalling of the output power shaft, while the input continues to rotate, shall have means to detect the stalled output, and reduce the likelihood of ignition.

Where a belt drive is equipped with a device to detect a stalled output, slippage, broken belts or misalignment, this shall be taken into account when assessing the maximum temperature during malfunctions.

The instructions shall include the power transmission capability, the maximum belt speed, the correct tension range, and how this can be measured, and alignment tolerance of the pulley system.

Malfunction can also be detected by abnormal process parameters.

5.8.3 Chain drives

Chain drives shall comply with the requirements of 5.1.

Chain drives operating at speeds greater than 1 m/s, and containing a potential ignition source (identified by the ignition hazard assessment required by ISO 80079-36), shall be fitted with means to ensure continuous positive engagement of the chain with its associated sprocket to avoid an effective ignition source. Where this is not possible, it shall be fitted with a device that removes the driving power to the drive sprocket in the event of the chain breaking, becoming disengaged, or slackening beyond a limit specified by the manufacturer's instructions (see Clause 6).

5.8.4 Other drives

Other drives shall fulfill the requirements set out in 5.1.

5.8.5 Hydrostatic, hydrokinetic and pneumatic equipment

5.8.5.1 Hot surfaces

Hydrostatic, hydrokinetic, and pneumatic power transmission equipment shall be constructed of pipes, enclosures or other external parts, which do not produce hot surfaces exceeding the maximum surface temperature, even when operating continuously at maximum normal rating.

5.8.5.2 Hydrostatic and hydrokinetic equipment

Hydrostatic and hydrokinetic equipment shall comply with the requirements of ISO 4413.

The maximum temperature of any power transmission fluid which can be released shall not exceed the maximum surface temperature of the equipment, if this can create an ignition risk.

NOTE 1 A suitable over-temperature protection device is a fusible plug in a fluid coupling which melts to release the power transmission fluid from the coupling during overload / over-temperature (see Clause 6).

To reduce the likelihood of ignition of the explosive atmosphere by burning liquid the power transmission fluid shall have a suitable fire resistance rating.

NOTE 2 National legislation often requires the use of different fire resistant fluids in certain hydraulic systems, e.g. for mining applications.

5.8.5.3 Pneumatic equipment

Pneumatic equipment shall comply with the requirements of ISO 4414.

Air compressors used for pneumatic equipment shall:

- incorporate a filter on the intake system to avoid the ingress of dust or similar foreign material into the parts where compression takes place;
- contain only lubricants which are resistant to ignition or carbonisation within anticipated temperatures. Manufacturer’s instructions shall recommend types of lubricant that are suitable.

NOTE Carbonization of compressor lubricant (caused by exposure to elevated temperatures) results in the formation of oily carbon deposits in the compressor delivery, which can cause it to overheat and explode.

If fitted with flexible hoses for air delivery, the hoses shall not be manufactured from elastomeric materials that can carbonize and form glow particles within anticipated temperatures.

5.9 Requirements for clutches and variable speed couplings

5.9.1 General

Clutches and couplings shall be arranged or monitored (see Clause 6) so that no fixed or moving part that is exposed to the explosive atmosphere exceeds the maximum surface temperature of the equipment. In the case of plastic or other non-metallic parts of a clutch or coupling, their material or arrangement shall exclude the possibility of an incendive electrostatic discharge.

NOTE Examples of the above types of clutch and coupling are friction plate clutches, bell type centrifugal clutches, fluid couplings, torque converters and scoop-controlled fluid couplings.

5.9.2 Slipping

During the period of full engagement, there shall be no slipping, or similar relative movement between the input and output mechanisms likely to cause a hot surface exceeding the maximum surface temperature.

The above requirements can be achieved by one or more of the following methods:

- fitting an overload / over-temperature protection device, for example a fusible plug in a fluid coupling which 'ruptures' to release the power transmission fluid from the coupling during overload / over-temperature; or
- fitting a control device(s), so arranged as to remove the input drive power, if any part of the coupling or clutch assembly, or its housing, attains the maximum surface temperature; or

- fitting a control device(s), so arranged as to remove the drive power, if slippage occurs, because of malfunction, incorrect adjustment, or excessive wear on the mechanisms / friction pads (e.g. clutch plates).

5.9.3 Friction

So as to avoid unsafe frictional heating, the maximum time taken for mechanisms to achieve full-engagement from a standing start, or full disengagement, shall not cause the equipment to exceed the maximum surface temperature. One method of achieving this is to determine the maximum safe engaging time as described in B.2.

5.10 Flexible couplings

When operated within their design parameters, flexible couplings shall not generate hot surfaces, which exceed the permitted maximum surface temperature, nor disintegrate in a way which would create the risk of an ignition source, through for example contact between moving metal parts. Manufacturers shall define the design parameters using established calculation methods or testing.

NOTE 1 Suitable calculation methods are given in DIN 740-2.

Flexible couplings shall be designed and built of materials to minimize the likelihood of an incendive electrostatic discharge as required by the assigned EPL.

NOTE 2 This does not necessitate an electrical conductive path (through the flexible coupling) between the coupled shafts unless specified as necessary to complete an earth path from other parts of the coupled machinery.

Where flexible couplings employ non-metallic elements to separate metallic components which could otherwise contact and cause incendive sparks, instructions shall specify the installation and maintenance procedures needed to reduce the likelihood of metal / metal contact during normal use.

Flexible couplings designed to accommodate shaft misalignment shall be installed such that misalignment does not exceed the manufacturers' maximum values, with due regard to any foreseeable movement or flexure of machinery after installation. In particular, the bores in the hubs shall be sufficiently accurate to ensure concentric running of coupling hubs, and of appropriate diameter tolerance to help ensure secure and accurate shaft fixing.

The manufacturer's instructions shall include maximum torque, maximum rotational speed, limits on angular and linear alignment deviations, the temperature rise of polymeric or metal spring components during normal operation at the limiting parameters, and any other information necessary for safe use.

5.11 Requirements for brakes and braking systems

5.11.1 Brakes used only for stopping in emergency

Brakes, designed to be used only for emergency stopping of equipment, shall be constructed to meet the following:

- Emergency brakes where the likelihood of emergency stopping is not specifically defined shall meet the requirements of 5.11.2.
- Emergency brakes of EPL Gb/Db with a rare likelihood of emergency stopping need no further means of protection. If emergency stopping is required due to the presence of explosive atmosphere, the requirements of 5.11.2 apply.
- Emergency brakes of EPL Gc/Dc need no further means of protection. If emergency stopping is due to the presence of explosive atmosphere, the requirements of 5.11.2 apply.

5.11.2 Service brakes (including friction brakes and fluid based retarders)

Service brakes shall be constructed to allow for the maximum kinetic energy to be dissipated so that neither the maximum surface temperature shall be exceeded nor shall incendive mechanically generated sparks be generated at any part exposed to the explosive atmosphere.

5.11.3 Parking brakes

Parking brakes shall be fitted with an interlock to avoid the drive power being applied if the brake is not fully released. Alternatively a control device shall be fitted which monitors the parking brakes and provides an audible warning to the operator if the equipment / machine moves before the brake is released completely.

5.12 Requirements for springs and absorbing elements

Springs and absorbing elements shall be constructed and, where necessary, provided with lubrication or cooling, so that no part exposed to the explosive atmosphere either produces a hot surface exceeding the maximum surface temperature or incendive mechanically generated sparks if they fracture or break in service.

5.13 Requirements for conveyor belts

5.13.1 Electrostatic requirements

Conveyor belts shall be incapable of developing an incendive electrostatic discharge during operation. Electrostatic properties shall be assessed according to IEC/TS 60079-32-1.

5.13.2 Materials

The materials used in the construction shall be non-combustible or not supporting or propagating combustion. This includes materials classified as A1, A2 or B according to EN 13501-1 (see ISO 19353). Their selection shall be made under consideration of the ignition hazard assessment.

NOTE 1 The requirements in ISO/IEC 80079-38 for conveyor belts used in underground mining comply with these requirements.

NOTE 2 National legislation can require mining conveyor belts to pass more stringent fire resistance tests, based on the application of a propane gas burner to a test sample, a full scale fire test in a mining gallery and a rotating conveyor drive roller in contact with a stationery conveyor belt.

5.13.3 Belt tension

Conveyor belt systems capable of producing hot surfaces exceeding the maximum surface temperature as a result of slackening or slipping of the belt on the conveyor drive or other rollers shall be fitted with a means to ensure that the correct belt tension, as recommended by the manufacturer, is maintained.

The correct belt tension can be achieved by either monitoring the tension in the belt, or by comparing the relative speeds of the drive roller and the belt. Monitoring can be either continuous or by appropriate inspection and examination. The manufacturer shall specify the maximum allowable speed differential between the drive roller and the belt.

If the relative speeds of the drive roller and the belt are being compared, a difference exceeding 10 % should cause the drive power to shut down.

5.13.4 Alignment

Conveyor belt systems which are capable of running out of alignment and hence producing hot surfaces exceeding the maximum surface temperature shall be fitted with a means to detect incorrect alignment.

5.13.5 Earthing and bonding

The supporting frame, chassis, or structure of equipment containing belt(s) shall be constructed of electrically conducting material and shall be so arranged as to provide a leakage path to earth for any static electricity which occurs on the belt(s). The frame, chassis or structure includes the driving pulley or drum and any idler pulleys or rollers associated with the belt drive. Specific electrical bonding between the separate parts and earth shall be provided where the electrical resistance of the leakage path to earth exceeds 1 MΩ.

Where the drive pulley or drive roller is powered by a mains fed electrical motor the electrical connection to earth, normally provided for the electrical motor, can be taken into account.

NOTE Additional information can be found in IEC/TS 60079-32-1.

The manufacturer shall include in the instructions a requirement for verification of bonding during installation and maintenance periods.

6 Requirements for equipment with Type of Protection control of ignition source “b”

6.1 General

For application of Type of Protection “b”, control systems are required that are:

- suitable to control the specific ignition source, and
- reliable enough for the EPL to be achieved.

It is the intent of this standard to use simple systems as far as possible to achieve the relevant levels of protection.

NOTE Examples of such simple systems are mechanical switching systems (including hydraulic and pneumatic systems) or electro-mechanical switching systems such as:

– a sensor connected to a warning light which requires operator intervention;

– a belt alignment switch on a bucket elevator. The elevator stops if the alignment is lost;

– oil pressure switch on a machine which requires lubrication in order to be safe;

– a thermally actuated bypass valve to control liquid temperature of a pump;

– mechanical speed control by centrifugal governor.

It is recognized that systems with proven reliability according to functional safety standards (IEC 61508, IEC 61511 or ISO 13849-1) are available and may be used to demonstrate that the required reliability has been achieved but the use of such systems is not a requirement of this standard.

6.2 Determination of the control parameters

6.2.1 General

Where the ignition hazard assessment described in ISO 80079-36 has revealed potential ignition sources and the manufacturer has decided to reduce the likelihood of them becoming effective by the application of the protection described in Clause 6, the equipment manufacturer shall determine, by calculation or type tests, the control parameters (e.g. temperature, speed, pressure, etc.) associated with those potential ignition sources. To be able to deal with these control parameters it is necessary to define the corresponding normal

operating parameters of the equipment. Where applicable, this shall be done also for expected or rare malfunctions (see Table 1).

NOTE Often sensors fitted to the equipment are used to monitor the proper functioning of the equipment. In the case of deviation from normal operation they give an alarm or a switch function. The information of these sensors are processed locally or by the process control-systems. This sensor information is used in some cases to generate alarms or switch functions to reduce the likelihood of potential ignition sources becoming effective ignition sources.

6.2.2 Determination of the safety critical values

Each safety critical value shall be determined by the manufacturer as that value above or below which a potential ignition source may become effective. The set points relevant for control of ignition sources shall be given in the instructions of the controlled equipment and shall be clearly identified as safety critical.

NOTE Examples of safety critical control parameters that are determined:

a) maximum surface temperature arising from normal or abnormal friction or heat generated by the machine or process;

b) maximum allowable over-speed that if exceeded may result in ignition capable break-up or frictional sparking;

c) maximum allowable over-pressure that if exceeded may result in ignition capable break-up or frictional sparking;

d) maximum allowable vibration, before clearances between fixed and moving parts are reduced to ignition capable levels;

e) maximum allowable amount of wear on brake linings / clutch linings before slippage or frictional rubbing results in an ignition capable sparking or hot surface;

f) minimum amount or flow of coolant needed to keep hot surfaces below the ignition temperature of the atmosphere;

g) minimum level of lubricant needed to reduce the likelihood of ignition capable frictional heating or sparking;

h) maximum misalignment to reduce the likelihood of moving parts making contact with fixed parts.

6.3 Ignition prevention system design and settings

6.3.1 Determining the performance requirements or operating characteristics

The manufacturer shall specify the performance requirements or operating characteristics (e.g. if the device is a fusible plug) of the ignition prevention systems / devices intended to be used in the equipment. Examples of the factors that should be taken into account are:

- speed of change of the potential source becoming an effective source;
- response time of the sensor / detector;
- response time of the ignition prevention system / device;
- difference in level between the normal parameters and critical parameters (e.g. normal temperature and critical temperature);
- safety factor considered necessary.

6.3.2 Instructions

The performance characteristics of the ignition prevention system specified by the manufacturer shall be included in the instructions.

6.3.3 System lockout

Where the ignition prevention device / system is constructed to stop the equipment operating and thereby reduce the likelihood of a potential ignition source becoming an effective ignition source, the device/system shall be arranged so that the stop function locks out, so that the equipment cannot be re-started without re-setting of the devices.

6.3.4 Operator intervention

Where the ignition protection device/system is constructed to indicate, provide a warning or display to the operator to take action to reduce the likelihood of a potential ignition source becoming an effective ignition source, the warning or display shall be designed to avoid operator confusion or misunderstanding with regard to the action required.

NOTE In some cases the ignition protection device/system has at least two levels: The first level, to provide a warning to the operator and a second level, to actuate the system. In some cases the warning can be used to reduce the likelihood of spurious activation of the ignition protection system.

6.4 Ignition protection of sensors and actuators

Parts of the ignition protection system that may be located in an explosive atmosphere shall themselves not be an ignition source (see ISO 80079-36 and IEC 60079-0).

6.5 Ignition protection types

6.5.1 Ignition protection type b1

An ignition protection system of type b1 shall comprise components having a suitable level of reliability, assembled and installed in accordance with any relevant standards, adopting well tried safety principles, able to withstand expected influences during operation. An ignition protection system of level b1 shall comply with the following requirements:

- if a control parameter passes a critical value (see 6.2.2) action is taken to minimize the likelihood of the ignition source becoming effective or a warning is given that an ignition source can develop;
- the ignition protection system is capable of being checked at suitable intervals and the check shall be designed to detect the loss of safety function;
- the equipment manufacturer’s instructions required by ISO 80079-36 shall specify the interval between the periodic maintenance checks and include advice on the methods of detecting faulty sensors or control of ignition devices/systems (e.g. the tests to be performed). They shall also specify the action to be taken by the user if faults on the sensors or ignition protection device/systems are detected during the maintenance checks.

NOTE Normally, the instructions will specify that such faults need to be remedied before the equipment is put back into service.

6.5.2 Ignition protection type b2

A b2 system shall comprise components having proven suitable level of reliability, assembled and installed in accordance with any relevant standards, adopting well tried safety principles, able to withstand expected influences during operation. An ignition protection system type b2 shall comply with the following requirements:

- if a control parameter passes a critical value (see 6.2.2) automatic action is taken to minimize the likelihood of the ignition source becoming effective;

NOTE 1 As a consequence, a warning only (with consecutive manual action) cannot be used in this case.

- the ignition protection system is capable of being checked at suitable intervals and the loss of safety function shall be detected by the check;
- if a single fault occurs in the ignition protection system it does not lead to loss of the protection system safety function;
- the equipment manufacturer’s instructions required by ISO 80079-36 shall specify the interval between checks on the sensor and ignition protection devices / system.

The manufacturer’s instructions shall describe the action to be taken if malfunctions in the ignition protection device / systems are detected.

NOTE 2 These actions might, for example, vary in degree, between immediate stopping of the equipment, to the performance of repairs to the faulty sensors / ignition protection devices/systems without stopping the, otherwise ignition safe, equipment from operating.

6.5.3 Application of ignition protection types

The ignition protection types in Table 1 or Table 2 shall be used as appropriate for the EPL.

The EPL can be achieved either by manual intervention following a warning signal or by automatic intervention. The decisions on which of these shall be used shall be based on the results from the ignition hazard assessment. For EPL Ga, Da or Mb automatic intervention is required.

NOTE Manual intervention could be as simple as a regular maintenance procedure like checking oil level. Alternatively the manual intervention might require a fairly immediate action to reduce the likelihood of an ignition in which case staff needs to be available. Automatic intervention where control system takes pre-programmed action to reduce the likelihood of a potential ignition source from becoming effective.

Table 1 – Minimum ignition protection types required when Ex "b" is selected to achieve the intended EPL for Group II and III equipment

Intended EPL of the equipment	Result of the ignition hazard assessment for the existing equipment:	Ex "b" control system necessary:	Ignition protection type
Gc, Dc	Effective ignition source during normal operation	A single system to avoid ignition sources during normal operation	b1
	No effective ignition sources to be expected during normal operation	None	
Gb, Db	Effective ignition source during normal operation	An independent or fail-safe system to avoid ignition sources during normal operation and expected malfunctions	b2 or two b1
	No effective ignition sources to be expected during normal Operation	A single system to avoid ignition sources in expected malfunctions	b1
	No effective ignition sources to be expected during normal operation and expected malfunctions	None	
Ga, Da	No effective ignition sources to be Expected during normal operation	An independent or fail-safe system to avoid ignition sources during expected malfunctions and rare malfunctions	b2 or two b1
	No effective ignition sources to be expected during normal operation and expected malfunctions	A single system to avoid ignition sources in rare malfunctions	b1
	No effective ignition sources to be expected during normal operation, expected malfunctions and rare malfunctions	None	
For additional information see Annex C.			

Table 2 – Minimum ignition protection types required when Ex "b" is selected to achieve the intended EPL for Group I equipment

Intended EPL of the equipment	Result of the ignition hazard assessment for the existing equipment:	Ex "b" control system necessary:	Ignition protection type
Mb	No effective ignition sources to be expected during normal operation under severe operating conditions, in particular those arising from rough handling and changing environmental conditions	A single system to avoid ignition sources in expected malfunctions	b1
Ma	For type of protection "b", EPL Ma is not covered by this standard (see scope)		

6.5.4 Requirements for ignition protection types

The required EPL shall be achieved either by:

a) installing ignition protection devices that have been shown to comply with the required ignition protection by previous evaluation and operating experience; or

b) evaluating the particular performance requirements necessary for the equipment, taking account of its intended use for ignition protection, and constructing the equipment to the required level. This evaluation shall take account of;

- the types of ignition protection devices used to protect the equipment;
- whether or not, they are single line or duplicated (e.g. by other independent devices);
- individual resistance to faults;
- whether faults are self-revealing or not;
- whether the ignition protection system is fail safe or not;
- the probability of failure, resulting in the ignition protection being lost at the same time as a potential source of ignition (being protected by them) converts to an effective ignition source relating to the Equipment Protection Level of the equipment.

NOTE See also Annex D for the thought process used to assign performance to the different EPL and Annex E for some background information on ISO 13849-1 and IEC 62061.

6.5.5 Programmable electronic devices

Where programmable electronic devices are used as part of the ignition protection system they shall comply with the requirements for the appropriate ignition protection.

NOTE This can be achieved for example by control systems by complying with the requirements of IEC 61508 with an appropriate safety integrity level (see Annex E).

7 Requirements for equipment with Type of Protection liquid immersion "k"

7.1 Determination of the maximum / minimum criteria

The manufacturer of the equipment shall determine by calculation and / or by type testing the following maximum / minimum criteria:

- the maximum and minimum level, or if more appropriate, the maximum and minimum pressure or flow of the protective liquid;
- the maximum working angle to the horizontal of the equipment; the maximum and minimum viscosity of the protective liquid, unless the nature of the protective liquid is specified by the manufacturer;
- any other maximum and minimum parameters relevant to reduce the likelihood of potential ignition sources from becoming effective.

These criteria ensure that the designated potential ignition sources, are either totally immersed, or continuously coated with sufficient protective liquid, to ensure they cannot become effective. Account shall be taken of the effects of contraction during starting surges, splashing, turbulence, churning of the liquid, the worst case filling condition and standstill of the equipment throughout the normal range of operating temperatures.

Where the ignition protection is achieved by partial immersion and a pumped or directed flow of liquid provides the necessary continuous coating on the potential ignition sources, the manufacturer shall determine the most effective location of any nozzle, spray or coating device to give required protection.

The results of the calculation, or type tests, described above, shall be included in the manufacturer's technical documentation; the minimum / maximum criteria to be given in the instructions.

7.2 Protective liquid

The protective liquid used shall be of such viscosity and chemical composition that it:

- prevents the explosive atmosphere from coming into direct contact with the potential ignition source(s) identified in the ignition hazard assessment by providing a continuous coating, or film on the potential ignition source(s); and
- does not itself produce an explosive atmosphere on any of the potential ignition source(s). This includes voids, bubbles or mists caused by the churning action of moving parts in service, and/or a chemical reaction between the protective liquid and the materials used in the equipment's construction;

NOTE This does not preclude the use of flammable liquids used as a protective liquid.

- does not itself produce an ignition source (e. g. production of deposits prone to self-heating or generation of static electricity.).

7.3 Equipment construction

7.3.1 General

The equipment shall be constructed to ensure that the necessary amount of protective liquid is present. If required by the level of protection, this can be achieved for example by monitoring device(s), indicator(s) or gauge(s), which are provided on the equipment to indicate the maximum and minimum levels or, if more appropriate, pressure and flow rate of the protective liquid determined in accordance with 7.1. Where fitted, these devices, indicators or gauges shall be so arranged, that they can easily be read by the user.

7.3.2 Working angle

In the case where the ignition protection would be reduced to an unacceptable level if the equipment is used at an angle to the horizontal, the maximum allowable working angle, or gradient necessary to maintain the required maximum/minimum criteria, determined according to 7.1, shall be visible or detectable on the equipment and specified in the instructions.

7.3.3 Measures to ensure effectiveness of liquid

Where contamination, deterioration, or degradation, of the protective liquid by external means can reduce the level of the ignition protection below that commensurate with the EPL, constructional measures shall be incorporated and/or maintenance instructions provided by the manufacturer, to ensure that the liquid continues to maintain the requisite level of ignition protection.

This may be achieved, for example, by:

– in the case of equipment with continuously flowing protective liquids, providing filtration to limit solid contaminants from being carried into moving parts;
– in the case of open equipment, selecting a protective liquid that is not adversely affected by atmospheric contamination, such as atmospheric moisture and dust;
– in the case of equipment needing protection against high levels of atmospheric dust and water vapour, providing a degree of ingress protection for the enclosure of at least IP66 as described in IEC 60529;
– in the case of equipment with a sealed enclosure, providing an over pressure relief device having an IP rating of at least IP23 according to IEC 60529 and set by the manufacturer of the liquid filled equipment to operate at least at 1,1 times the absolute pressure above the liquid level and a minimum of 0,1 bar above the normal operating pressure;
– in the case of equipment having a vented enclosure, constructing it so that any gas or vapour which may evolve from the protective liquid in normal service can readily escape through a breathing device having an IP rating of at least IP23 according to IEC 60529 and incorporating a suitable drying agent if necessary;
– in the case where manufacturer's instructions are used, requiring the liquid to be subjected to routine condition monitoring and specifying the maximum allowable periods between checks for contaminants such as deposits in the liquid and degradation, for example, by chemical changes to the liquid’s composition such as abnormal change in acidity, or water content.

7.3.4 Accidental loosening

Means shall be provided to guard against accidental loosening of external and internal fasteners associated with covers giving access to the protective liquid. This also applies to any devices needed to indicate the level of the protective liquid and plugs and other parts for filling or draining the protective liquid which could result in unacceptable reduction in the ignition protection if it/they were not maintained in leak proof condition.

Examples of good practice of the means to guard against accidental loosening are:

a) good design and correctly torqued fasteners;
b) cementing of threads;
c) locking washers;
d) wiring of bolt heads.

7.3.5 Level monitoring

Monitoring device(s), indicator(s), or gauge(s) shall be so designed and constructed that they indicate the actual level.

Indicating devices shall be constructed, situated, and protected in such a manner that they do not leak and cannot be damaged, in normal operation.

If a dipstick is used to check the level of the protective liquid in normal service the dipstick shall be secured in its measurement position so that any requirements for ingress protection or sealing are maintained. If necessary an adjacent label shall be provided, requiring the dipstick to be reinserted after use.

7.3.6 Loss of liquid

Where there is the possibility of the protective liquid being lost e.g. by evaporation, capillary or siphon action, the loss shall be avoided or means provided to replenish the liquid.

7.3.7 Open equipment

For open equipment, or equipment with a vented enclosure, the maximum temperature of any surface of the protective liquid exposed to the explosive atmosphere shall not exceed the maximum surface temperature of the equipment according to its classification in ISO 80079-36.

8 Type tests

8.1 Type tests for equipment with Type of Protection constructional safety “c”

See ISO 80079-36.

8.2 Type tests for equipment with Type of Protection control of ignition source “b”

8.2.1 Determination of control parameters

See 6.2.1.

8.2.2 Function and accuracy check of the ignition protection system

Sensors shall be checked to ensure they produce the correct output signal in response to the characteristic being monitored and their accuracy is within the range described in this document.

The ignition protection systems shall be checked for correct operation as intended, also to see if they indicate a “fault” condition when defective or if a signal outside of the limits of the pre-determined maximum / minimum range is applied to it.

8.3 Type tests for equipment with Type of Protection liquid immersion “k”

8.3.1 General

When tested in accordance with 8.3.2 or 8.3.3 no loss of liquid shall occur to the equipment, which would cause the liquid level to fall below the minimum criteria determined in Clause 5. The following tests shall be performed without the equipment operating.

The pressure test is not required for the enclosure in the case of open equipment.

8.3.2 Increased pressure test on enclosed equipment having a sealed enclosure that contains static, or flowing protective liquid

The enclosure shall be submitted to an internal pressure, equal to at least 1,5 times the maximum normal working gauge pressure with a minimum of 50 kPa overpressure for a minimum period of 60 s, with the enclosure filled to the specified maximum liquid level. There shall be no visible leakage.

8.3.3 Overpressure test on enclosed equipment having a vented enclosure

The enclosure shall be submitted to an internal pressure at least 1,2 times of the set pressure of the pressure relief device for a minimum period of 60 s with the enclosure filled with the protective liquid to the specified maximum liquid level. There shall be no visible leakage.

9 Documentation

9.1 Documentation for equipment with Type of Protection constructional safety “c”

The documentation shall be made in accordance with ISO 80079-36, The type of Protection applied shall be given in the instructions (see ISO 80079-36 and Clause 9 of this standard).

Technical documentation shall include as a minimum the following information as applicable:

a) details of ingress protection;
b) details of type of liquid;
c) details of safety critical parts;
d) details of running in period;
e) details for intervals of calibration;
f) details of chemical compatibility;
g) check interval of clearances;
h) dry run capability.

9.2 Documentation for equipment with Type of Protection control of ignition sources “”b”

The documentation shall be made in accordance with ISO 80079-36, the Type of Protection applied shall be given in the instructions (see ISO 80079-36 and Clause 9 of this standard).

It shall include the following information as applicable:

a) instructions relating to the action / reaction level settings of ignition protection systems (see Clauses 5 and 6),
b) the method and the frequency of routinely checking that the ignition protection system is functioning and calibrated correctly,
c) specifications of indicator(s), or gauge(s) or other similar types of monitoring device, with the correct level, or if more appropriate the correct pressure and flow rate, of any coolant, lubricant or protective liquid necessary to maintain the ignition protection commensurate with the assigned Equipment Protection Level (EPL) when in service. Where necessary, indicators or gauges intended for operator controlled equipment shall be so arranged that they can be easily seen by the operator responsible for applying the control measures.

9.3 Documentation for equipment with Type of Protection liquid immersion “k”

The documentation shall be made in accordance with ISO 80079-36, the type of protection applied shall be given in the instructions (see ISO 80079-36 and Clause 9 of this standard).

It shall include the following information as applicable:

a) details of the maximum and minimum level of the protective liquid, or if more appropriate, the maximum and minimum pressure and flow rate of protective liquid;
b) details of the maximum normal working pressure;
c) details of the maximum allowable working angle to the horizontal of the equipment;
d) details of the type of liquid to be used, and any limitations on the liquids, or its minimum viscosity;
e) if necessary, any specific mounting instruction for the equipment;
f) instructions relating to maintenance, recommended duty life, replacement, replenishment and disposal of the protective liquid;
g) where applicable instructions regarding the periodic internal cleaning to remove deposits that could self-heat;
h) instructions about the commissioning, initial filling, and putting into service of the equipment.

10 Marking

10.1 General

Non-electrical equipment meeting the requirements of this standard supplemental to those of ISO 80079-36 shall be marked in accordance with ISO 80079-36, there is no additional marking with regard to the Type of Protection applied. For example, equipment intended for use in a Group IIB flammable gas or vapour which has a temperature class of T4 and Equipment Protection Level Gb and protected by constructional safety, liquid immersion and/or control of ignition sources shall be marked with Ex h IIB T4 Gb.

NOTE The Type of Protection based on ISO 80079-37 applied to the equipment cannot be recognised from the Ex-marking code “h”. Description of the Type of Protection applied is given in the instructions (see ISO 80079-36 and Clause 9 of this standard).

10.2 Safety devices

Safety devices with the intention to be part of an ignition protection system designed for type b1, b2 (see 6.4) and not intended to be placed in explosive atmospheres shall be marked with [Ex h].

It is recommended that where practical, equipment which is part of a b1 or b2 safety system and which is to be placed in a non-hazardous area be marked with a suitable warning label, either on the control components themselves, or on the enclosure containing them, e. g.

"WARNING – this enclosure contains equipment forming part of an ignition protection system in accordance with ISO 80079-37".

Annex A
(informative)

Approach and application: equipment with Type of Protection “c”

A.1 General remarks regarding ignition hazard assessment

The full ignition hazard assessment according to ISO 80079-36 is done by the manufacturer of the complete equipment. Examples are given there. The following examples (Table A.1) demonstrate specific aspects of the application of Type of Protection constructional safety "c" to particular parts and sources of ignition in parts of equipment.

Table A.1 – List of examples for some of the thought processes and principles used

Clause	Example	Table
A.2	Stuffing box seal/Packed gland	A.2
A.3	Mechanical seal/Slide ring seal	A.3
A.4	Radial seal	A.4
A.5	Belt drives	A.5

A.2 Stuffing box seal (see Table A.2)

For the assessment of a stuffing box seal it is necessary to keep in mind where the contact to the explosive atmosphere is possible. The inner parts with frictional contact to the shaft may be covered under liquid or without contact to explosive atmosphere. The probability of an inner or an outer ignition source to become effective may be different. It is not possible to protect the inner parts by means of control of ignition sources like temperature limitation placed outside. The heat generating parts are the moving shaft or the packing gland. The packing gland has a poor heat conductance and the maximum heat generating area may vary over its service life. To monitor the moving part is complicated. Therefore it is necessary to make a statement in the marking, accordingly to distinguish between the inner and the outer parts.

Table A.2 – Stuffing box seal

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to reduce the likelihood of 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
No.	potential ignition source	description / basic cause (Which conditions originate which ignition hazard ?)	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	reasons for assessment	description of the measure applied	basis (citation of standards, technical rules, experimental results)	technical documentation	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	resulting EPL in respect of this ignition hazard	necessary restrictions
1	hot surface	friction between the moving and the stationary parts of a stuffing box seal	x				frictional heating in normal operation	determination of the surface temperature during normal operation under most adverse conditions in a test	ISO 80079-36:2016, 8.2	record of the test, measured temperature = 170 °C		x			Gc	T3
	Application of type of protection “c” and resulting frequency of ignition source in addition to no.1															
2	hot surface	friction between the moving and the stationary parts of a stuffing box seal	x				frictional heating in normal operation in a liquid pump application	determination of the surface temperature during normal operation under most adverse conditions in a test, the contact force between the shaft and the stuffing box is limited by a stop to prevent excessive force when the equipment is correctly adjusted and a minimum leakage is present	ISO 80079-36:2016, 8.2, ISO 80079-37	record of the test, measured temperature = 170 °C, instructions			x		Gb	T3

A.3 Slide ring seal

Table A.3 demonstrates a possible method to carry out an ignition hazard assessment for a slide ring seal. To fulfill the different requirements for the necessary categories, the seal has to be assessed concerning the possible occurrence of malfunctions. A slide ring seal designed and manufactured to the state of the art is capable to fulfill requirements of EPL Gc without any additional protective measures (line 1). To reach the higher level of EPL Gb additional measures are required. These measures are described in line 2. An example for EPL Ga is given in line 3.

For EPL Ga, rare malfunctions of the equipment as well as the malfunction of the ignition protection system need to be considered. In this example the use of an ignition protection system b1 is acceptable.

The ignition protection system shall be able to detect the monitoring parameter without any unsafe time delay in the activating of the ignition protection system. It is necessary to demonstrate the capability to switch the ignition source into a safe status. The coupling of the sensors to the ignition source is very important. It is not possible to detect e.g. a temperature gradient because of a rare malfunction at the wear point in an admissible time, when the sensor is placed in the storage tank of the protective liquid of the slide ring seal. For some applications an additional monitoring of the cooling liquid flow is required to avoid excessive local heat. The protective liquid needs to be selected under consideration of the ambient temperatures to avoid evaporation of the liquid in the seal gap.

In total the slide ring seal can only be assessed when a dynamic routine test is carried out on every single unit and the assessment is carried out under consideration of the mounting position of the unit in the assembly.

Table A.3 – Slide ring seal

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to reduce the likelihood of 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
No.	potential ignition source	description / basic cause (Which conditions originate which ignition hazard ?)	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	reasons for assessment	description of the measure applied	basis (citation of standards, technical rules, experimental results)	technical documentation	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	resulting EPL in respect of this ignition hazard	necessary restrictions
1	hot surface	friction between the moving and the stationary parts of a slide ring seal with product lubrication	x				frictional heating during normal operation	determination of the surface temperature during normal operation under most adverse conditions in a type test; measured temperature <130 °C (135 °C minus 5 K for type testing)	ISO 80079-36: 2016, 8.2	record of the type test, requirements for maintenance in the instructions		x			Gc	T4

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to reduce the likelihood of 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
No.	potential ignition source	description / basic cause (Which conditions originate which ignition hazard ?)	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	reasons for assessment	description of the measure applied	basis (citation of standards, technical rules, experimental results)	technical documentation	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	resulting EPL in respect of this ignition hazard	necessary restrictions
	Application of type of protection “c” and resulting frequency of ignition source in addition to no.1															
2	hot surface	friction between the moving and the stationary parts of a slide ring seal with product lubrication	x				frictional heating during normal operation; absence of lubrication liquid is expected because of normal leakage quantities	determination of the surface temperature during normal operation under most adverse conditions in a type test; measured temperature <130 °C (135 °C minus 5 K for type testing); lubrication with an additional thermo siphon cooling device with forced circulation, e.g. by a pump (specification of maintenance procedure and time period for replacement of the fluid)	ISO 80079-36:2016, 8.2 ISO 80079-37	record of the type test, requirements for maintenance in the instructions			x		Gb	T4

	1		2					3			4					
No.	ignition hazard		assessment of the frequency of occurrence without application of an additional measure					measures applied to reduce the likelihood of 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 (Which conditions originate which ignition hazard ?)	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	reasons for assessment	description of the measure applied	basis (citation of standards, technical rules, experimental results)	technical documentation	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	resulting EPL in respect of this ignition hazard	necessary restrictions
	Application of type of protection “c”, and type of protection “b” as a second independent type of protection in addition to no.2 and resulting frequency of ignition source															
3	hot surface	friction between the moving and the stationary parts of a slide ring seal with product lubrication Temperature class T4 intended		x			Frictional heating during normal operation does not lead to effective ignition source below T4; absence of lubrication liquid is foreseeable because of normal leakage quantities; wrong operating pressure and blocked or interrupted lubrication system are considered as rare malfunctions	determination of the surface temperature during normal operation under most adverse conditions in a type test a); measured temperature <100 °C (less than 80 % of 135 °C as required for EPL Ga equipment) with minus 5 K for type testing; and lubrication with an additional thermosiphon cooling device with forced circulation, insured e.g. by a suitable monitoring device or a pump (specification of maintenance procedure and time period for replacement of the fluid);	ISO 80079-37	record of the type test, instructions ignition protection system with one ignition protection type and additional measures for ignition protection of the monitoring device				x	Ga	T4

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to reduce the likelihood of 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
No.	potential ignition source	description / basic cause (Which conditions originate which ignition hazard ?)	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	reasons for assessment	description of the measure applied	basis (citation of standards, technical rules, ex-perimental results)	technical documenta-tion	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	resulting EPL in respect of this ignition hazard	necessary restrictions
3	continue d	continued	X cont.				continued	additional monitoring of liquid in dependence on failure modes by 1) insuring the liquid fill level and/or 2) temperature of the stationary part of the slide ring seal are monitored, 80 % of the required temperature class and and/or 3) pressure and/or 4) flow						X cont .	Ga cont .	T4 cont .

a) Type Test: The type test can be performed by the manufacturer or a test house according to the conformity assessment procedure.

A.4 Radial seal

The radial seal is used through all EPLs. In Table A.4 a typical assessment is demonstrated. It is necessary to distinguish between the function of ingress protection and the zone separation. For the zone separation, for example, the natural ventilation or an overpressure of a protective gas may be necessary.

The combination of the malfunction of the seal and the release of flammable liquid or combustible gas should be considered according to increased ignition risks because of leakage.

Table A.4 – Radial seal

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to reduce the likelihood of 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
No.	potential ignition source	description / basic cause (Which conditions originate which ignition hazard?)	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	reasons for assessment	description of the measure applied	basis (citation of standards, technical rules, experimental results)	technical documentation	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	resulting EPL in respect of this ignition hazard	necessary restrictions
	Application of ISO 80079-36 and resulting frequency of ignition source															
1	hot surface	friction between the shaft and the radial sealing	x				frictional heating in normal operation	determination of the surface temperature under most adverse conditions during a type test	ISO 80079-36:2016, 8.2	record of the test		x			Gc	T4
	Application of type of protection “c” and resulting frequency of ignition source in addition to line no.1															
2	hot surface	friction between the shaft and the radial sealing	x				frictional heating in normal operation, the seal may run dry or a failure of mounting may occur	determination of the surface temperature under most adverse conditions during a test, measured temperature <130 °C (135 °C minus 5 K for type testing); the dry run can be excluded, specific measures are described in the operating manual, e.g. original radial sealing spare parts are used, lubrication is assured	ISO 80079-36:2016, 8.2 ISO 80079-37:2016, 5.7	record of the test, instructions			x		Gb	T4

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to reduce the likelihood of 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
No.	potential ignition source	description / basic cause (Which conditions originate which ignition hazard?)	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	reasons for assessment	description of the measure applied	basis (citation of standards, technical rules, experimental results)	technical documentation	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	resulting EPL in respect of this ignition hazard	necessary restrictions
	Application of type of protection “c” and type of protection “b” as a second independent type of protection in addition to no.2 resulting frequency of ignition source (Variation to line 3)															
3a	hot surface	friction between the shaft and the radial sealing	x				frictional heating in normal operation, the seal may run dry or a failure of mounting may occur as rare malfunction (see no.2) a seizure of the seal cannot be excluded	determination of the surface temperature under most adverse conditions during a type test [a)], measured temperature <130 °C (135 °C minus 5 K for type testing) <80 % of the required temperature class limit; the seal is protected by means of control of ignition sources, the temperature rising in a failure of the seal is checked as noncritical, instructions in the operating manual are given, the capability of the ignition prevention type b1 is demonstrated	ISO 80079-36:2016, 8.2 ISO 80079-37:2016, 6.5	record of the type test, instructions, ignition prevention type b1				x	Ga	T4
	Alternative application type of protection “c” and resulting frequency of ignition source (Variation to line 3a)															

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to reduce the likelihood of 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
No.	potential ignition source	description / basic cause (Which conditions originate which ignition hazard?)	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	reasons for assessment	description of the measure applied	basis (citation of standards, technical rules, experimental results)	technical documentation	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	resulting EPL in respect of this ignition hazard	necessary restrictions
3b	hot surface	friction between the shaft and the radial sealing	x				frictional heating in normal operation, the seal may run dry or a failure of mounting may occur, as rare malfunction (see no.2) a scuffing of the seal cannot be excluded	determination of the surface temperature under most adverse conditions during a type test measured temperature <80 % of the required temperature class limit the seal is tested with dry run conditions and a failure of mounting, the temperature rising in a failure of the seal is checked as noncritical, instructions in the operating manual are given	ISO 80079-36:2016, 8.2	record of the type test, instructions				x	Ga	T4

a) Type Test: The type test can be performed by the manufacturer or a test house according to the conformity assessment procedure.

A.5 Belt drives

Table A.5 demonstrates a typical solution for V-belt drives. The example given in Table A.5 describes only the ignition risk from hot belt surfaces.

The electrostatic properties like resistance or charge generating processes should also be mentioned. It is necessary to check the amount of generated charge in relation to the conducted charge to ground. Therefore the speed of the belt drive needs to be limited or a test has to be carried out.

Table A.5 – Belt drives

	1		2					3			4					
	ignition hazard		**assessment of the frequency of occurrence without application of an additional measure**					**measures applied to reduce the likelihood of 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
No.	potential ignition source	description / basic cause (Which conditions originate which ignition hazard ?)	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	reasons for assessment	description of the easure applied	basis (citation of standards, technical rules, experimental results)	technical documentation	during normal operation	during expected malfunction	during rare malfunction	no need for further consideration	resulting EPL in respect of this ignition hazard	necessary restrictions
	Application of ISO 80079-36 and resulting frequency of ignition source															
1	hot surface	slippage of the belt drive	x				frictional heating in normal operation	determination of the surface temperature under most adverse conditions during a test (<190 °C)	ISO 80079-36: 2016, 8.2	record of the test, instructions		x			Gc	T3
	Application of type of protection “c” and resulting frequency of ignition source in addition to no.1															
2	hot surface	slippage of the belt drive	x				frictional heating in normal operation additional heating in case of incorrect tension of the belt	determination of the surface temperature under most adverse conditions during a test (<190 °C), maintenance is required in regular intervals	ISO 80079-36: 2016, 8.2 ISO 80079-37: 2016, 5.8.2.3	record of the test, instructions			x		Gb	T3

Annex B
(normative)

Test requirements

B.1 "Dry run" type test for lubricated sealing arrangements

The test attempts to simulate the heating which can occur when the lubrication provided for lubricated type sealing elements, between fixed and moving parts of equipment, is lost. Examples of the sealing arrangements concerned, are gasket seals, shell type seals and other similar seals used for sliding or rotating shafts.

Before the test remove the lubricant without cleaning. Then subject the sealing arrangement to a "dry run" type test with the moving part operating at its maximum normal operating speed. The duration of the dry run test shall be three times the maximum time during which the equipment may run dry considering the intended use and the target EPL. If the maximum time for dry running cannot be assessed, the maximum surface temperature requirements of ISO 80079-36 apply under dry run conditions (until final temperature is reached).

Measure the temperature on the fixed part of the equipment as near as possible to the place where the seal makes contact with the moving parts. For example, an accurate determination can usually be made by inserting a thermocouple into a small hole drilled at an angle near the seal so that it extends underneath the sealing element. Towards the end of the test several temperature readings may need to be taken to ensure that a final 'steady state' temperature has been attained. Note the temperature readings together with the ambient temperature and the speed of moving part during the test.

B.2 Type test for determining the maximum engaging time of clutch assembly

B.2.1 Apparatus

B.2.1.1 Clutch assembly

One clutch assembly of the type intended to be used in the explosive atmosphere. If the clutch assembly forms part of a series having different input and output characteristics, select the assembly designed to transmit the largest amount of power and torque from its input shaft to its output shaft.

NOTE If the clutch assembly is fitted with an overload protection device, such as a shear pin (for friction pad types), or fusible link/plug (for liquid filled types), this might need to be disabled during the test to avoid it affecting the results.

B.2.1.2 Temperature sensor

Temperature sensor(s) – able to measure temperatures up to and including at least the maximum surface temperature for the explosive atmosphere in which the clutch is intended to be used. The sensor(s) also need to be capable of measuring the temperature of fixed and moving parts exposed to the surrounding atmosphere. Suitable sensor(s) are for example specially calibrated infra-red heat detectors, arranged to measure the actual temperature of moving parts without being mechanically connected to them.

B.2.1.3 Drive motor

Drive motor able to transmit the clutch assembly manufacturer's maximum recommended input power and torque to the assembly.

B.2.1.4 Locking mechanism

Locking mechanism able to keep the output shaft of the clutch assembly from rotating when the manufacturer's maximum recommended input drive power and torque is applied to the input shaft.

B.2.1.5 Recording devices

Timer/recorder arranged to start when the drive power is first applied to the input shaft and stopped when the temperature sensor detects that a part of the assembly has attained the maximum surface temperature allowed for the atmosphere.

B.2.1.6 Conditioning chamber

Conditioning chamber able to condition the clutch assembly whilst it is connected to the drive motor and locking mechanism.

B.2.2 Procedure

B.2.2.1 Sample preparation

Condition the clutch assembly at (20 ± 5) °C for at least 8 h.

B.2.2.2 Timing

Simultaneously start the drive motor (to apply power to the clutch input shaft) and the timer.

B.2.2.3 Temperature recording

Determine and record the 'Maximum engaging time' for the assembly, which is the time taken in seconds, from the instant when drive power is applied to the assembly, to the instant when the temperature sensor ascertains that part of the clutch assembly has reached the maximum surface temperature allowed for the atmosphere in which it is intended to be used. Stop the drive motor.

B.2.2.4 Results

The test report shall contain;

- the number of this standard;
- the clutch assembly manufacturer's name;
- the manufacturer identification for the assembly;
- the 'maximum engaging time' for the clutch assembly in seconds.

B.2.2.5 Reporting

The “Maximum safe engaging time" shall be given in the information for use supplied with the equipment.

Annex C
(informative)

Methodology: equipment with Type of Protection “b”

Figure C.1 demonstrates the procedure related to equipment with Type of Protection control of ignition source “b”.

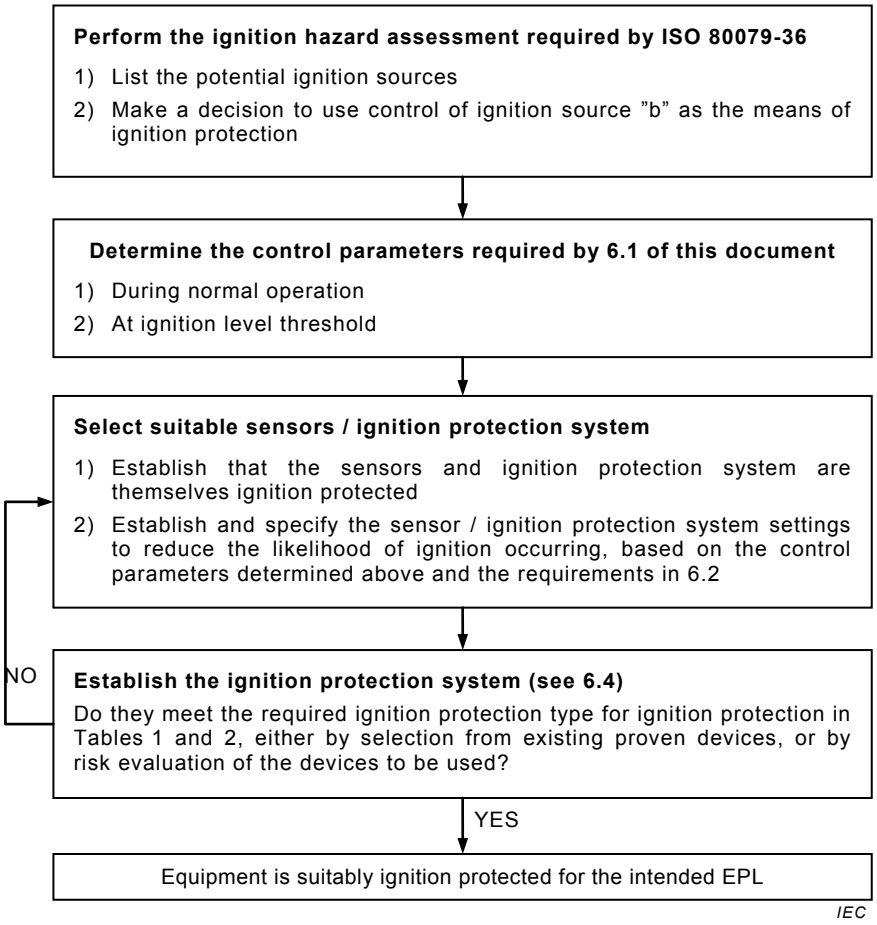

Figure C.1 – Flow diagram of the procedures described in this document

Annex D
(informative)

Approach to assign the required ignition protection type used for equipment to achieve different EPL

D.1 For EPL Gc and Dc

This equipment, by definition, does not contain sources of ignition in normal operation. To meet this basic requirement, it will not usually be necessary to apply additional control of ignition source ”b” protection to cater for abnormal operation of the equipment. The exception to this is equipment that has to be controlled by some device as part of its normal operation. For example, a speed control device fitted to ensure that a rotating part of a machine maintains the correct speed in normal operation. In this case, the speed control device can be interpreted as an ignition protection system as described in this document.

It might also be necessary to fit an ignition protection system of type b1 device to normal industrial equipment, thereby convert it from equipment that is not intended for use in an explosive atmosphere to a type that meets the requirements of EPL Gc and Dc.

In all of the above cases, the probability of a failure of the ignition protection system at the same time as an explosive atmosphere occurs will be rare and consequently, a low ignition protection level should be sufficient.

D.2 For EPL Gb and Db

The equipment that meets the requirements of EPL Gb and Db has to be protected against ignition sources occurring in normal operation and also with expected malfunction. In this case, the probability of an ignition source developing in the equipment at the same time as the ignition protection system is faulty and an explosive atmosphere is present is higher than for EPL Gc, Dc equipment. Ignition protection type b2 has therefore been assigned by this document to the ignition protection systems used to protect EPL Gb, Db equipment that would otherwise have an effective ignition source in normal operation. Where the effective ignition source is only likely to occur in expected malfunctions an ignition protection system with type b1 is sufficient to achieve the required degree of protection.

D.3 For EPL Mb

EPL Mb needs to be protected against ignition sources occurring in normal operation and also with expected malfunction on the equipment, even under severe operating conditions. In this case, the probability of an ignition source developing in the equipment at the same time as the ignition protection system is faulty and an explosive atmosphere is present is as high as for EPL Gb equipment.

Case 1:

Where the general ventilation and gas detection arrangements guarantee that presence of explosive atmosphere in the environment of the EPL Mb equipment is detected and leads to an automatic de-energizing within short time, an ignition protection system with type b1 is sufficient to achieve the required EPL Mb.

Case 2:

Where the effective ignition source is only likely to occur in case of expected malfunctions an ignition protection system with type b1 is sufficient to achieve EPL Mb.

D.4 For EPL Ga and Da

EPL Ga, Da needs to be ignition protected in normal operation, also with expected malfunctions and rare malfunctions.

The definitions and requirements for this EPL also include reference to such equipment being either safe with more than one fault applied, or protected by two protection methods. For this reason, EPL Ga and Da can only be achieved to equipment that does not have an effective ignition source in normal operation. Where the effective ignition source is only likely to occur in rare malfunctions an ignition protection system with type b1 (with automatic action only) is sufficient to achieve the required EPL provided, and keep the ignition source from becoming effective if any control parameter critical is exceeded. Where the ignition source is likely to occur in expected malfunctions two independent ignition protection systems of type b1, or alternatively one ignition protection system of type b2, are necessary to achieve the required EPL.

Annex E
(informative)

Information on functional safety concept

E.1 ISO 13849-1

International Standard IEC 13849-1:2006 "*Safety of machinery – Safety related parts of control systems – Part 1: General principles for design*" supersedes 1999 edition of IEC 13849-1. It describes 5 performance levels (a, b, c, d and e), it considers MTTF, diagnostic coverage, common cause failure and other aspect and it should be applied to assess the quality of the safety related parts of machinery control systems.

E.2 IEC 61508-1

IEC 61508, *Functional safety of electrical/electronic/programmable electronic safety-related systems* has been prepared by the IEC to assist manufacturers of safety related systems. It contains the requirements for four Safety Integrity Levels (SIL 1, 2, 3 and 4) that can be applied to describe the quality of the safety related parts of a control system.

E.3 IEC 62061

The IEC has elaborated an International standard for electrical/electronic and programmable controlled machine safety: IEC 62061, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*.

E.4 Reliability according to functional safety standards

The correlation between reliability according to functional safety standards and ignition prevention types is given in Table E.1.

Table E.1 – Application of ignition protection type

Hardware Fault Tolerance (related to effective ignition source)	**2**	**1**	**0**	**1**	**0**	**-1**	**0**	**-1**
Ignition protection type achieved by the control system (*safety device*)								
Hardware Fault Tolerance	-	0	1	-	0	1	-	0
Safety Integrity Level (IEC 61508) Performance Level/ Category acc. to ISO 13849-1 Ignition protection type according to this standard	-	SIL 1 PL c cat.2 **b1**	SIL 2 PL d cat.3 **b2**	-	SIL 1 PL c cat.2 **b1**	SIL 2 PL d cat.3 **b2**	-	SIL 1 PL c cat. 2 **b1**
Equipment Protection Level achieved after implementation of safety measures								
EPL Group II, III	Ga, Da			Gb, Db			Gc, Dc	

NOTE 1 Hardware Fault Tolerance (HFT):

- -1 indicates effective ignition source during normal operation (incendive in normal operation).
- 0 indicates that the equipment under control is safe in normal operation, no effective ignition sources to be expected during normal operation. One single fault may cause the apparatus to fail so a single system is necessary to avoid ignition sources during normal operation
- 1 indicates that the apparatus is safe with one single fault. Two independent faults may cause the apparatus to fail.
- 2 indicates that the apparatus is safe with two independent faults. Three faults may cause the apparatus to fail.

NOTE 2 SIL1 or SIL2 indicates the Safety Integrity Level of the Safety device according to IEC 61508 series. PL c or PL d indicates the Safety Performance Level of the Safety device according to ISO 13849 series.

NOTE 3 "-" means that no safety device is required

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