IEC TS 60079-42

Edition 1.0 2019-04

TECHNICAL SPECIFICATION

SPECIFICATION TECHNIQUE

colour inside

Explosive atmospheres
Part 42: Electrical Safety Devices for the control of potential ignition sources from Ex-Equipment

Atmospheres explosives
Partie 42: Dispositifs électriques de sécurité pour la commande des sources potentielles d'inflammation des appareils Ex

IEC TS 60079-42:2019-04(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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FOREWORD

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International Technical Specification IEC 60079-42 has been prepared by IEC technical committee 31: Equipment for explosive atmospheres.

The text of this Technical Specification is based on the following documents:

FDIS	Report on voting
31/1418/DTS	31/1441/RVDTS

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

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

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- withdrawn,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.

This International Technical Specification is to be read in conjunction with the International Standards for the specific types of protection listed in the ISO 80079-37 and the IEC 60079 series.

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

INTRODUCTION

Generally, the probability of potential ignition sources becoming effective is mitigated by applying the protection measures according to the IEC 60079 and the ISO 80079 series. If the probability of an ignition source becoming effective cannot be mitigated by these measures, it could be controlled by using a suitable safety device. The combination of the safety device and the Ex Equipment may then comply with the relevant standards of the IEC 60079 series and the ISO 80079 series with respect to the Equipment Protection Level.

Safety devices, which are used as part of the protection of equipment for explosive atmospheres for control of potential ignition sources, should consider reliability for the intended purpose to recognise the principles for the classification of hazardous areas and explosion protection techniques. This document provides guidance for the application of safety functions to provide a reduction of ignition risk for equipment as part of the IEC 60079 series and ISO 80079 series. It relies on relevant IEC and ISO standards for safety related control systems.

EXPLOSIVE ATMOSPHERES

Part 42: Electrical Safety Devices for the control of potential ignition sources from Ex-Equipment

1 Scope

This part of IEC 60079, which is a Technical Specification, provides guidance for equipment manufacturers where electrical safety devices are used to reduce the likelihood of potential ignition sources becoming effective in Ex Equipment located in Explosive Atmospheres. Electrical safety devices perform a safety function to control potential ignition sources from both, electrical or non-electrical Ex Equipment in explosive atmospheres.

This document may also be applied to a combination of elements performing a safety function. For example:

- Sensor
- Logic system
- Final element

This Technical Specification can also be used for assessing the safety device independently, without being designed for a specific Ex Equipment.

A safety device can be a measure to achieve a required EPL of the Ex Equipment with respect to a potential ignition source. The combination of the safety device and the Ex Equipment could then comply with the relevant standards of the IEC 60079 series and the ISO 80079 series with respect to the Equipment Protection Level. However, increasing the EPL of Ex Equipment by the simple addition of a safety device is not within the scope of this document.

This document does not apply to:

- mechanical control equipment such as pressure relief valves, mechanical governors and other mechanical safety devices
- the use of gas detection
- control equipment to prevent the occurrence of explosive atmospheres, e.g. inerting systems and ventilation systems
- mitigation of an explosion

NOTE Some potential ignition sources might not be practicably controlled by safety devices.

Electrical safety devices, where the level of safety integrity is identified under other parts of the IEC 60079 series, this document can be used as a reference for the realization of the level of safety integrity.

Electrical safety devices may be installed either as part of or separate to the Ex Equipment under control (EEUC) and may be located inside or outside the hazardous area.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61508-4, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 4: Definitions and abbreviations (see http://www.iec.ch/functionalsafety)*

IEC 61511-1, *Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and application programming requirements*

ISO 80079-37, *Non Electrical Equipment for Explosive Atmospheres – Non electrical Type of Protection constructional safety 'c', control of ignition Source 'b', liquid immersion 'k'*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60079-0, IEC 61508-4, IEC 61511-1, ISO 80079-37 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
safety device
device intended for use inside or outside explosive atmospheres but required for or contributing to the safe functioning of Ex Equipment and protective systems with respect to the risks of explosion

Note 1 to entry: Safety devices differ from the term devices used in the IEC 61508 and IEC 61511 series. Safety devices can be compared to the terms like "safety-related system (IEC 61508)" or "safety instrumented system (IEC 61511)".

3.2
Ex Equipment under control
EEUC
Ex Equipment which contains a potential ignition source which is controlled by a safety device

3.3
risk reduction factor
RRF
factor by which the probability of the occurrence of an ignition source in the EEUC is reduced by the safety device

4 Basic requirements

Safety functions shall respond before a potential ignition source of the EEUC becomes effective. Safety functions shall therefore be considered as operating in low demand mode.

The detection of a dangerous failure in a safety device (by diagnostic tests, proof tests or by any other means) shall result in a specified action to achieve or maintain a safe state of the EEUC.

The safety device and the Ex Equipment shall be assessed for use as a combination according to the relevant standards of the IEC 60079 series and the ISO 80079 series and shall be marked accordingly.

NOTE If safety devices are located in a hazardous area, they are selected and installed in accordance with IEC 60079-14.

5 Ignition prevention by safety devices

5.1 General concept of ignition risk reduction

To comply with a defined EPL, Ex Equipment shall first be protected against potential ignition sources by applying the measures according to the IEC 60079 and the ISO 80079 series. If an ignition source cannot be prevented by these measures, it may be controlled by using a suitable safety device.

The ignition hazard assessment of Ex Equipment starts with the evaluation of potential ignition sources including the assessment of malfunctions related to the Ex Equipment. The Ex Equipment to be controlled and the safety devices shall first be assessed as a combination relevant to the EPL. The minimum risk reduction factor of the safety devices shall meet the requirements of 5.2.

NOTE Equipment may have also been assessed without the control of a safety device, but with a lower EPL rating.

If Ex Equipment contains several potential ignition sources, for each ignition source the same procedure shall be performed and the ignition risk mitigated by appropriate measures.

5.2 Safety characteristics of a safety device

A safety device shall provide a safety integrity suitable for the required ignition risk reduction for the Ex Equipment. Safety devices shall provide a minimum risk reduction factor for the Ex Equipment according to Table 1.

Table 1 – Minimum RRF for a safety device for ignition risk reduction

Ex Equipment with a residual ignition source	Target EEUC EPL	Safety device RRF
which is not a source of ignition in normal operation and could become active as an ignition source in the case of regular expected occurrences	Gc, Dc	≥10
	Gb, Db	≥100
	Ga, Da	Not permitted
which could become a source of ignition only during expected malfunctions	Gc, Dc	Not required
	Gb, Db	≥10
	Ga, Da	≥100
which could become a source of ignition only during rare malfunctions	Gc, Dc	Not required
	Gb, Db	Not required
	Ga, Da	≥10

NOTE 1 Regular expected occurrences include anticipated conditions such as high temperatures on a brake, failure of a lamp or opening of a fuse. Such devices cannot be controlled by a safety device to achieve EPL Ga or Da.

NOTE 2 For EPL Gc/Dc the risk reduction factor provides for additional protection to ensure an ignition source remains inactive in the case of regular expected occurrences. For EPL Gb/Db the definition from IEC 60079-0 does not identify the case of regular expected occurrences but these still have to be considered. Thus the higher RRF provides additional integrity for control of such ignition sources.

NOTE 3 Regular expected occurrences do not include ignition sources during normal operation. Additional measures are provided to avoid that those regular expected occurrences would become effective ignition sources (see IEC 60079-0, definition EPL Gc).

Ignition sources during normal operation (e.g. sparking contacts or sparking relays) shall not be controlled by safety devices as they are considered as unacceptable risk.. Such ignition sources cannot be controlled by safety devices.

Where an additional risk reduction measure is applied in the event of an ignition e.g. a dust explosion suppression system, the RRF shown in Table 1 may be reduced. In this case the additional RRF has to be verified.

Examples of the use of Table 1 are provided in Annex B and C.

5.3 Associated safety device

A safety device not designed for specific equipment to be controlled may be assessed independently. The safety integrity and other technical parameters of this associated safety device as well as the interface to the Ex Equipment shall be specified in the instructions of the Ex Equipment.

The combination of the equipment to be controlled and the associated safety device is to be considered as Ex Equipment (EEUC) and shall be assessed according to Table 1. See example in B.2.

6 Functional requirements for a safety device

6.1 General requirements

A safety device shall be specified taking into account the potential ignition source to be controlled. The safety function for the safety device shall be determined.

The safety device shall be designed to provide the safety function reliably under the specified range of operating conditions. For example, during commissioning, the number of accessible parameters shall be minimized and locked after parameterisation, e.g. by password, jumper, or switch. Cyber security risks and protection against external interference e.g. EMC, shall be considered.

6.2 Specification of the safety function

On demand the safety function shall bring the EEUC into a safe state. The activation threshold (maximum or minimum) of the parameters to be controlled to prevent ignition shall be specified for the ignition hazard (e.g. temperature) in the instructions. All aspects of the relevant safety parameters (e.g. measuring range, accuracy and the response time) shall be taken into account. If a safety factor is required by the relevant standard from the IEC 60079 series or the ISO 80079 series, this shall additionally be taken into account.

6.3 Requirements for achieving the safety integrity

6.3.1 Simple safety devices

A safety device can be regarded as a simple safety device if the components required to achieve the safety function meet the following requirements:

a) the failure modes of all constituent components are well defined; and

b) the behaviour of the element under fault conditions can be completely determined; and

c) there is sufficient dependable failure data to show that the claimed rates of failure for detected and undetected dangerous failures are met.

NOTE 1 Examples of simple safety devices are; a basic switch with discrete contacts, such as a mechanically operated level switch (Float); proximity sensor; PT100 or bi-metal thermal probe.

NOTE 2 A device with software or microprocessor control would not be considered to be a simple safety device.

A simple safety device may not require a complete assessment according to 6.3.2. It can be assessed according to its dangerous hardware failure rate in an FMEA (see Annex A).

In addition, a systematic capability assessment should be provided. However, if the systematic capability was not assessed a justification shall be documented.

6.3.2 Complex safety device

Safety devices not covered under 6.3.1 shall be considered as complex safety devices.

The safety device shall be designed to comply with an applicable functional safety standard.

7 Testing and verification

7.1 Type tests

Appropriate functional tests shall be performed to ensure that the safety function will operate correctly across the specified range of operational conditions and considering the range of manufacturing tolerances or other factors that may affect the performance of the safety system.

7.2 Proof tests

The manufacturer shall specify in the instructions all necessary information to enable the user to perform functional proof tests. See Clause 9.

NOTE A proof-test interval of at least 12 months is common practice for many applications.

8 Marking

Specific marking is not required by this document for safety devices.

NOTE 1 Specific marking for safety devices might be required by other standards including IEC 60079-0.

NOTE 2 The EEUC is marked according to IEC 60079-0.

9 Instructions

The instructions shall be prepared as a safety manual which shall contain information according to the applicable parts of the IEC 60079 series and ISO 80079 series and other necessary information for the use of the safety-related system. For example:

– description of the safety device and its safety function(s);

– relevant safety parameters including RRF and/or safety integrity (e.g. SIL) and failure rates;

– safety relevant instructions for installation, calibration, putting into service and use;

– nominal values including tolerances for the electrical interfaces (voltage, current, power, etc.);

– the associated Type of Protection, if relevant;
– safe state and power off condition;
– interface for the safety device;
– ambient and operational conditions;
– activation threshold (e.g. electrical thresholds, temperatures);
– response time of the safety function;
– proof test interval with detailed description of the test procedure, or useful lifetime for simple safety devices as applicable.

Annex A
(informative)

Guidance for assessment of a simple safety device

1) The safety device is verified according to the definition of a ‘simple safety device’ (see 6.3.1).
2) The dangerous failure rate λ_d for the loss of the safety function is determined. If not specified by the supplier of the safety device one of the following methods may be used to determine the dangerous failure rate λ_d in the following order of preference:
   a) an FMEA of the safety device using generic failure rates of its components from recognised industrial databases.
   b) an estimation from the MTBF value of the device, leading to a conservative value of $\lambda_d \leq 1/\text{MTBF}$.
   c) a documented failure statistics from field feedback data experience of the supplier or user.

   If required, the determined failure rate is adjusted for deviating operation and environmental conditions (e.g. according to IEC 61709).
3) The RRF can be determined from λ_d with a proof test interval of less than two years according to Table A.1.

Table A.1 – Relationship between λ_d and RRF

Dangerous failures per hour λ_d [1/h]	Minimum Risk Reduction Factor RRF
10^{-6} .... 10^{-5}	10
10^{-7} .... 10^{-6}	100
10^{-8} .... 10^{-7}	1000
10^{-9} .... 10^{-8}	10000

NOTE results from the comparison of Tables 4 and 5 of IEC 61511-1:2016.