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Sistemi za dušenje eksplozij

Explosion suppression systems

Explosions-Unterdrückungssysteme

Systèmes de suppression d'explosion

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Explosion suppression systems

Systèmes de suppression d'explosion

Explosions-Unterdrückungssysteme

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 14373:2021) has been prepared by Technical Committee CEN/TC 305 “Potentially explosive atmospheres - Explosion prevention and protection”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2022, and conflicting national standards shall be withdrawn at the latest by November 2022.

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

This document supersedes EN 14373:2005.

The significant changes between this document and EN 14373:2005 are given in Annex D.

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

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

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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

1 Scope

This document describes the basic requirements for the design and application of explosion suppression systems. This document also specifies test methods for evaluating the effectiveness and the scaling up of explosion suppression systems against defined explosions. This document covers:

— general requirements for explosion suppression system parts;

— evaluating the effectiveness of an explosion suppression system;

— evaluating the scale up of an explosion suppression system to larger than tested volumes;

— development and evaluation of design tools for explosion suppression systems;

— installation, operation and maintenance instructions for an explosion suppression system.

This document is applicable only to explosion suppression systems intended for the protection of closed, or essentially closed, enclosures in which an explosion could result as a consequence of ignition of an explosible mixture, e.g. dust-air, gas(vapour)-air, dust-gas(vapour)-air and mist-air.

This document is not applicable for explosions of materials listed below, or for mixtures containing some of those materials:

— unstable materials that are liable to dissociate;

— explosive materials;

— pyrotechnic materials;

— pyrophoric materials.

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.

EN 1127-1:2019, *Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology*

EN 13237:2012, *Potentially explosive atmospheres - Terms and definitions for equipment and protective systems intended for use in potentially explosive atmospheres*

EN 15233:2007, *Methodology for functional safety assessment of protective systems for potentially explosive atmospheres*

EN 15967:2011, *Determination of maximum explosion pressure and the maximum rate of pressure rise of gases and vapours*

EN 14034-1:2004+A1:2011, *Determination of explosion characteristics of dust clouds - Part 1: Determination of the maximum explosion pressure pmax of dust clouds*

EN 14034-2:2006+A1:2011, *Determination of explosion characteristics of dust clouds - Part 2: Determination of the maximum rate of explosion pressure rise (dp/dt)max of dust clouds*

EN IEC 60079-0:2018, *Explosive atmospheres - Part 0: Equipment - General requirements (IEC 60079-0:2017)*

EN 60079-14:2014, *Explosive atmospheres - Part 14: Electrical installations design, selection and erection (IEC 60079-14:2013)*

EN 60529:1991,[1] *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN ISO 80079-36:2016, *Explosive atmospheres - Part 36: Non-electrical equipment for explosive atmospheres - Basic method and requirements (ISO 80079-36:2016)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1127-1:2019 and EN 13237:2012 and the following apply.

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

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

3.1
high rate discharge suppressor
HRD-suppressor
vessel with opening mechanism, which upon activation discharges an explosion suppressant at a high rate

3.2
suppressant
substance contained in the HRD-suppressor which, when dispersed into an enclosure to be protected, can arrest and mitigate a developing explosion in that enclosure

3.2.1
powder suppressant
powder with recognised flame extinguishing properties such as products based on monoammonium phosphate, potassium bicarbonate or sodium bicarbonate

3.2.2
liquid suppressant
substance stored as a liquid with recognised flame extinguishing properties such as cold or hot water

3.3
dispersion pressure
p_s
pressure in HRD-suppressor to disperse the suppressant, which is provided by gas, chemical reaction or the application of heat

[1] As impacted by amendments EN 60529:1991/A1:2000 and EN 60529:1991/A2:2013.

3.4
suppressant charge
M_s
mass of the suppressant contained within the suppressor

3.5
explosion detector
device that responds to an explosion (e.g. developing pressure and/or radiation) and provides a signal to the control and indicating equipment

Note 1 to entry: See 3.10.

3.6
activation pressure
p_a
pressure at which the control and indicating equipment activates the high rate discharge suppressor(s)

3.7
maximum reduced (suppressed) explosion pressure
$p_{red,max}$
maximum explosion overpressure generated by an explosion of an explosive atmosphere in an enclosure at optimum fuel concentration, after effective explosion venting or explosion suppression

3.8
explosion suppression
technique limiting and/or avoiding the destructive effect of an explosion by the deployment of suppressant

3.9
explosion suppression system
arrangement comprising one or more explosion detectors, control and indicating equipment and one or more high rate discharge suppressors aiming at achieving explosion suppression

3.10
control and indicating equipment
CIE
safety device, which is an electronic system which controls, records and monitors the status of the explosion protection system and initiates the explosion protection devices upon detection

Note 1 to entry: The CIE is intended to activate the explosion protection devices and to initiate alarm systems and process shutdown.

3.11
dispersion nozzle
device fitted on a HRD-suppressor and designed to distribute the suppressant throughout the enclosure to be protected

3.12
compact enclosure/cubic enclosure
enclosures having a length (height) to diameter ratio of less than 2

3.13
elongated enclosures
enclosures with a length (height) to diameter ratio of 2 to 10

3.14
pipe
construction with a length (height) to diameter ratio greater than 10

3.15
hazard sector
three-dimensional space for which the explosion suppression system is designed to be active

3.16
lowest observable adverse effect level
LOAEL
lowest concentration of the suppressant at which an adverse toxicological or physiological effect has been observed

3.17
suppression model
mathematical calculation which predicts the course of an explosion, the action of the suppression system and its interaction with the explosion, in order to enable an accurate design of explosion suppression systems

3.18
maximum throw
maximum distance from a suppressor at which the concentration of the expelled suppressant is still sufficiently high to extinguish an explosion flame

3.19
arming
enabling the explosion suppression system for fault free operation

3.20
activation
initiation of the high rate discharge suppressor to discharge

3.21
discharge
opening and consequential emptying of the high rate discharge suppressor

3.22
lock out
mechanical device to prevent discharge of the high rate discharge suppressor

4 Symbols and abbreviations (EN 14373)

CIE	control and indicating equipment
C_p	heat capacity at constant pressure
HRD	high rate discharge
IP	ingress protection

K_{max}	maximum rate of pressure rise to be applied and determined according to EN 14034-2:2006+A1:2011 for a certain dust and dust concentration normalised to a 1 m^3 volume or according to EN 15967:2011 for a certain gas or vapour and gas or vapour concentration normalised to a 1 m^3 volume
K_{min}	minimum rate of pressure rise to be applied and determined according to EN 14034-2:2006+A1:2011 for a certain dust and dust concentration normalised to a 1 m^3 volume or according to EN 15967:2011 for a certain gas or vapour and gas or vapour concentration normalised to a 1 m^3 volume
K_{St}	maximum rate of pressure rise of a dust determined according to EN 14034-2:2006+A1:2011 normalised to a 1 m^3 volume
L/D	length-to-diameter ratio
LEL	lower explosion limit
LOAEL	lowest observable adverse effect level
MIE	minimum ignition energy
MIT	minimum ignition temperature of a dust cloud
MSDS	material safety data sheets
M_s	suppressant charge
p_a	activation pressure
p_{max}	maximum explosion overpressure of a dust determined according to EN 14034-2:2006+A1:2011 or gas or vapour determined according to EN 15967:2011
p_{red}	reduced (suppressed) overpressure
$p_{red,max}$	maximum reduced (suppressed) explosion pressure
p_s	dispersion pressure
p_t	pressure transducer
S_u	laminar burning velocity
TPED	Transportable Pressure Equipment Directive
PED	Pressure Equipment Directive
V	volume

5 Explosion suppression

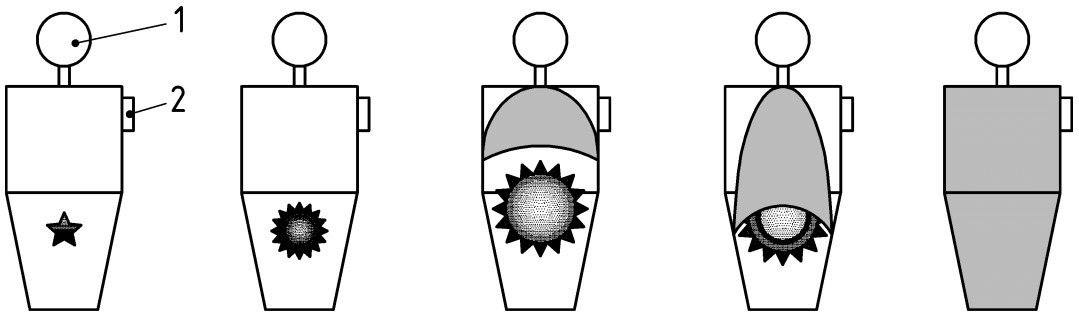
5.1 Design

Explosion suppression systems shall be designed to extinguish propagating flames and to reduce the maximum explosion pressure, $p_{max,}$ to a reduced explosion pressure (p_{red}), following an ignition in the protected enclosure. Successful explosion suppression implies that the p_{red} will not exceed the strength of the protected equipment. Explosion suppression systems can be applied to flammable gases, mists, dusts or hybrid mixtures.

See Annex B for examples of applications of explosion suppression systems.

5.2 General function

Explosion suppression is a protective measure for enclosures, where a gas, mist, dust or hybrid mixture explosion is detected and arrested during incipient stages (see Figure 1).



Key

1 suppressor

2 explosion detector (D)

a The explosive atmosphere in an enclosure is ignited. The enclosure is provided with one (or more) explosion detectors (D) and one (or more) suppressors (1).

b The explosion is detected by the explosion detector(s).

c The control and indicating equipment CIE (not shown) has received the signal from the explosion detector(s) and activated the suppressor(s). The suppressor(s) has (have) started to inject suppressant into the enclosure.

d The suppressant cloud reaches the explosion flame.

e The flame is extinguished: the explosion is suppressed.

Figure 1 — Stages in explosion suppression of an enclosure

The performance of an explosion suppression system depends on:

— the response time of the system: time until explosion is detected + response time of the various items + time required to inject sufficient suppressant into the enclosure;

— the suppressant dispersion: spatial distribution, as a function of time;

— the effectiveness of the suppressant.

Explosion suppression measures shall be designed and installed such that their operational effectiveness is assured.

The effectiveness of a suppression system is dependent on many factors also related to the application:

— volume and geometry of the component to be protected;

— reactivity of the combustible dust:

- p_{max} maximum explosion pressure,
- K_{St} explosion rate constant,

— process conditions: airflow and turbulence;

— detection pressure threshold value;

— type and efficiency of explosion suppressors;

— number, and geometric distribution of suppressors;

— propellant pressure.

5.3 Requirements for explosion suppression systems

An explosion suppression system consists of at least one: explosion detector, HRD suppressor, complete with suppressant / dispersion nozzle and connected to control and indicating equipment (CIE).

Essential requirements are:

— the overall requirement of the explosion suppression system is to detect an explosion in the incipient stage and to have a fast response to allow for the dispersion of suppressant and extinguishment of the flame in order to limit the maximum reduced explosion pressure below the admissible pressure of the protected equipment - Experimental validation shall be performed as described in Clause 7;

— the system as installed or any of its parts shall not introduce ignition hazards, such as electrostatic discharge, mechanical friction, electrical sparks, hot surfaces:

- All electrical and non-electrical equipment and components, as parts of explosion suppression system, intended for use in potentially explosive atmospheres, shall be designed and constructed in conformity with the required categories for group II equipment to ensure avoidance of any ignition sources as detailed in EN 1127-1:2019.
- Any electrical equipment as a part of an explosion suppression system installed and located in hazardous areas shall conform to the requirements of EN 60079-14:2014 through at least EN IEC 60079-0:2018 and relevant type(s) of protection.
- Any non-electrical equipment as a part of an explosion suppression system installed and located in hazardous areas shall conform to the requirements of EN ISO 80079-36:2016 and relevant type(s) of protection.

— the activation of the suppression system shall not result in dangerous ejected parts;

— the explosion suppression system shall have a defined reliability for safety-functions according to the intended use (see 5.3 h);

— if discharging the suppressant during maintenance or inspection can result in injury, the explosion suppression system shall have safe provisions in place to prevent an unintended suppressor discharge prior to performing such operations;

— the supplier shall provide instructions which ensure safe operation of the explosion suppression system and the system is always armed when explosible atmospheres are present and is disarmed and locked out before access to be inside protected equipment is granted (see 8.5);

— the explosion suppression system shall avoid operation of the protected process by provision of a safe signal interface through the CIE so that operation cannot be started or resumed until the suppression system is armed and fault free;

— relevant parts of the explosion suppression system directly exposed to the explosion shall be capable of withstanding the expected maximum explosion pressure.