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Explosion Isolation Systems

Explosionsentkopplungs-Systeme

Systeme d'Explosion Isolation

Ta slovenski standard je istoveten z: **EN 15089:2009**

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Explosion isolation systems

Système d'isolation d'explosion

Explosions-Entkopplungssysteme

This European Standard was approved by CEN on 7 February 2009.

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Foreword

This document (EN 15089:2009) has been prepared by Technical Committee CEN/TC 305 “Potentially explosive atmospheres - Explosion prevention and protection”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by September 2009, and conflicting national standards shall be withdrawn at the latest by September 2009.

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

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1 Scope

This European Standard describes the general requirements for explosion isolation systems. An explosion isolation system is a protective system, which prevents an explosion pressure wave and a flame or only a flame from propagating via connecting pipes or ducts into other parts of apparatus or plant areas. This European Standard specifies methods for evaluating the efficacy of the various explosion isolation systems, and methods for evaluating design tools for such explosion isolation systems when applying these in practice.

This European Standard also sets out the criteria for alternative test methods and interpretation means to validate the efficacy of explosion isolations.

It covers e.g.:

a) general requirements for the explosion isolation components;

b) evaluating the effectiveness of an explosion isolation system;

c) evaluating design tools for explosion isolation systems.

This European Standard is applicable only to the use of explosion isolation systems that are intended for avoiding explosion propagation between interconnected enclosures, in which an explosion may result as a consequence of ignition of an explosive mixtures e.g., dust-air mixtures, gas-(vapour-)air mixtures, dust-, gas-(vapour-)air mixtures and mists.

In general explosion isolation systems are not designed to prevent the transmission of fire or burning powder either of which can initiate an explosion in downstream plant items. It is necessary to take this situation into account in risk assessments.

This European Standard is only applicable for gas and dust explosions of chemically stable substances and mixtures of these (flame propagating at subsonic velocity).

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

i) chemically unstable substances that are liable to decompose;

ii) explosive substances;

iii) pyrotechnic substances.

This European Standard does not cover flame arresters. For these devices refer to EN 12874.

2 Normative references

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

EN 12874:2001, *Flame arresters – Performance requirements, test methods and limits for use*

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

EN 13673-1, *Determination of the maximum explosion pressure and the maximum rate of pressure rise of gases and vapours – Part 1: Determination of the maximum explosion pressure*

EN 13673-2, *Determination of maximum explosion pressure and the maximum rate of pressure rise of gases and vapours – Part 2: Determination of the maximum rate of explosion pressure rise*

EN 14034-1, *Determination of explosion characteristics of dust clouds – Part 1: Determination of the maximum explosion pressure p_{max} of dust clouds*

EN 14034-2, *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 14373, *Explosion suppression systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13237, EN 14373 and the following apply.

3.1
indicating equipment
IE
explosion protection equipment, which monitors the explosion sensors/detectors and the explosion protection devices

3.2
closing time
time needed for closing an isolation device

3.3
closing time of the system
sum of the activation time of sensor, activation time of isolation device and closing time of the isolation device

3.4
design strength of enclosure p (plant strength)

3.4.1
explosion-pressure-resistant
property of vessels and equipment designed to withstand the expected explosion pressure without becoming permanently deformed

[EN 13237:2003, 3.31]

3.4.2
explosion-pressure-shock-resistant
property of vessels and equipment designed to withstand the expected explosion pressure without rupturing, but allowing permanent deformation

[EN 13237:2003, 3.32]

3.5
explosion
abrupt oxidation or decomposition reaction producing an increase in temperature, pressure, or in both simultaneously

[EN 13237:2003, 3.28]

3.6
explosion diverter
mechanical device, which will divert the explosion to a safe area

NOTE It prevents flame jet ignition and pressure piling but cannot effectively stop explosions from travelling.

3.7
explosion isolation system

3.7.1
active explosion isolation system
system which is designed to stop explosions from travelling through pipelines or limit the associated destructive effects of the explosion and is activated by detectors and a control and indicating equipment (CIE), which are parts of the system

3.7.2
passive explosion isolation system
system which is designed to stop explosions from travelling through pipelines or limit the associated destructive effects of the explosion and does not require detectors and a control and indicating equipment (CIE)

3.8
explosion isolation valve
fast acting valve able to stop explosions from travelling through pipelines

3.9
explosion proof interlocked double valve arrangement
device, which will act in closed position as isolation valve

3.10
explosion isolation flap
hinged door which is kept in open position by the air flow and closes by gravity when the air flow is interrupted

3.11
extinguishing barrier
system that is used to discharge suppressant agent into ductwork to isolate a flame and keep it from propagating to other process areas

3.12
extinguishing distance
needed distance behind an extinguishing barrier to guarantee a proper isolation of the flame of an explosion

3.13
flame arrester
device fitted to the opening of an enclosure or to the connecting pipework of a system of enclosures and whose intended function is to allow flow but prevent the transmission of flame

[EN 12874:2001, 3.1.1]

3.14
flame velocity
S_f
velocity of a flame front relative to a fixed reference point

3.15
installation distance

3.15.1
maximum installation distance
longest distance from the outlet of the enclosure with the potential explosion to the isolation system, which is limited by the explosion resistance of the isolation device or pipe but still guaranteeing a successful isolation

3.15.2
minimum installation distance
shortest distance from the outlet of the enclosure with the potential explosion to the isolation system guaranteeing a successful isolation

3.16
minimum ignition energy
MIE
lowest energy which is sufficient to effect ignition of the most easily ignitable explosive atmosphere under specified test conditions

[EN 13237:2003, 3.85]

3.17
minimum ignition temperature of an explosive atmosphere
MIT
ignition temperature of a combustible gas or of a vapour of a combustible liquid or the minimum ignition temperature of a dust cloud under specified test conditions

3.18
response time
time necessary for actuation of the system after a detection of an explosion

4 Explosion isolation systems

4.1 General

Explosion isolation is achieved by a protective system, which prevents an explosion pressure wave and a flame or only a flame from propagating via connecting pipes or ducts into other parts of apparatus or plant areas. Systems providing complete isolation by operation of the isolation device(s) prevent the propagation of the flame as well as pressure effects. Systems providing partial isolation only isolate the flame propagation. This distinction is important for practical application, because it is not necessary in all cases to achieve a complete isolation of flame and pressure. In some cases it is sufficient to achieve only flame isolation.

4.2 Isolation types

4.2.1 Passive isolation type

Passive isolation systems do not require the addition of detection and control and indicating equipment to function.

4.2.2 Active isolation type

Active isolation systems require detection and control and indicating equipment to function. Detection systems are systems usually based on optical or pressure sensors.

5 Requirements of explosion isolation components

5.1 General

To prevent an explosion occurring in a protected installation from spreading through a pipeline to another part of the installation, explosion isolation measures shall be implemented. Therefore isolation is normally installed into a pipe which connects two enclosures. It can also be located immediately after equipment e.g., a rotary valve underneath the cone of a filter or silo.

As explosions are generally propagated by flames and not by the pressure waves, it is especially important to detect, extinguish or block this flame front at an early stage, i.e. to isolate the explosion.

5.2 Detection devices

5.2.1 General

To initiate an active explosion isolation system one or more detectors are used to detect either an explosion pressure wave or flame of a propagating explosion. Each detector provides a signal to the CIE unit. It is important to locate the detector in its correct position, to ensure sufficient time for the isolation system to detect and activate the isolation device to stop the explosion.

NOTE In many cases it is favourable to use a combination of a pressure detector in the enclosure and an optical detector in the pipe, and they should be switched in an OR-type of logic for activating the isolation device.

5.2.2 Optical detection

Detection of a flame can be achieved using UV, IR or visible radiation sensors. It is important to mount the detector so that the angle of vision allows it to cover the full area to be monitored. The performance of an optical sensor will also be affected by any obstacles within its vision, which can be overcome by the introduction of more detectors. It shall be assured that the optical lenses of the sensors are kept clean, e.g. by air shields.

5.2.3 Pressure detection

Threshold detectors provide a signal when a pre-set overpressure – p_a (the systems activation pressure) – is exceeded.

Dynamic detectors have rate-of-pressure rise triggering points and may include additional pressure threshold triggering points. Although this type of detector minimises spurious activation of the isolation system (due to pressure fluctuations other than explosion pressure rise), care shall be taken to set-up such detectors to meet appropriate detection response criteria for the particular application and protected geometry.

5.2.4 Other actuation

Bursting discs, vent panels or explosion doors can be fitted with switches or break wires, which actuate an isolation system.

5.3 Indicating equipment (IE) and control and indicating equipment (CIE)

5.3.1 General

Whether control and indicating equipment (CIE) or so-called indicating equipment (IE) is to be used on an isolation device/system is dependant on the type of protection device. IE will only indicate the status of the device; CIE will actively control the operation of the protection device and provide status indication of the device and is therefore critical for the correct functioning of the device/system.

5.3.2 Indicating equipment

Indicating equipment (IE) monitors and provides the status indication only of the isolation device/system.

5.3.3 Control and indicating equipment

Control and indicating equipment (CIE) records and monitors the signals transmitted by the system detectors. Dependent on configuration, by interrogation and interpretation of the detector data the CIE selectively controls the actuation of protection device, process equipment shut down (direct or indirect) and all audible and visual alarms. System internal monitoring gives fault indication in the event of device or field wiring defect, and alarm and fault relay contacts shall be connected as appropriate. Emergency standby power shall be facilitated such that full explosion protection is assured during any power failure. System isolation to facilitate safe working on or in a protected enclosure shall be implemented.

5.4 Safety integrity of control and indicating equipment (CIE)

5.4.1 General

The following requirements are intended to ensure the safety integrity for active systems.

5.4.2 Measures to avoid and control systematic faults

Systematic and transparent system analyses shall be made in all design stages to prevent potential defects. This methodical and comprehensible design approach ensures a clearly specified level of functional safety for any kind of product (see e.g. EN 15233).

5.4.3 Control of electric connections

As a minimum, the electric connections for the following equipment shall be monitored for short circuit, open circuit and earth faults:

a) detector(s);

b) protection isolation device(s).

In case of an identifiable fault such that the safety function of the system cannot be guaranteed to the agreed level of safety integrity, the explosion isolation system shall provide a fail-safe means to place the installation into a safe condition.

5.4.4 Indicators and messages on CIE

The activation and fault messages shall be shown and indicated at the CIE indicating its origin and nature. In case of activation of the explosion isolation device/system, the CIE shall provide a means to commence an emergency stop procedure of the protected installation.

5.4.5 Energy supply

For the energy supply of the CIE two independent energy sources shall be available. Where batteries are applied, they shall be suitable for the local operation and maintain a sufficient charge. Batteries, where used as a back-up power supply, shall supply a minimum of 4 hours. The power supply shall be independent and suitably protected, and shall not be de-activated by an emergency switch. After loss of the back-up power supply the CIE shall activate an emergency stop procedure of the protected installation.

5.5 Explosion isolation devices

5.5.1 General

The following is a list of explosion isolation devices.

The different objectives to be addressed can be summarized as follows:

Flame (F): objective is to stop flame propagation. The protected area is defined as the point beyond the isolation device, opposite to the ignition source.

Pressure (P): objective is to stop the pressure wave from travelling beyond the isolation device.

The explosion resistance of the equipment of the isolation device shall meet the expected pressure according to the intended use.

5.5.2 Explosion protection valve (active or passive) – F&P

To prevent flame and pressure propagation in pipes and ducts, valves or gates may be used which close in a sufficient short time. The closure can be affected by means of an actuating mechanism initiated by a pressure detector or a flame detector or a combination thereof or by the explosion overpressure itself.

NOTE Explosion protection valves need not be gas tight.

5.5.3 Extinguishing barrier (active) – F

The extinguishing medium is dispersed into the pipeline and the flame extinguished. The extinguishing medium shall be suitable for the specific explosive atmosphere.

5.5.4 Rotary valve (passive) – F

The effectiveness of the rotary valve against flame propagation and its explosion resistance shall be proven. Upon detection of an explosion the rotary valve shall be stopped automatically and instantaneously.

5.5.5 Explosion proof interlocked double valve arrangement (passive) – F&P

Enclosures that are explosion-resistant can be protected by at least two explosion proof process valves in series. By means of proper control, it shall be assured that at least one of the valves is always closed. Upon detection of an explosion the explosion proof interlocked double valve arrangement shall be stopped automatically and instantaneously.

5.5.6 Diverters, explosion isolation flaps and flame arresters

The isolation systems diverters, explosion isolation flaps and flame arresters are covered in separate standards (see upcoming diverters standard, explosion isolation flap standard and EN 12874).

6 System design

6.1 General

It is very important for explosion isolation systems that a detailed analysis of all relevant characteristics and conditions is made. This analysis shall include at least the following:

a) Specification of the physical characteristics of the connected equipment where the isolation device shall be installed, e.g.:

   1) type of connected equipment (pipe, belt, screw etc),

   2) strength of connected equipment,

   3) layout of connected equipment including length, bends, junctions,

   4) cross sections including changes in cross sections,

   5) presence of internal obstructions;

b) Specification of the relevant process conditions:

   1) indoors/outdoors,

   2) area classification (zones),