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Explosion venting devices

Einrichtungen zur Explosionsdruckentlastung

Dispositifs de décharge d'explosion

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Explosion venting devices

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Einrichtungen zur Explosionsdruckentlastung

This European Standard was approved by CEN on 4 November 2006.

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Contents

Page

Foreword 4

1 Scope 5

2 Normative references 5

3 Terms and definitions 6

4 Design requirements 8
4.1 General 8
4.2 Potential sources of ignition 9

5 Types of explosion venting devices 9
5.1 Explosion venting devices with reusable elements 9
5.2 Explosion venting devices with non reusable elements 9

6 Back pressure supports 9
6.1 General 9
6.2 Opening back pressure supports 10
6.3 Non-opening back pressure supports 10

7 Testing of explosion venting devices 10
7.1 General 10
7.2 Static activation pressure 10
7.3 Explosion testing 12

8 Information for use 16

9 Assembly, replacements or reusability 17

10 Marking 17
10.1 General 17
10.2 Explosion venting devices with reusable retaining elements 17
10.3 Explosion venting devices with non-reusable retaining elements 18
10.4 Omission of markings 18

11 Packaging 19
11.1 General 19
11.2 Marking 19

Annex A (informative) Examples for explosion venting devices 20
A.1 Re-closing explosion venting devices 20
A.2 Devices which require manual repositioning or replacement of the retaining element 21
A.3 Devices with non reusable elements 23

Annex B (informative) Service and maintenance 26
B.1 General 26
B.2 Servicing 26

Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 94/9/EC 27

Bibliography 29

Figures

Figure 1 — Direct comparison method 14

Figure 2 — Example for direct comparison method 15

Figure A.1 — Example for an explosion door....21

Figure A.2 — Example for a buckling-rod device....22

Figure A.3 — Example for a bursting panel device....23

Figure A.4 — Example for a restrained pop-out panel device....24

Figure A.5 — Example for a back pressure support....25

Tables

Table 1 — Symbols and their descriptions....8

Table 2 — Number of tests of explosion venting devices with non-reusable elements....12

Table ZA.1 — Correspondence between this European Standard and Directive 94/9/EC....27

Foreword

This document (EN 14797:2006) 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 June 2007, and conflicting national standards shall be withdrawn at the latest by June 2007.

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 EU Directive(s).

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

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

1 Scope

This European Standard specifies the requirements for venting devices used to protect enclosures against the major effects of internal explosions arising from the rapid burning of suspended dust, vapour or gas contained within. It includes the requirements for the design, inspection, testing, marking, documentation and packaging. This European Standard specifies explosion venting devices which are put on the market as autonomous protective systems.

Explosion venting devices are safety devices comprised of a pressure sensitive membrane fixed to and forming part of the structure that it protects, designed to intervene in the event of an explosion at a predetermined low pressure, to immediately open a vent area sufficient to ensure that the maximum pressure attained by the explosion within the enclosure does not exceed its designed resistance to pressure.

The application and specification of explosion venting devices is outlined for dust explosion protection in EN 14491 and for gas explosion protection in prEN 14994. The use of venting devices according to this European Standard on pipelines and on applications other than described in EN 14491 or prEN 14994 needs to be carefully evaluated and where appropriate their suitability needs to be confirmed by tests.

Flameless explosion venting devices avoid the breakthrough of flames into the surroundings. They are used to allow explosion venting in situations where the hazards of flames resulting from the venting action are not acceptable. Flameless explosion venting devices are treated in a separate standard.

This European Standard does not cover details for the avoidance of ignition sources from detection devices or other parts of the venting devices.

2 Normative references

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

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

EN 13463-1, *Non-electrical equipment for potentially explosive atmospheres — Part 1: Basic method and requirements*

EN 14491, *Dust explosion venting protective systems*

prEN 14994:2005, *Gas explosion venting protective systems*

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

prEN 61241-0, *IEC 61241-0, Ed. 1: Electrical apparatus for use in the presence of combustible dust — Part 0: General requirements*

3 Terms and definitions

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

3.1
batch
quantity of non-reusable retaining elements made as a single group of the same type, size, materials and specified static activation pressure requirements when the non-reusable retaining elements are manufactured from the same lot of material

3.2
effective vent area
A_E
product of the geometric vent area A_d and the venting efficiency E_f for the venting device

NOTE It is the effective vent area that should be used in making up the vent area for explosion venting.

3.3
explosion venting
protective measure which will prevent the explosion pressure in a vessel or other closed volume from exceeding the vessel design strength by exhausting the explosion through an explosion venting device in the vessel walls

3.4
explosion venting device
device which protects a vessel or other closed volume by explosion venting

3.5
gas explosion constant
K_G
maximum value of the pressure rise per unit time $(dp/dt)_{max}$ during the explosion of a specific explosive atmosphere in a closed vessel under specific test conditions normalized to a vessel volume of 1 m^3 multiplied by $V^{1/3}$

[prEN 14994:2005, 3.8]

3.6
dust explosion constant
K_{st}
maximum value of explosion pressure rise per unit of time $(dp/dt)_{max}$ in a volume of 1 m^3 multiplied by $V^{1/3}$

3.7
retaining element
part or parts of the explosion venting device that determines the activation pressure

NOTE It may or may not be re-useable.

3.8
reduced explosion pressure
p_{red}
overpressure generated by an explosion of an explosive atmosphere in an enclosure protected by explosion venting

3.9
restraining element
parts of some explosion venting devices that prevent components or objects from becoming dangerous missiles

NOTE They may or may not be reusable.

3.10
specific mass
total mass per unit area (A_d) of the venting element. The specific mass is used in determining the effect of inertia

3.11
static activation pressure
***p*stat**
differential pressure at which the retaining element activates such that the venting element is able to open

3.12
static activation pressure tolerance range
range of differential pressure between the specified maximum static activation pressure and the specified minimum static activation pressure or the range of differential pressure in positive and negative percentages or quantities which is related to the specified static activation pressure

3.13
vent area
***A*d**
geometric vent area of an explosion venting device.

NOTE The vent area is the minimum cross-sectional flow area of the explosion venting device taking into consideration the possible reduction of the cross section, e.g. by back pressure support, restraining devices and parts of the explosion venting device which remain after venting

3.14
venting efficiency
***E*f**
dimensionless number used to define the efficiency of the explosion venting device as determined in 7.3.4

3.15
venting element
part of the explosion venting device that covers the vent area and opens under explosion conditions

NOTE It may or may not incorporate the retaining element - it may or may not be reusable.

Table 1 — Symbols and their descriptions

Symbol	Description	Units
A	Required vent area	m^2
A_E	Effective vent area	m^2
A_d	Geometric vent area	m^2
E_f	Venting efficiency	-
p_{stat}	Static activation pressure	bar
p_{red}	Reduced explosion pressure	bar
$p_{red,\ baseline}$	Reduced explosion pressure measured using an explosion venting device with a specific mass < 0,5 kg m^{-2}	bar
$p_{red,\ test\ device}$	Reduced explosion pressure measured using an explosion venting device under investigation	bar
K_G	Gas explosion constant	bar m s^{-1}
K_{st}	Dust explosion constant	bar m s^{-1}
V	Volume of vessel to be protected by explosion venting	m^3

4 Design requirements

4.1 General

Explosion venting devices shall be designed so that they open when subjected to pressure exceeding their static activation pressure (within a stated static activation pressure tolerance range). Any part not designed to rupture shall not rupture. Venting elements shall be designed so that they shall not fragment to produce dangerous missiles. These requirements may be proved by explosion testing, but other methods e.g. calculation, may be used if their validity has been verified from representative explosion tests.

Explosion venting devices shall employ re-usable elements or non re-usable elements (see Clause 5). Explosion venting devices may be provided with back pressure supports (see Clause 6).

The performance capability of an explosion venting device is defined by the following parameters:

— the static activation pressure p_{stat} and its tolerance;

— the maximum K_G/K_{st} values specified by the manufacturer;

— the maximum reduced pressure p_{red} specified by the manufacturer;

— the minimum venting efficiency E_f of the device.

Tests to determine or prove these parameters are given in Clause 7.

Explosion venting devices shall be designed to maintain their specified performance taking into account environmental and process conditions. Build-up or addition of any substance on external surfaces of the device (e.g. snow and ice) and the build-up of product on the internal surfaces of the device may affect the correct operation of the device, so particular attention shall be given to preventing such effects.

Material used for the parts of explosion venting devices shall be selected on the basis of their suitability with regard to the chemical and physical conditions to which they will be subjected in service.

It is common practice to use electrical detection devices to sense vent function, to operate an alarm or shut plant down. Such detection devices shall meet the requirements of EN 13463-1, EN 60079-0 and prEN 61241-0.

Explosion venting devices can incorporate thermal insulation on the internal or external or both sides to prevent heat loss and/or condensation.

Gaskets or seals forming part of an explosion venting device, shall be as specified by the manufacturer and shall be compatible with the chemical, thermal, mechanical and environmental demands of the application.

4.2 Potential sources of ignition

Due consideration shall be given to potential sources of ignition in the design and material specification of venting devices, e.g. static electricity, heating and detection devices. Requirements for potential sources of ignition in electrical and non-electrical equipment apply, as stated in EN 13463-1.

5 Types of explosion venting devices

5.1 Explosion venting devices with reusable elements

Explosion venting devices with re-usable elements shall be distinguished as follows:

a) normally automatically re-closing devices;

b) devices which require manual re-positioning of the retaining elements.

For examples see Annex A.

5.2 Explosion venting devices with non reusable elements

Explosion venting devices with non reusable elements describe all devices which after having functioned can not be reused without the replacement of an individual element or a number of elements.

For examples see Annex A.

NOTE Flameless explosion venting devices are treated in a separate standard.

6 Back pressure supports

6.1 General

When the pressure external to the explosion venting device is greater than the pressure inside the protected vessel, unless the device is capable of withstanding this pressure difference, a back pressure support shall be fitted which prevents damage to the venting element.

The back pressure support shall be either permanently attached to the venting element or it shall form part of the explosion venting device that ensures it is fitted to the correct side of the venting element.

The back pressure support shall not cause the explosion venting device to perform incorrectly. When back pressure supports are used consideration shall be given to the effects of the back pressure support on the vent area and venting efficiency.

6.2 Opening back pressure supports

The opening back pressure support shall give adequate support to the venting element. The support shall be of a design such that the pressure in the system is transmitted to the venting element.

When the explosion venting device is activated, the back pressure support shall open simultaneously with the venting element.

The effect of the specific mass of the opening back pressure supports shall be considered in the determination of the efficiency of an explosion venting device.

6.3 Non-opening back pressure supports

The non-opening back pressure support shall give adequate support to the venting element. The support shall be of a design such that the pressure in the system is transmitted to the venting element.

The effect of non-opening back pressure supports shall be considered when determining the effective vent area.

7 Testing of explosion venting devices

7.1 General

Each design of explosion venting device shall be subject to type tests and design assessments to assure:

a) function and mechanical integrity (type testing only);

b) efficiency, where required (type testing only);

c) static activation pressure.

The static activation pressure and the mechanical strength of the explosion venting device shall be proven.

7.2 Static activation pressure

7.2.1 General

All explosion venting devices shall be tested for static activation pressure. The number of tests required shall be in accordance with 7.2.5.

Depending on the explosion venting device type, the static activation pressure can be measured using either a pressure test method or a mechanical test method. The observed static activation pressure shall be recorded.

The static activation pressure test shall have starting conditions where inside and outside pressure conditions are equal.

The static activation pressure is observed:

— when discharge begins;

— when the venting element releases from the retaining element.