

# SVENSK STANDARD

## SS-EN 16009:2011



Fastställt/Approved: 2011-07-22  
Publicerad/Published: 2011-08-31  
Utgåva/Edition: 1  
Språk/Language: engelska/English  
ICS: 13.230

---

### **Explosiv atmosfär – Tryckavlastning vid flamlös explosion**

### **Flameless explosion venting devices**

This preview is downloaded from [www.sis.se](http://www.sis.se). Buy the entire standard via <https://www.sis.se/std-80834>

# Standarder får världen att fungera

*SIS (Swedish Standards Institute) är en fristående ideell förening med medlemmar från både privat och offentlig sektor. Vi är en del av det europeiska och globala nätverk som utarbetar internationella standarder. Standarder är dokumenterad kunskap utvecklad av framstående aktörer inom industri, näringsliv och samhälle och befrämjar handel över gränser, bidrar till att processer och produkter blir säkrare samt effektiviserar din verksamhet.*

## Delta och påverka

Som medlem i SIS har du möjlighet att påverka framtida standarder inom ditt område på nationell, europeisk och global nivå. Du får samtidigt tillgång till tidig information om utvecklingen inom din bransch.

## Ta del av det färdiga arbetet

Vi erbjuder våra kunder allt som rör standarder och deras tillämpning. Hos oss kan du köpa alla publikationer du behöver – allt från enskilda standarder, tekniska rapporter och standardpaket till handböcker och onlinetjänster. Genom vår webbtjänst e-nav får du tillgång till ett lättnavigerat bibliotek där alla standarder som är aktuella för ditt företag finns tillgängliga. Standarder och handböcker är källor till kunskap. Vi säljer dem.

## Utveckla din kompetens och lyckas bättre i ditt arbete

Hos SIS kan du gå öppna eller företagsinterna utbildningar kring innehåll och tillämpning av standarder. Genom vår närhet till den internationella utvecklingen och ISO får du rätt kunskap i rätt tid, direkt från källan. Med vår kunskap om standarders möjligheter hjälper vi våra kunder att skapa verklig nytta och lönsamhet i sina verksamheter.

**Vill du veta mer om SIS eller hur standarder kan effektivisera din verksamhet är du välkommen in på [www.sis.se](http://www.sis.se) eller ta kontakt med oss på tel 08-555 523 00.**



# Standards make the world go round

*SIS (Swedish Standards Institute) is an independent non-profit organisation with members from both the private and public sectors. We are part of the European and global network that draws up international standards. Standards consist of documented knowledge developed by prominent actors within the industry, business world and society. They promote cross-border trade, they help to make processes and products safer and they streamline your organisation.*

## Take part and have influence

As a member of SIS you will have the possibility to participate in standardization activities on national, European and global level. The membership in SIS will give you the opportunity to influence future standards and gain access to early stage information about developments within your field.

## Get to know the finished work

We offer our customers everything in connection with standards and their application. You can purchase all the publications you need from us - everything from individual standards, technical reports and standard packages through to manuals and online services. Our web service e-nav gives you access to an easy-to-navigate library where all standards that are relevant to your company are available. Standards and manuals are sources of knowledge. We sell them.

## Increase understanding and improve perception

With SIS you can undergo either shared or in-house training in the content and application of standards. Thanks to our proximity to international development and ISO you receive the right knowledge at the right time, direct from the source. With our knowledge about the potential of standards, we assist our customers in creating tangible benefit and profitability in their organisations.

**If you want to know more about SIS, or how standards can streamline your organisation, please visit [www.sis.se](http://www.sis.se) or contact us on phone +46 (0)8-555 523 00**



Europastandarden EN 16009:2011 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 16009:2011.

The European Standard EN 16009:2011 has the status of a Swedish Standard. This document contains the official version of EN 16009:2011.

© Copyright/Upphovsrätten till denna produkt tillhör SIS, Swedish Standards Institute, Stockholm, Sverige. Användningen av denna produkt regleras av slutanvändarlicensen som återfinns i denna produkt, se standardens sista sidor.

© Copyright SIS, Swedish Standards Institute, Stockholm, Sweden. All rights reserved. The use of this product is governed by the end-user licence for this product. You will find the licence in the end of this document.

*Uppllysningar om sakinnehållet i standarden lämnas av SIS, Swedish Standards Institute, telefon 08-555 520 00. Standarder kan beställas hos SIS Förlag AB som även lämnar allmänna uppllysningar om svensk och utländsk standard.*

*Information about the content of the standard is available from the Swedish Standards Institute (SIS), telephone +46 8 555 520 00. Standards may be ordered from SIS Förlag AB, who can also provide general information about Swedish and foreign standards.*

Denna standard är framtagen av kommittén för Utrustning för användning i explosiv atmosfär, SIS/TK 112.

Har du synpunkter på innehållet i den här standarden, vill du delta i ett kommande revideringsarbete eller vara med och ta fram andra standarder inom området? Gå in på [www.sis.se](http://www.sis.se) - där hittar du mer information.



EUROPEAN STANDARD

**EN 16009**

NORME EUROPÉENNE

EUROPÄISCHE NORM

July 2011

---

ICS 13.230

English Version

## Flameless explosion venting devices

Dispositifs de décharge d'explosion sans flamme

Einrichtungen zur flammenlosen  
Explosionsdruckentlastung

This European Standard was approved by CEN on 11 June 2011.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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.

CEN members are the national standards bodies of 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, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



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

**Management Centre: Avenue Marnix 17, B-1000 Brussels**

<b>Contents</b>	<b>Page</b>
Foreword.....	3
<b>1 Scope .....</b>	<b>4</b>
<b>2 Normative references .....</b>	<b>4</b>
<b>3 Terms and definitions .....</b>	<b>4</b>
<b>4 Requirements .....</b>	<b>5</b>
4.1 General requirements.....	5
4.2 Flameless explosion venting system design.....	6
<b>5 Types of flameless explosion venting devices.....</b>	<b>6</b>
<b>6 Testing of flameless explosion venting devices .....</b>	<b>7</b>
6.1 General.....	7
6.2 Dust and gas characteristics.....	8
6.2.1 Dust for functional testing .....	8
6.2.2 Gases for functional testing .....	8
6.3 Functional testing .....	8
6.3.1 General.....	8
6.3.2 Volume of test vessel and $V_{\max, FV}$ .....	8
6.3.3 Venting device and $p_{\text{stat}}$ .....	9
6.3.4 Explosion testing for mechanical integrity .....	9
6.3.5 Explosion testing for flame transmission .....	9
6.3.6 Venting efficiency of flameless explosion venting devices .....	9
6.4 External effects .....	9
6.5 Test report .....	10
<b>7 Information for use .....</b>	<b>11</b>
<b>8 Marking .....</b>	<b>12</b>
<b>9 Packaging .....</b>	<b>12</b>
<b>Annex A (informative) Examples/types of flameless explosion venting devices.....</b>	<b>13</b>
A.1 General.....	13
A.2 Ribbon type flame quenching element.....	13
A.3 Parallel plate type flame quenching element.....	14
A.4 Mesh or gauze type flame quenching element.....	14
A.5 Ceramic type flame quenching element.....	14
<b>Annex B (informative) Flameless venting example .....</b>	<b>16</b>
<b>Annex C (informative) Flameless venting criteria.....</b>	<b>17</b>
C.1 Nature of combustible dust, heat of combustion, flame temperature .....	17
C.2 Effect of flame quenching device blockage.....	18
<b>Annex D (informative) Flameless venting - Pressurization of the surrounding volume.....</b>	<b>20</b>
<b>Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 94/9/EC .....</b>	<b>21</b>
<b>Bibliography .....</b>	<b>22</b>

## Foreword

This document (EN 16009:2011) 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 January 2012, and conflicting national standards shall be withdrawn at the latest by January 2012.

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.

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, Bulgaria, Croatia, 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 the United Kingdom.

## 1 Scope

This European Standard specifies the requirements for flameless explosion 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 standard is applicable to flameless explosion venting devices which are put on the market as autonomous protective systems.

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

Flameless explosion venting devices typically consist of an explosion venting device in combination with a flame quenching element to avoid the transmission of flames into the surroundings. They are used to allow explosion venting in situations where otherwise the hazards of flames and pressure resulting from the venting would harm personnel or damage structures.

The application and specification of explosion venting devices is outlined for dust explosion protection in EN 14491 and for gas explosion protection in EN 14994.

This European Standard covers the flameless explosion venting of dust, vapour and gas explosions.

This European Standard does not cover details for the avoidance of ignition sources from detection devices or other parts of the flameless explosion 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, *Potentially explosive atmospheres — Terms and definitions for equipment and protective systems intended for use in potentially explosive atmospheres*

EN 14491, *Dust explosion venting protective systems*

EN 14797:2006, *Explosion venting devices*

EN 14994, *Gas explosion venting protective systems*

EN ISO 16852:2010, *Flame arresters — Performance requirements, test methods and limits for use (ISO 16852:2008, including Cor 1:2008 and Cor 2:2009)*

EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2005)*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13237, EN 14491, EN 14994, EN 14797 and the following apply.



### 3.1

#### flameless explosion venting

explosion venting protective measure which will in addition prevent the transmission of flames and reduce the external explosion effects

NOTE Examples of external explosion effects are; temperature, pressure and dust/combustion products.

### 3.2

#### flameless explosion venting device

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

### 3.3

#### flame quenching element

part of the flameless explosion venting device that prevents flame transmission and reduces the external explosion effects

Table 1 — Symbols and their descriptions

Symbol	Description	Units
$V_{\max, FV}$	largest volume that can be protected by one single flameless venting device	m <sup>3</sup>
$p_{\text{red}, V}$	the highest reduced explosion pressure for venting only	bar
$p_{\text{red}, FV}$	the highest reduced explosion pressure for flameless venting	bar

## 4 Requirements

### 4.1 General requirements

Flameless explosion venting devices consist of an explosion venting device and a flame quenching element as a minimum. Flame quenching elements shall be suitable for the intended use (e.g. temperature range, mechanical strength, fuel type).

Explosion venting devices shall be designed according to EN 14797. 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.

Dust leaking from the process into the flame quenching element can impair the efficiency of the venting, which shall be avoided.

The performance capability of a flameless explosion venting device can be influenced by e.g.:

- a) the fuel characteristics (gas, vapour, dust):
  - 1) minimum ignition temperature (MIT), minimum ignition energy (MIE) (dusts);
  - 2) maximum experimental safe gap (MESG) (gases, vapours);
  - 3) the maximum  $K_G$  or  $K_{St}$ -values specified by the manufacturer;
  - 4) the heat of combustion liberated during the explosion event;
  - 5) flame temperature;
  - 6) particle size and distribution, shape (dusts);

7) melting characteristics (dusts);

NOTE 1 During the venting process, burnt, unburnt dust or explosion products can partially block the flame quenching element, which can lead to reduced venting efficiency. Specific testing to determine this effect can be necessary.

- b) the maximum reduced explosion overpressure  $p_{red, max}$  specified by the manufacturer;
- c) the venting efficiency  $E_f$  of the combination flame quenching element and venting device;
- d) volume and  $L/D$  ratio.

Flameless explosion venting devices shall be designed to maintain their specified performance taking into account environmental, process and product conditions.

All parts of the flame quenching element shall resist the expected mechanical, thermal and chemical loads of the intended use. During or after the venting process, deformations of the flameless explosion venting device may occur. This shall not lead to gaps in the housing that could lead to flame transmission into the surrounding. The flame quenching capability of the device shall be demonstrated by tests according to 6.3.5.

It is mandatory to use detection devices sensing venting device function. The user shall use the signal to bring the plant process to a safe status when the flameless venting device operates.

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

NOTE 2 Due consideration should be given to the external effects with particular attention to the risk of a secondary explosion external to the flameless venting device. For more information, see 6.4.

NOTE 3 Due consideration should be given to equipment related sources of ignition in the design and material specification of flameless explosion venting devices; e.g. static electricity, heating and detection devices. Requirements for equipment-related sources of ignition in electrical and non-electrical equipment should apply as specified in EN 1127-1.

## 4.2 Flameless explosion venting system design

Flameless explosion venting system shall be sized according to EN 14491 or EN 14994 taking into account the efficiency as determined in Clause 6. Unique to the use of flameless venting devices is that the effective vent area will be adversely impacted by flow resistance and possible blockage.

The use of flameless explosion venting devices for applications other than described in EN 14491 or EN 14994 shall be carefully evaluated and where appropriate their suitability shall be confirmed by tests.

The maximum volume to be protected by a single flameless explosion venting device shall be limited to the volume of the test vessel the device was tested on during type testing, see also Clause 6.

If a single flameless explosion venting device is not sufficient to protect a volume due to this limitation, multiple flameless explosion venting devices of the same type and the same dimension shall be used. If the volume to be protected is  $n$  times  $V_{max, FV}$ , at least  $n$  devices shall be used, for a calculated example see Annex B. The protected volume shall be maximum 4 times  $V_{max, FV}$ .

NOTE For more information on the maximum volume to be protected, see 6.3.2.

## 5 Types of flameless explosion venting devices

Flameless explosion venting devices consist of an explosion venting device in combination with a flame quenching element and, where fitted, an integrated particle retention element (for dusts). The explosion venting device can be of various types, outlined in EN 14797. Examples of flame quenching elements are

- ribbon type,
- parallel plate,
- mesh or gauze,
- ceramic.

NOTE Examples of different types are included in Annex A.

## 6 Testing of flameless explosion venting devices

### 6.1 General

The manufacturer shall specify the intended use and the devices to be tested:

- process conditions;
- range of nominal sizes of the device;
- $p_{stat}$  of the explosion venting device;
- maximum intended volume to be protected;
- maximum intended volume to be protected by one single device;
- $p_{red, max}$ ;
- dust and/or gas characteristics;
- any limitations with respect to orientation;
- type and construction of the device (e.g. material specification, physical dimensions) and other parameters relevant for production quality control.

Flameless explosion venting devices shall be subject to type testing for a given dust (see 6.2.1), gas/vapour or mixture thereof to determine

- a) external effects;
- b) mechanical integrity;
- c) venting efficiency;
- d) static activation pressure of the venting device according to EN 14797;
- e) flame quenching;
- f) ignition hazards introduced by the device, before and during the venting process;
- g) functional safety of the detection device to sense vent function;

NOTE The functional safety of a detection device to sense vent function is not considered to be part of this standard, for further information see e.g. EN 15233, EN 61508-series, EN 62061 and EN ISO 13849-1.

- h) volume limitations (single device, multiple devices);
- i) the effect of any cover or insulation.