



**SLOVENSKI STANDARD**  
**SIST EN 14034-2:2006+A1:2011**  
**01-maj-2011**

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**Ugotavljanje eksplozijskih značilnosti oblakov prahu - 2. del: Ugotavljanje največje hitrosti naraščanja tlaka eksplozije (dp/dt)<sub>max</sub> oblakov prahu**

Determination of explosion characteristics of dust clouds - Part 2: Determination of the maximum rate of explosion pressure rise (dp/dt)<sub>max</sub> of dust clouds

Bestimmung der Explosionskenngrößen von Staub/Luft-Gemischen - Teil 2: Bestimmung des maximalen zeitlichen Druckanstiegs (dp/dt)<sub>max</sub> von Staub/Luft-Gemischen

Détermination des caractéristiques d'explosion des nuages de poussière - Partie 2: Détermination de la vitesse maximale de montée en pression d'explosion (dp/dt)<sub>max</sub> des nuages de poussière

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13.230            Varstvo pred eksplozijo            Explosion protection

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 14034-2:2006+A1**

January 2011

ICS 13.230

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English Version

Determination of explosion characteristics of dust clouds - Part  
2: Determination of the maximum rate of explosion pressure rise  
( $dp/dt$ )<sub>max</sub> of dust clouds

Détermination des caractéristiques d'explosion des nuages  
de poussière - Partie 2: Détermination de la vitesse  
maximale de montée en pression d'explosion ( $dp/dt$ )<sub>max</sub> des  
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Bestimmung der Explosionskenngrößen von Staub/Luft-  
Gemischen - Teil 2: Bestimmung des maximalen zeitlichen  
Druckanstiegs ( $dp/dt$ )<sub>max</sub> von Staub/Luft-Gemischen

This European Standard was approved by CEN on 20 April 2006 and includes Amendment 1 approved by CEN on 13 November 2010.

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

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**EN 14034-2:2006+A1:2011 (E)****Foreword**

This document (EN 14034-2:2006+A1:2011) 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 July 2011, and conflicting national standards shall be withdrawn at the latest by July 2011.

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 includes Amendment 1, approved by CEN on 2010-11-13.

This document supersedes EN 14034-2:2006.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** and **A1**.

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 Directives.

For relationship with the EU Directive 94/9/EC, see informative Annex ZA, which is an integral part of this document.

[SIST EN 14034-2:2006+A1:2011](https://standards.iteh.ai/catalog/standards/sist/en-14034-2-2006a1-2011)

This European Standard is one of a series of standards as listed below.

EN 14034 "Determination of explosion characteristics of dust clouds"

- Part 1: Determination of the maximum explosion pressure  $p_{\max}$  of dust clouds;
- Part 2: Determination of the maximum rate of explosion pressure rise  $(dp/dt)_{\max}$  of dust clouds;
- Part 3: Determination of the lower explosion limit LEL of dust clouds;
- Part 4: Determination of the limiting oxygen concentration LOC of dust clouds.

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 United Kingdom.

## Introduction

This European Standard specifies a method for experimental determination of the maximum rate of explosion pressure rise of dust clouds. The maximum rate of explosion pressure rise is the maximum value of the pressure rise per unit time during explosions of explosive atmospheres in the explosion range of a combustible dust in a closed vessel. The measurement of the maximum rate of explosion pressure rise forms the basis for explosion protection by design and construction of equipment, protective systems and components to reduce the explosion effects.

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## EN 14034-2:2006+A1:2011 (E)

## 1 Scope

This standard describes a test method for the determination of the maximum rate of explosion pressure rise of dust clouds in a closed vessel under defined initial conditions of pressure and temperature.

This method is not suitable for use with recognised explosives, like gunpowder and dynamite, explosives which do not require oxygen for combustion, pyrophoric substances, or substances or mixtures of substances which may under some circumstances behave in a similar manner. Where any doubt exists about the existence of hazard due to explosive properties, expert advice should be sought.

## 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 14460, *Explosion resistant equipment*

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

### 3.1

**dust**

small solid particles in the atmosphere which settle out under their own weight, but which may remain suspended in air for some time (includes dust and grit, as defined in ISO 4225)

NOTE Generally maximum particle size will not exceed 500 µm.

### 3.2

**combustible dust**

dust able to undergo an exothermic reaction with air when ignited

NOTE The terms “flammable” and “combustible” are used synonymously.

### 3.3

**explosion pressure**

$p_{ex}$   
highest overpressure occurring during an explosion of a dust cloud in a closed vessel

### 3.4

**explosive atmosphere**

mixture with air, under atmospheric conditions, of flammable (combustible) substances in the form of gases, vapours, mists or dusts, in which, after ignition has occurred, combustion spreads to the entire unburned mixture

### 3.5

**ignition delay**

$t_v$   
time between the initiation of the dust dispersion and the activation of the ignition source



**3.6****initial pressure** $p_i$ 

pressure in the explosion vessel at the moment of ignition

**3.7****initial temperature** $T_i$ 

temperature in the explosion vessel at the moment of ignition

**3.8** $K_{\max}$ ,  $K_{St}$ 

dust specific, volume independent characteristic which is calculated using the cubic law equation

$$\left(\frac{dp}{dt}\right)_{\max} \cdot V^{1/3} = \text{const.} = K_{St} = K_{\max}$$

**3.9****rate of explosion pressure rise** $(dp/dt)_{ex}$ 

the maximum slope of the pressure/time curve during an explosion of a dust cloud in a closed vessel

**3.10****maximum rate of explosion pressure rise** $(dp/dt)_{\max}$ 

maximum value of the pressure rise per unit time during explosions of all explosive atmospheres in the explosion range of a combustible substance in a closed vessel under specified test conditions and standard atmospheric conditions

NOTE This parameter when determined in the 1 m<sup>3</sup> vessel is numerically identical with the parameters  $K_{\max}$  (EN 26184-1) and  $K_{St}$  (VDI 2263-1) but the units of the latter are bar · m · s<sup>-1</sup> whereas the unit of the  $(dp/dt)_{\max}$  is bar · s<sup>-1</sup>.

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**4 Test apparatus****4.1 General**

The standard test apparatus to determine the maximum rate of explosion pressure rise  $(dp/dt)_{\max}$  of dust clouds is an explosion pressure resistant vessel of 1 m<sup>3</sup>, as used for the determination of the maximum explosion pressure and the lower explosion limit of dust clouds as well as the limiting oxygen concentration of dust/air/inert gas mixtures.

The main components of the test apparatus are

- explosion vessel;
- dust dispersion system;
- ignition source;
- control unit;
- pressure measuring system.

NOTE The 20 l sphere apparatus is an alternative explosion vessel for these determinations (see Annex C).

**EN 14034-2:2006+A1:2011 (E)****4.2 Explosion vessel**

The standard explosion vessel is an explosion pressure resistant, spherical or cylindrical vessel having a volume of 1 m<sup>3</sup> in accordance with EN 14460. The aspect ratio of the cylindrical vessel shall be 1:1 ± 10 % (see Figure 1).

NOTE It is recommended that the explosion vessel be designed to withstand an overpressure of at least 20 bar.

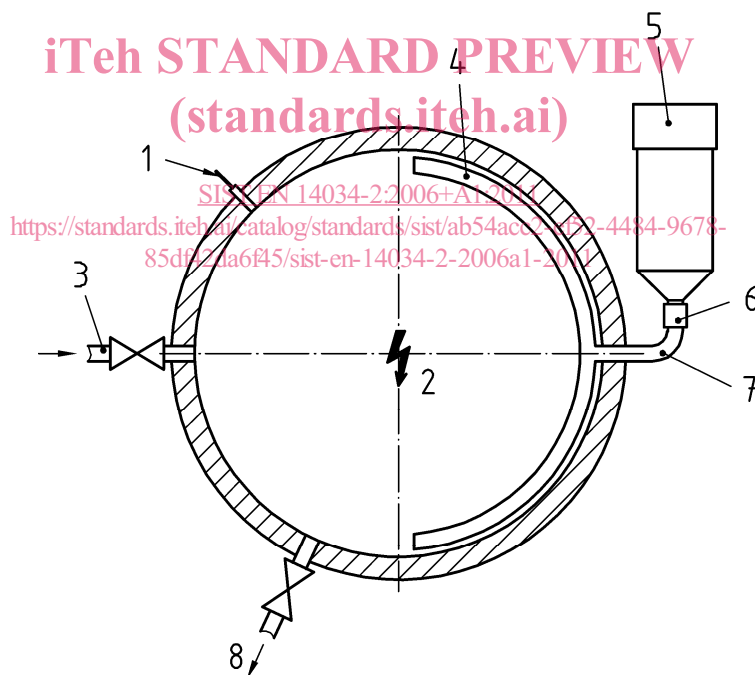
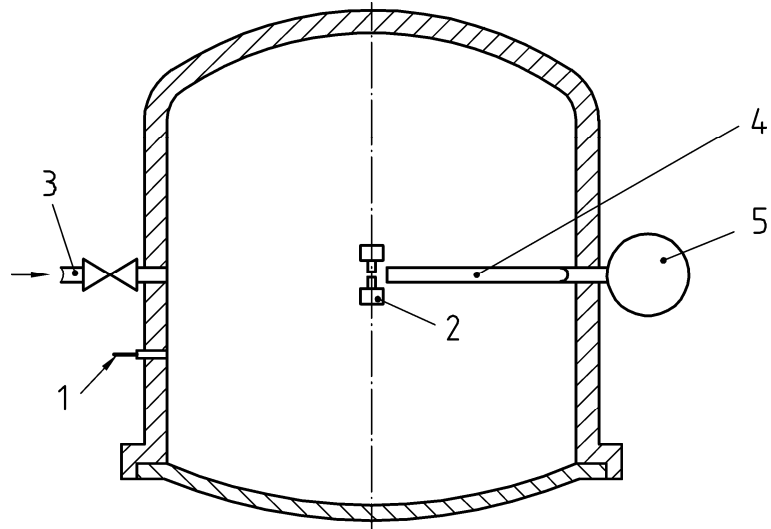
The apparatus shall be fitted with electrical and/or mechanical cut-offs as far as possible to ensure that any openings in the vessel (e.g. main door, instrument ports, inlet or outlet) are properly closed before a test procedure can start.

The apparatus shall also be equipped as far as possible to ensure that any residual pressure inside the vessel is vented before the vessel can be opened.

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### Key

- |   |                     |   |                        |
|---|---------------------|---|------------------------|
| 1 | pressure sensor     | 5 | dust container         |
| 2 | chemical igniters   | 6 | fast acting valve      |
| 3 | inlet for purge air | 7 | connecting tube        |
| 4 | dust disperser      | 8 | outlet for exhaust gas |

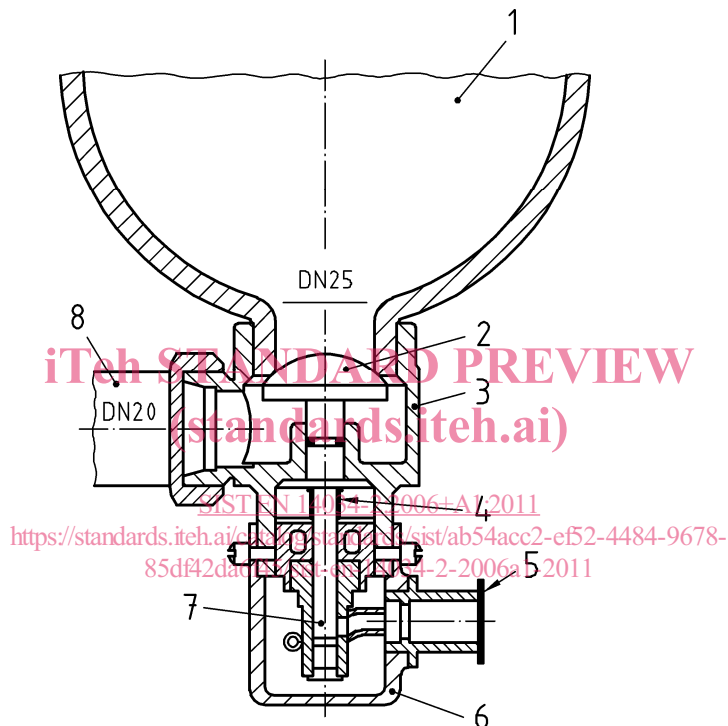
Figure 1 — 1 m<sup>3</sup> vessel (schematic)

## EN 14034-2:2006+A1:2011 (E)

### 4.3 Dust dispersion system (dust container, fast acting valve, connecting tube, dust disperser)

The dust to be dispersed is charged into a dust container having a volume of 5,4 dm<sup>3</sup>. Its aspect ratio is 3:1. It is designed to withstand an overpressure of at least 20 bar (see Figure 2).

The dust container has an outlet at the base, through which the dust leaves the container. This outlet is closed by a fast acting valve activated by a blasting cap. The valve has a mushroom-shaped seal. The seal is held in position against the pressure in the dust container by a small ring. The ring is destroyed by firing a blasting cap and the valve opens due to the pressure inside the dust container (see Figure 2). The valve shall be designed so that it opens in less than 10 ms. For alternative valves see Annex A. The fast acting valve is connected to the side of the explosion vessel. The connecting tube between the fast acting valve and the dust disperser shall be not longer than 350 mm (see Figure 1).



#### Key

1	dust container	5	protective hood
2	mushroom shaped seal	6	protective hood
3	seal housing	7	blasting cap
4	support ring	8	connecting tube

**Figure 2 — Dust container with blasting cap activated valve as commonly used for explosion suppression (schematic; it is commercially available)**

For dispersing the dust, a perforated semicircular spray pipe (dust disperser) is mounted inside the explosion vessel, concentric with its wall. The spray pipe, with an internal diameter of 21,7 mm<sup>1)</sup> is fitted with 13 holes of a diameter of 6 mm (incl. one hole in each end cap) which are located as shown in Figure 3 (see also Figure 1).

For coarse, voluminous, fibrous or poorly flowing dust samples, it may not be possible to properly discharge the dust through the dust dispersers detailed in Figures 3 and B.1. It may, therefore, be necessary to use

1) (e.g. EN ISO 1127, DN 20, 3/4")