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Irish Standard
I.S. EN 15967:2011

Determination of maximum explosion pressure and the maximum rate of pressure rise of gases and vapours

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I.S. EN 15967:2011

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15967

August 2011

ICS 13.230

Supersedes EN 13673-1:2003, EN 13673-2:2005

English Version

Determination of maximum explosion pressure and the maximum rate of pressure rise of gases and vapours

Détermination de la pression maximale d'explosion et de la vitesse maximale de montée en pression des gaz et des vapeurs

Verfahren zur Bestimmung des maximalen Explosionsdruckes und des maximalen zeitlichen Druckanstieges für Gase und Dämpfe

This European Standard was approved by CEN on 1 July 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.

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Foreword

This document (EN 15967:2011) 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of an identical text or by endorsement, at the latest by February 2012, and conflicting national standards shall be withdrawn at the latest by February 2012.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 supersedes EN 13673-1:2003, EN 13673-2:2005.

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 and B which are an integral part of this document.

The significant changes between this European Standard and EN 13673-1:2003 and EN 13673-2:2005 are given in Table G.1

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.

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Introduction

This European Standard describes test methods for the determination of:

— the explosion pressure and the maximum explosion pressure; and

— the rate of explosion pressure rise and the maximum rate of explosion pressure rise;

of a quiescent flammable gas/air/inert mixture at ambient temperature and pressure.

Maximum explosion pressure and maximum rate of explosion pressure rise are used for designing explosion protection measures, such as explosion pressure resistant or explosion pressure shock resistant apparatus, explosion venting and explosion suppression. These characteristics are particularly influenced by:

— the size and shape of the vessel;

— the type and energy of the ignition source;

— the temperature and pressure;

— the turbulence.

It is therefore necessary to standardise the conditions at which the maximum explosion pressure and the maximum rate of explosion pressure rise are determined.

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1 Scope

This European Standard specifies a test method that is designed to produce measurements of explosion pressure and the maximum explosion pressure, the rate of explosion pressure rise and the maximum rate of explosion pressure rise of a quiescent flammable gas/air/inert mixture in closed volume at ambient temperature and pressure. In this European Standard, the term "gas" includes vapours but not mists. Detonation and decomposition phenomena are not considered in this European Standard.

The pressures and rates of pressure rise measured by the procedures specified in this European Standard are not applicable to flameproof enclosures, that is enclosures intended to withstand an internal explosion and not to transmit it to an external explosive atmosphere, or any other closed volume where the internal geometry can result in pressure piling. Even in an enclosure of relatively simple geometry the disposition of the internal components can lead to rates of pressure rise significantly higher than those measured using this European Standard. This European Standard does not apply to the design and testing of flameproof enclosures in conformity with EN 13463-6 (for non-electrical equipment) and EN 60079-1 (for electrical equipment).

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*

3 Terms and definitions

For the purpose of this European Standard, the terms and definitions given in EN 13237 and the following apply.

3.1
explosion pressure
p_{ex}
highest pressure occurring in a closed vessel during the explosion of a specific mixture of flammable substances with air or air and inert gases determined under specified test conditions

NOTE p_{ex} is expressed as absolute pressure with gases and vapour and as overpressure with dusts.

3.2
maximum explosion pressure
p_{max}
maximum value of explosion pressure measured in the tests for explosion pressure when the content of the flammable substances in the mixture is varied

NOTE p_{max} is expressed as absolute pressure with gases and vapour and as overpressure with dusts.

3.3
rate of explosion pressure rise
$(dp/dt)_{ex}$
highest value of the slope (first derivative) of the pressure-time curve (smoothed if necessary), measured in a closed vessel during the explosion of a specific mixture of flammable substances with air or air and inert substances determined under specified test conditions

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3.4
maximum rate of explosion pressure rise
$(dp/dt)_{max}$
maximum value of the explosion pressure rise per unit time measured in the tests when the content of the flammable substances in the mixture is varied

NOTE For the purpose of this document, all pressures are expressed in bar absolute and rate of explosion pressure rises are expressed in bar/s.

4 Test method

4.1 Principle

An explosive test mixture is ignited by a defined ignition source which is positioned in the centre of a test vessel. By means of a pressure measuring system the pressure-time curve that develops following the ignition of the test mixture is recorded.

From the pressure- time curve the highest rate of explosion pressure rise $(dp/dt)_{ex}$ is calculated, and the highest pressure p_{ex} is determined.

Repeat measurements are made with stepwise variations in the content of flammable gas in the mixture.

a) The maximum explosion pressure p_{max} is determined as the maximum observed value of $p_{ex.}$

b) The maximum rate of explosion pressure rise $(dp/dt)_{max}$ is determined as the maximum observed value of $(dp/dt)_{ex}$

4.2 Apparatus

4.2.1 General

The test apparatus consists of:

— a test vessel;

— equipment for preparing the test mixture;

— an ignition system;

— a pressure measuring system;

— a temperature measuring device;

— safety equipment.

4.2.2 Test vessel

The test vessel shall be spherical or cylindrical. The internal volume of the test vessel shall be equal to or greater than 0,005 m^3. If a cylindrical vessel is used, the length to diameter ratio shall be equal to 1.

The test vessel and any equipment (valves, igniter, transducer, etc) fitted on the vessel shall be designed to withstand a maximum pressure of at least 20 bar.

NOTE Guidance on the design of the test vessel can be found in EN 14460.

The vessel shall be made of stainless steel or any material free of any catalytic effects and resistant to corrosion from the initial gas mixture and the products of combustion.

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