
Sistemi za zaščito pred eksplozijo - 3. del: Ugotavljanje eksplozijskih karakteristik zmesi gorivo/zrak, drugačnih od zmesi prah/zrak in plin/zrak

Explosion protection systems - Part 3 : Determination of explosion indices of fuel/air mixtures other than dust/air and gas/air mixtures (ISO 6184-3:1985)

Explosions-Schutzsysteme - Teil 3 : Bestimmung der Explosionskenngrößen von Brennstoffen in Luft außer Staub/Luft- und Gas/Luft-Gemischen (ISO 6184-3:1985)

Systemes de protection contre les explosions - Partie 3 : Détermination des indices d'explosion des mélanges de combustibles et d'air autres que les mélanges air/poussiere et air/gaz (ISO 6184-3:1985)

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13.230 Varstvo pred eksplozijo Explosion protection

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English version

Explosion protection systems - Part 3:
Determination of explosion indices of fuel/air
mixtures other than dust/air and gas/air mixtures
(ISO 6184-3:1985)

Systèmes de protection contre les
explosions - Partie 3: Détermination
des indices d'explosion des mélanges de
combustibles et d'air autres que les
mélanges air/poussière et air gaz (ISO
6184-3:1985)

Explosions-Schutzsysteme - Teil 3:
Bestimmung der Explosionskenngrößen
von Brennstoffen in Luft außer
Staub/Luft- und Gas/Luft- Gemischen
(ISO 6184-3:1985)

This European Standard was accepted by CEN on 1990-10-05 and is identical to the ISO standard as referred to.

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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 CEN Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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FOREWORD

Based on the positive result of the Formal Vote procedure, the International Standard:

ISO 6184-3:1985 "Explosion protection systems - Part 3: Determination of explosion indices of fuel/air mixtures other than dust/air and gas/air mixtures"

is adopted as a European Standard.

In accordance with the Common CEN/CENELEC Rules, the following countries are bound to implement this standard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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ENDORSEMENT NOTICE

The text of the International Standard ISO 6184-3, edition 1985 was approved by CEN as a European Standard without any modification.

International Standard



6184/3

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Explosion protection systems — Part 3: Determination of explosion indices of fuel/air mixtures other than dust/air and gas/air mixtures

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UDC 614.835

Ref. No. ISO 6184/3-1985 (E)

Descriptors : explosion proofing, dust, air, gas mixtures, tests, explosion index.

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 6184/3 was prepared by Technical Committee ISO/TC 21, *Equipment for fire protection and fire fighting*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Explosion protection systems —

Part 3: Determination of explosion indices of fuel/air mixtures other than dust/air and gas/air mixtures

0 Introduction

0.1 The assessment of measures required to provide protection against explosion hazards involving fuel/air mixtures requires prior determination of the potential explosion severity of such mixtures, by the measurement of explosion indices. Conversely, the measurement of the effectiveness and performance of explosion protection systems requires that they should be tested against explosions of known severity.

The severity of a fuel/air explosion is a function of the following:

- a) the physical and chemical properties of the fuel;
- b) the concentration of the fuel in the fuel/air mixture;
- c) the homogeneity and turbulence of the fuel/air mixture;
- d) the type, energy, and location of the ignition source;
- e) the geometry of the container;
- f) the temperature, and pressure of the fuel/air mixture.

0.2 This part of ISO 6184 is one of a series dealing with explosion protection systems. The other parts are as follows:

Part 1: Determination of explosion indices of combustible dusts in air.

Part 2: Determination of explosion indices of combustible gases in air.

Part 4: Determination of efficacy of explosion suppression systems.

0.3 The interpretation of explosion indices determined by the method specified in this part of ISO 6184 and their relation to the development of explosions in commonly encountered explosion hazards should be recognized. In particular, the degree of turbulence can influence the hazard significantly. In practice, the link between a given degree of turbulence and a specific type of hazard is the responsibility of specialists in the fields of explosions and explosion protection.

Two extremes of turbulence commonly encountered in industrial plants are:

- a) quiescent turbulence conditions prevailing in storage vessels;
- b) high turbulence conditions prevailing in the region of an extraction fan.

It should be realized that turbulence can arise in two ways:

- a) turbulence intrinsic to the plant, under normal operating conditions, as a consequence of perturbations to the air-flow;
- b) turbulence induced by obstructions within an installation on a gas which expands as the result of an explosion.

1 Scope

This part of ISO 6184 specifies a method for the determination of the explosion indices of fuels in air (other than dust/air and gas/air mixtures) in an enclosed space. Fuel/air mixtures may be, for example, gas/air/dust mixtures and vaporized liquid/air mixtures. It gives the criteria by which results obtained using other test procedures can be correlated to yield explosion indices as determined by the method specified in this part of ISO 6184.

2 Field of application

This part of ISO 6184 is applicable only to the determination of explosion indices pertaining to the development of contained fuel/air explosions after ignition of the reactants. It does not apply to indices pertaining to the conditions necessary to cause ignition of the reactants.

NOTE — Dust and gas/air mixtures, both at concentrations below the explosive range, can form explosive mixtures when combined. Dust which cannot be caused to explode even with a high energy ignition source may become explosive if a flammable gas or vapour is added.

ISO 6184/3-1985 (E)

3 Definitions

For the purpose of this part of ISO 6184 the following definitions apply.

3.1 explosion: Propagation of a flame in a pre-mixture of combustible gases, suspended dust(s), combustible vapour(s), mist(s), or mixtures thereof, in a gaseous oxidant such as air, in a closed or substantially closed vessel.

3.2 explosion index: Numerical term, determined in accordance with the test methods specified in this part of ISO 6184, which characterizes the contained explosion of a specified concentration of reactants in a vessel having a volume of 1 m³.

NOTE — Figure 1 shows the pressure/time curve, expressed in bars¹⁾ and seconds respectively, of a typical explosion.

3.2.1 explosion index p_m : Maximum overpressure relative to the pressure in the vessel at the time of ignition attained during an explosion.

3.2.2 explosion index p_{max} : Maximum value of the explosion index p_m determined by tests over a wide range of reactant concentrations.

3.2.3 explosion index K : Constant defining the maximum rate of pressure rise with time $(dp/dt)_m$ of an explosion in a volume V , according to the equation

$$K = \left(\frac{dp}{dt} \right)_m \times V^{1/3}$$

NOTE — Under certain circumstances, this equation is not valid for vessels with a length to diameter ratio greater than 2 : 1 or with a volume of less than 1 m³.

3.2.4 explosion index K_{max} : Maximum value of the explosion index K determined by tests over a wide range of reactant concentrations. The violence of an explosion is evaluated from the value of K_{max} .

3.3 turbulence index: Numerical term which characterizes the degree of turbulence in the experimental conditions under which the explosion indices are determined.

3.3.1 turbulence index t_v (ignition delay): Experimental parameter defined as the time interval between the initiation of a fuel dispersion procedure in an experimental apparatus, and the activation of the ignition source. It characterizes the degree of turbulence prevailing at the moment of ignition.

3.3.2 turbulence index T_u : Ratio of the explosion index $K_{max, turbulent}$ determined as specified in this part of ISO 6184 to the explosion index $K_{max, quiescent}$ of the quiescent reactants. It is given by the equation

$$T_u = \frac{K_{max, turbulent}}{K_{max, quiescent}}$$

NOTE — For fuel/air mixtures, $K_{max, quiescent}$ is a theoretically derived parameter.

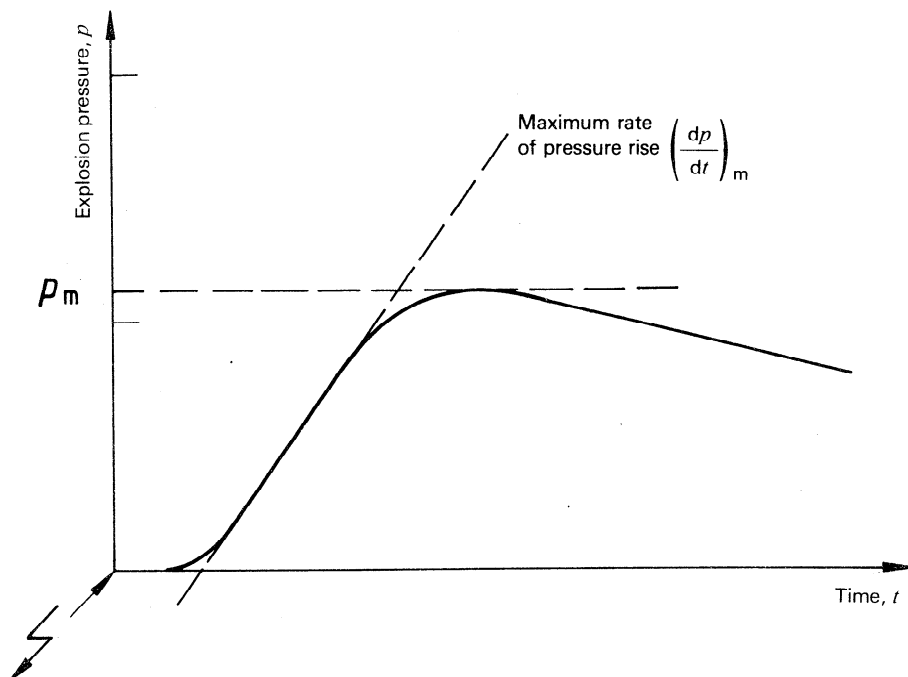


Figure 1

1) 1 bar = 10⁵ Pa

4 Test method

4.1 General

The experimental apparatus described in this part of ISO 6184 is chosen as an example, and is suitable for the evaluation of explosion indices of fuels mixed with air. If the fuel is a combustible gas or a combustible dust, the test procedures described in parts 1 and 2 respectively of this International Standard should be used. This part of ISO 6184 specifies the test procedure for the cases where the fuel is a hybrid (combustible gas plus dust) mixture and gives recommendations for the procedure for a combustible mist (fine droplets of combustible liquid) in air.

NOTES

1 When the gaseous oxidant is not air, but, for example, a nitrogen/oxygen mixture of different composition, the test procedures described in this part of ISO 6184 can be adapted by reading "oxidant" instead of "air".

2 When the initial pressure or temperature of the fuel/air mixture is not ambient, a test procedure similar to the procedures described in this part of ISO 6184 can be used.

4.2 Apparatus

The apparatus consists essentially of a cylindrical explosion chamber with a volume of 1 m³ and an aspect ratio nominally of 1 : 1, as shown in figure 2.

A container of approximately 5 l capacity is attached to the explosion chamber and is capable of being pressurized with air to

20 bar. This container is fitted with a 19 mm (3/4 in) quick-opening valve which allows injection of the contents of the container within 10 ms of opening the valve. The container is connected to the explosion chamber by means of a 19 mm (3/4 in) internal diameter tube which is formed into a perforated (4 to 6 mm hole diameter) semicircular spray pipe. The number of holes in the pipe shall be chosen such that their total cross-sectional area is approximately 300 mm².

The ignition source comprises two pyrotechnic igniters with a total energy of 10 kJ and set to ignite after a fixed ignition delay, turbulence index $t_v = 0,6$ s. The total mass of the ignition source is 2,4 g and consists of 40 % zirconium metal, 30 % barium nitrate and 30 % barium peroxide. It is ignited by an electric fuse head. The igniter is located at the geometric centre of the explosion chamber. A pressure transducer is fitted to measure explosion chamber pressure, this being linked to a recorder.

4.3 Procedure

4.3.1 Hybrid mixture test

Prepare the gas/air mixture in the 1 m³ chamber by, for example, using the method of partial pressures. It is important to ensure that the correctness and the homogeneity of the required gas/air mixture is verified.

Place the dust sample, the mass of which shall be that required to obtain the appropriate concentration, in the 5 l container and pressurize it with air to 20 bar. Start the pressure recorder and

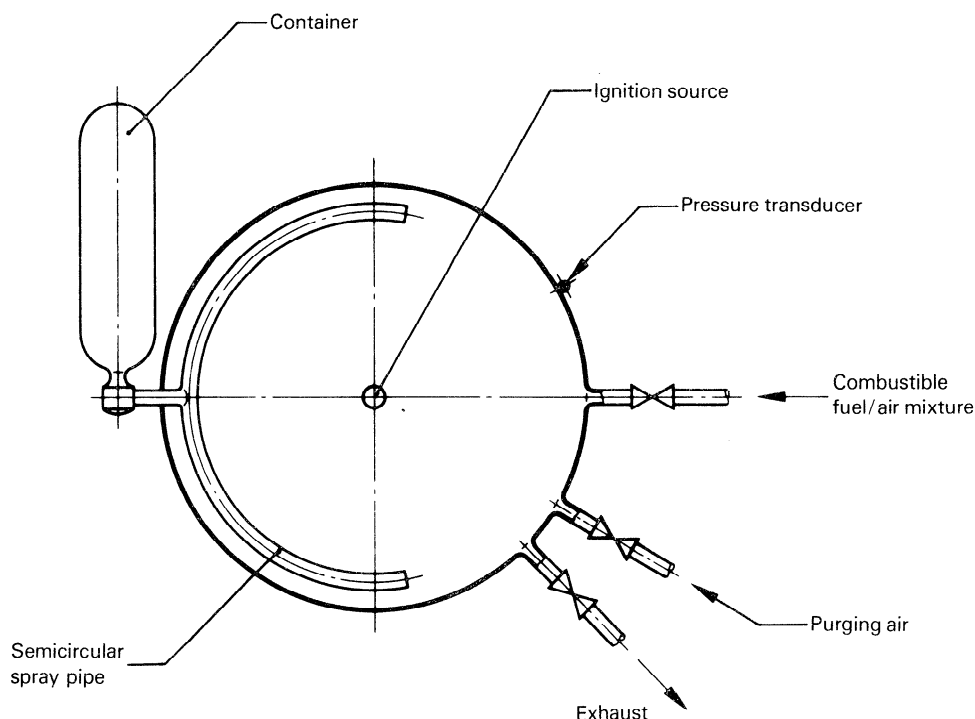


Figure 2