SLOVENSKI STANDARD

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Eksplozijsko vzdržljiva oprema

Explosion resistant equipment

Explosionsfeste Geräte

Appareil résistant a l'explosion

Ta slovenski standard je istoveten z: **EN 14460:2006**

ICS:

13.230	Varstvo pred eksplozijo	Explosion protection
29.260.20	Električni aparati za eksplozivna ozračja	Electrical apparatus for explosive atmospheres

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Explosion resistant equipment

Appareil résistant à l'explosion

Explosionsfeste Geräte

This European Standard was approved by CEN on 23 March 2006.

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Contents

Foreword

This document (EN 14460:2006) 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of an identical text or by endorsement, at the latest by November 2006, and conflicting national standards shall be withdrawn at the latest by November 2006.

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 94/9/EC of 23 March 1994.

For relationship with EU Directive 94/9/EC, 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.

Introduction

The principles of integrated explosion safety includes the following measures the manufacturer has to take:

a) prevention of formation of explosive atmospheres;

b) prevention of the ignition of the explosive atmospheres; and

c) if an explosion nevertheless occurs, to halt it immediately and/or to limit the range of explosion flames and explosion pressures to a sufficient level of safety.

It is essential that methods according to c) be used if the ignition hazard assessment of the equipment shows that the prevention of ignition sources, e.g. by using of types of ignition protection as defined in EN 13463 series, doesn't fulfil the requirements of the intended category which is necessary for the intended use of the equipment. This standard specifies requirements for equipment that shall be explosion resistant. Explosion resistance is the term applied to the construction of an enclosure so that it can withstand an expected explosion pressure without rupture. Giving equipment this property it limits the range of explosion flames and explosion pressures to a sufficient level of safety.

The equipment property "explosion resistance" can be used for equipment, protective systems and components.

1 Scope

This standard specifies requirements for explosion-pressure-resistant and explosion pressure shock-resistant equipment. This standard is applicable to process vessels and systems. It is not applicable to individual items of equipment such as motors and gearboxes that may be designed to withstand an internal explosion, which is the subject of EN 13463-3.

This standard is valid for atmospheres having pressures ranging from 800 hPa to 1100 hPa and temperatures ranging from - 20 °C to + 60 °C. This standard may also be helpful for the design, construction, testing and marking of equipment intended for use in atmospheres outside the validity range stated above, as far as this subject is not covered by specific standards.

This standard applies to equipment and combinations of equipment where deflagrations may occur and is not applicable to equipment and combination of equipment where detonation may occur. This standard should not be used for offshore applications.

It is essential that this standard be used for equipment made of metallic materials only.

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 10002-1, *Metallic materials - Tensile testing - Part 1: Method of test at ambient temperature*

EN 10204, *Metallic products – Types of inspection documents*

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

EN 13445-1, *Unfired pressure vessels – Part 1: General*

EN 13445-2, *Unfired pressure vessels – Part 2: Materials*

EN 13445-3, *Unfired pressure vessels – Part 3: Design*

EN 13445-4, *Unfired pressure vessels – Part 4: Fabrication*

EN 13980, *Potentially explosive atmospheres - Application of quality systems*

ISO 8421-1:1987, *Fire protection – Vocabulary - Part 1: General terms and phenomena of fire*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 13237:2003 and ISO 8421-1:1987 and the following apply.

3.1
deflagration
explosion propagating at subsonic velocity

[ISO 8421-1:1987, 1.11]

3.2
detonation
explosion propagating at supersonic velocity and characterized by a shock wave

[ISO 8421-1:1987, 1.12]

3.3
explosion
abrupt oxidation or decomposition reaction producing an increase in temperature, pressure, or in both simultaneously

[ISO 8421-1:1987, 1.13]

3.4
explosion resistant
property of vessels, and equipment designed to be either explosion-pressure-resistant or explosion-pressure-shock resistant

[EN 13237:2003, 3.34]

3.5
explosion-pressure-resistant
property of vessels, and equipment designed to withstand the expected explosion pressure without becoming permanently deformed

[EN 13237:2003, 3.31]

3.6
explosion-pressure-shock resistant
property of vessels, and equipment designed to withstand the expected explosion pressure without rupturing, but allowing permanent deformation

[EN 13237:2003, 3.32]

3.7
maximum explosion pressure
p_{max}
maximum pressure occurring in a closed vessel during the explosion of a specific explosive atmosphere determined under specified test conditions

[EN 13237:2003, 3.81]

3.8
maximum allowable explosion pressure
p_{exmax}
calculated maximum explosion pressure which the equipment will withstand

3.9
reduced explosion pressure
p**red**
pressure generated by an explosion of an explosive atmosphere in a vessel, protected by either explosion relief or explosion suppression

[EN 13237:2003, 3.100]

4 Explosion resistant equipment

4.1 General

Explosion resistant equipment shall be so constructed that it can withstand an internal explosion without rupturing.

In general, a distinction is made between the following designs:

— design for the maximum explosion pressure;

— design for the reduced explosion pressure in conjunction with explosion pressure relief or explosion suppression.

Components of the system can be either explosion-pressure-resistant or explosion-pressure shock resistant.

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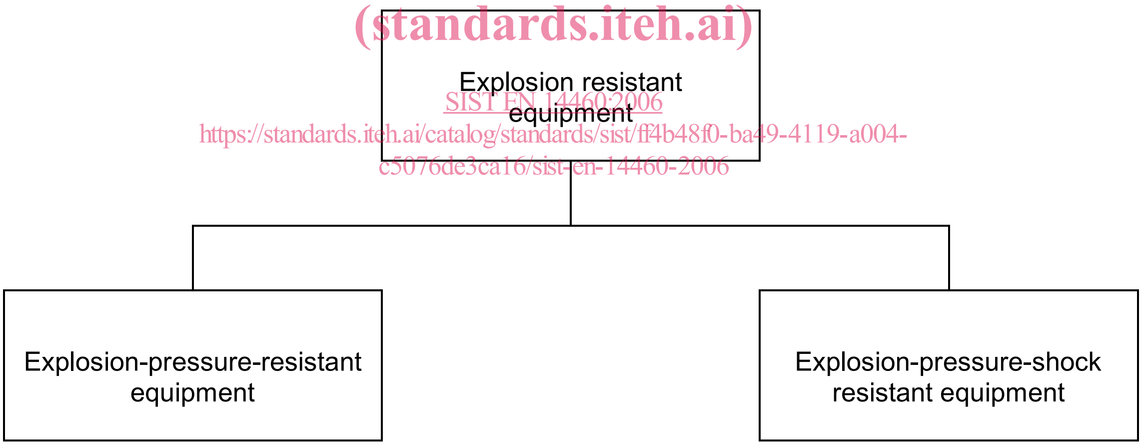

Figure 1 — Explosion resistant equipment

4.2 Design pressure

The design pressure shall not be less than the maximum gauge pressure occurring in the equipment, when subjected to explosion or reduced explosion conditions. The design pressure shall be used as the calculation pressure as detailed in EN 13445-3.

NOTE 1 If the inside of the equipment is divided into sections (e.g. tanks connected by a pipeline or containing baffles or surge plates), during an explosion in one of the sections the pressure in the other sections of the equipment will be increased. As a result, an explosion in these sections will occur at an elevated initial pressure. Further, pressure peaks occur which are higher than the value expected under atmospheric conditions. In the case of such arrangements, appropriate measures should be taken, either explosion de-coupling techniques or explosion resistant design derived from representative explosion trials.

NOTE 2 Pressures quoted are gauge pressures unless otherwise stated.

For guidance on the derivation of design pressure see Annex A.

4.3 Design temperature

For wall temperatures governed by the weather or by the vessel charge of less than – 10 °C EN 13445-2 shall be consulted for material requirements.

In case of an explosion there is only a marginal heat up of the vessel walls. Therefore, the anticipated operating temperature at the initial pressure shall be used as the design temperature.

4.4 Additional loads

Loads which are due to an activation of a venting device, due to product load and/or to hydrostatic load shall be considered. In addition any other load that may occur at the same time as an explosion e.g. windload, snowload, shall be considered, corresponding to EN 13445-3.

If brittle material is used for pressure shock-resistant apparatus and components, then care shall be taken to avoid excessive or uneven stressing during assembly.

4.5 Wall thickness allowance

If a corrosion and/or erosion allowance is requested by the customer this shall be deducted from the design wall thicknesses before design calculations are carried out (see Clause 8).

5 Explosion-pressure-resistant design

Explosion-pressure-resistant equipment shall withstand the maximum or reduced explosion pressure without becoming permanently deformed. EN 13445-3 which covers the design of and calculations for unfired pressure vessels shall be used when dimensioning and manufacturing these equipments. The maximum or reduced explosion pressure shall be used as the basis for the calculation pressure. Explosion pressure-resistant design fulfils the requirements of explosion-pressure-shock resistant design.

6 Explosion-pressure-shock resistant design

6.1 General

Explosion-pressure-shock resistant equipment shall be so constructed that they can withstand the maximum or reduced explosion pressure without rupturing, but may become permanently deformed (see 8.2 g)). Explosion-pressure-resistant equipment according to Clause 5 is considered to be explosion-pressure-shock resistant for a 50 % higher gauge pressure, if the requirements according to 6.2.1 are fulfilled.

Explosion pressure-shock resistant equipment shall be designed or tested either by

a) design according to 6.2 and pressure test according to 6.3.3, Table 1, column A for each device;

b) pressure test as a type test according to 6.3.3, Table 1, column B (with permanent deformation) and pressure test of all devices according to 6.3.3, Table 1, column A; or

c) explosion test as a type test according to 6.3.3, Table 1, column C and pressure test of all devices according to 6.3.3, Table 1, column A.

In case the pressure test of all devices according to 6.3.3, Table 1, column A is impossible because of technical and/or safety reasons the manufacturer has to demonstrate the quality of all devices by:

1) material certificates according to EN 10204;

2) non-destructive examination of welding, at least ultra sonic;

3) check of the measurements compared with the design drawings.

6.2 Design and manufacture according to EN 13445 with modified design criteria

6.2.1 General

EN 13445 for unfired pressure vessels shall be used with the following modifications:

- The nominal design stress for design conditions as defined in EN 13445-3 may be multiplied by 1,5 in the case of materials with sufficient ductility. These materials are:
  - steel, cast steel and spheroidal graphite castings with
    - rupture elongation A5 ≥ 14 %, test temperature 20 °C; and
    - notch impact energy ≥ 27 J, ISO V.
      The test temperature shall not be higher than the lowest intended operating temperature and shall not exceed 20°C.
  - aluminium with
    - rupture elongation A5 ≥ 20 %, test temperature 20 °C; and
    - notch impact energy not defined.

6.2.2 Materials

Only materials permitted by EN 13445-2 shall be used which fulfil the mechanical, thermal and chemical requirements of the design and operation of the equipment.

6.2.3 Design and manufacture

Manufacture shall be in accordance with EN 13445-4.

Detailed design features which can lead to cracking shall be avoided. This requires limitation of stress concentrations (For examples see Annex B).

6.2.4 Openings

Openings shall preferably be reinforced by increasing the wall thickness of the nozzle up to a maximum value $s_s \leq 1{,}5\ s_e$ (see Figure 2).

The wall thickness of the nozzle which contributes to the compensation of the weakening shall have an extended length, l, of at least:

$$l \geq \sqrt{(d_i + s_s - c_1 - c_2)(s_s - c_1 - c_2)} \quad (1)$$

where

l is the extended length of the nozzle with thickness s_s, in mm;

d_i is the inside diameter of the nozzle, in mm.