SLOVENSKI STANDARD
SIST EN 720-2:1999

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Plinske jeklenke - Plini in plinske mešanice - 2. del: Določitev stopnje gorljivosti in oksidativnosti plinov in plinskih mešanic

Transportable gas cylinders - Gases and gas mixtures - Part 2: Determination of flammability and oxidizing ability of gases and gas mixtures

Orstbewegliche Gasflaschen - Gase und Gasgemische - Teil 2: Bestimmung der Brennbarkeit und des Oxidationsvermögens von Gasen und Gasgemischen

Bouteilles a gaz transportables - Gaz et mélanges de gaz - Partie 2: Détermination du potentiel d'inflammabilité et d'oxydation des gaz et mélanges de gaz

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Descriptors: gas, gas mixtures, flammable gases, classifications, flammability testing, oxidation tests, computation, flammability, toxicity, tables (data)

English version

Transportable gas cylinders - Gases and gas mixtures - Part 2: Determination of flammability and oxidizing ability of gases and gas mixtures

Bouteilles à gaz transportables - Gaz et mélanges de gaz - Partie 2: Détermination du potentiel d'inflammabilité et d'oxydation des gaz et mélanges de gaz

Ortsbewegliche Gasflaschen - Gase und Gasgemische - Teil 2: Bestimmung der Brennbarkeit und des Oxidationsvermögens von Gasen und Gasgemischen

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN

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

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 23 "Transportable gas cylinders", the secretariat of which is held by BSI.

This European Standard is a two Part standard, belonging to a series of standards relating to gases and gas mixtures.

Part 1: Properties of single component gases;

Part 2: Determination of flammability and oxidizing ability of gases and gas mixtures.

ISO Standard ISO10156 was used as a base document.

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of an identical text or by endorsement, at the latest by January 1997, and conflicting national standards shall be withdrawn at the latest by January 1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard identifies test and calculation methods for the determination of flammability and oxidizing ability of gases and gas mixtures. The first test method determines whether or not a gas is flammable in air. The second test method determines if a gas or gas mixture has a greater or lesser oxidizing ability, than that of air.

The calculation method, uses the characteristics of the pure substances, of which the mixture is composed, to determine the characteristics of the mixture.

The results of the methods of determination, described in this standard, are intended to assist in the selection of safe gas cylinder valve outlet connections.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent references to or revisions of any these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 4589 Plastics - Determination of flammability by oxygen index

3 Definitions and symbols

3.1 Definitions

For the purposes of this standard, the following definitions apply:

3.1.1 gas or gas mixture flammable in air: A gas or gas mixture, which will ignite, in air, at atmospheric pressure and a temperature of 20 °C.

3.1.2 lower flammability limit in air: The minimum content of a gas or gas mixture, in air, at which the gas or gas mixture will ignite. This limit is determined at atmospheric pressure and a temperature of 20 °C.

3.1.3 gas or gas mixture less oxidizing than air: A Gas or gas mixture which is not able, at atmospheric pressure, to support the combustion of substances, which are flammable in air.

3.2 Symbols

A_i Molar fraction of a flammable gas in a mixture of gases.

A_{ri} Equivalent content of a flammable gas.

B_i Molar fraction of an inert gas in a mixture of gases.

C_i Coefficient of oxygen equivalency.

F_i ith flammable gas in a gas mixture.

I_i ith inert gas in a gas mixture.

K_i Coefficient of equivalency of an inert gas relative to nitrogen.

L_i Lower flammability limit, in air, of a flammable gas.

n Number of flammable gases in a gas mixture.

p Number of inert gases in a gas mixture.

T_{ci} Maximum flammable gas content for which a mixture of the flammable gas in nitrogen is not flammable in air.

x_i Concentration of a highly oxidizing gas.

y_i Minimum concentration of an oxidizing combustion gas, in a mixture with nitrogen, which will support combustion of a test piece, having a limiting oxygen index equal to 21%.

Ar Argon.

CF_4 Carbon tetrafluoride.

C_3F_8 Octofluoropropane.

CH_4 Methane.

CO_2 Carbon dioxide.

He Helium.

H_2 Hydrogen.

Kr Krypton.

Ne Neon.

N_2 Nitrogen.

N_2O Nitrous oxide.

O_2 Oxygen

SF_6 Sulphur hexafluoride.

SO_2 Sulphur dioxide.

Xe Xenon.

4 Flammability of gases and gas mixtures in air

4.1 General

It is necessary to identify gases and gas mixtures which are flammable. Such gases and gas mixtures have flammable limits in air. The following subclauses outline test and calculation methods for determining whether a gas or gas mixture is considered to be flammable. In cases where the test result is different to that achieved by calculation, the test result shall take precedence.

4.2 Test method

The gas is mixed, in the desired proportions, with air. An ignition energy is applied, from an electric arc across two electrodes (e.g. a spark plug).

4.3 Equipment

The equipment includes (see figure 1):

- a mixing apparatus;
- a chamber in which the reaction takes place;
- an ignition system;
- systems of analysis to test the gas compositions.

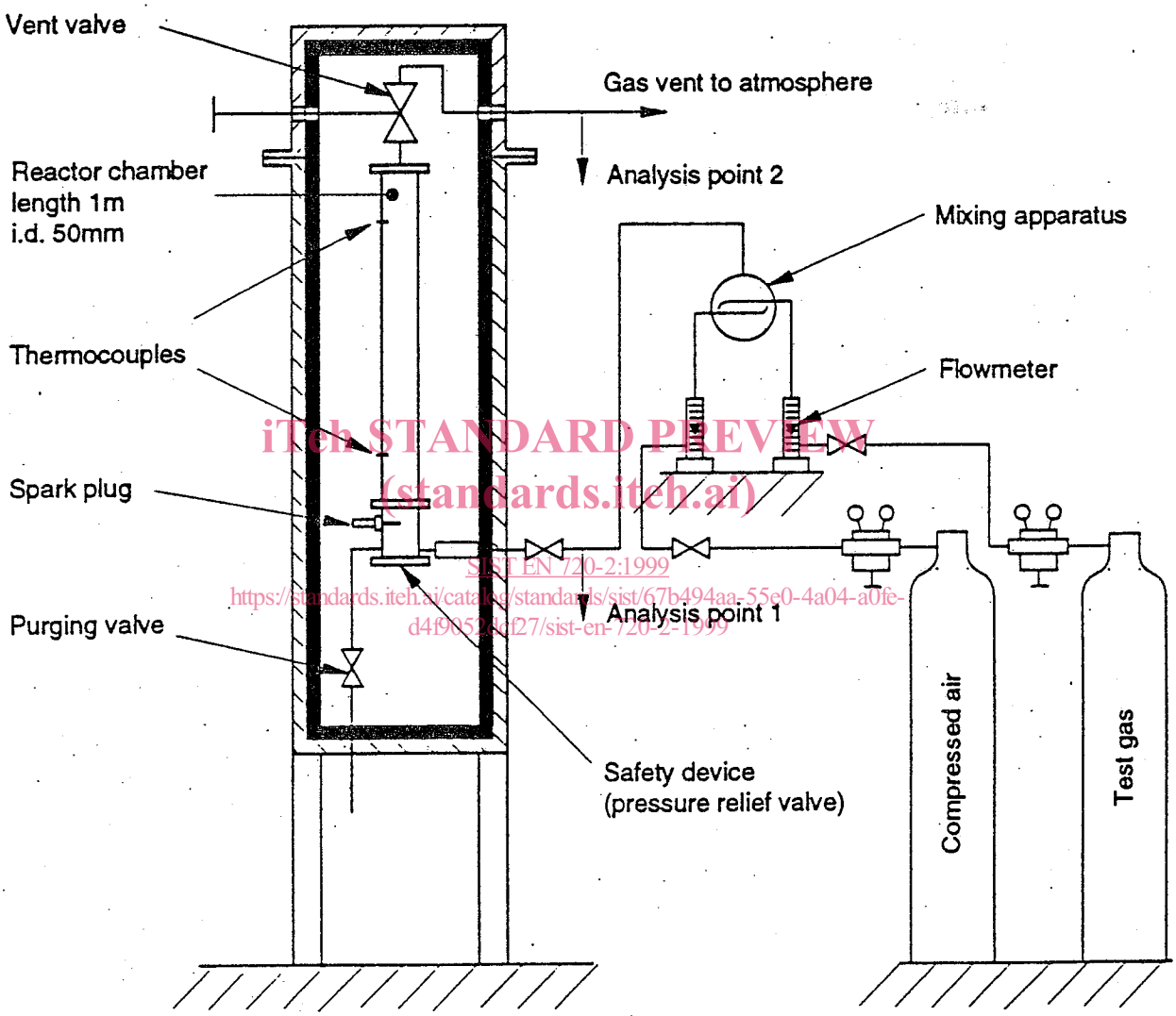

Figure 1: Example of equipment for the determination of flammability limits of gases, at atmospheric pressure and ambient temperature

4.3.1 *Reaction chamber* (see figure 1)

The reaction chamber shall be made of suitable material, of adequate thickness (e.g. borosilicate glass, 5 mm thick), having an inside diameter of at least 50 mm and a length of at least 5 times the diameter.

The reaction chamber shall incorporate the following:

- an ignition spark plug located approximately 50 mm from the base of the chamber;

- an inlet for the gas mixture being tested;

- a purging valve, at the bottom;

- two thermocouples, one close to the spark plug and the other close to the top of the chamber. The purpose of these thermocouples is to detect flame propagation;

- a safety device, (preferably located close to the spark plug), to minimize the risk of destruction of the chamber, in the event of an explosion;

- a vent valve, at the top, to atmosphere.

The reaction chamber is positioned inside a ventilated protective enclosure, one side of which has a window made of high strength transparent material. In a dark room, this window will enable detection of an ignition by an experienced observer. This visual detection is not possible with the almost colourless flames of hydrogen mixtures, for which thermocouples should be used.

4.3.2 *Flow measurement*

Volume flowmeters, mass flowmeters and other appropriate devices, such as proportioning pumps, may be used.

4.4 Preparation

4.4.1 *Test Gas*

The gas or gas mixture, to be tested, shall be prepared to represent the most flammable composition that can occur in the normal course of manufacture. The test gas shall reflect the manufacturing tolerances and shall contain the upper limit of flammable gases encountered in manufacture. The moisture content shall be equal to, or lower than 10 p.p.m. v/v. The test gas shall be thoroughly mixed and carefully analyzed to determine it's exact composition.

4.4.2 *Compressed air*

The compressed air shall be analyzed and be shown to have a moisture level, equal to, or lower than 10×10^{-6} (p.p.m. v/v).

4.4.3 *Test gas/air mixture*

The compressed air and the gas to be tested shall be mixed, at controlled flowrates, using a dynamic mixer. The gas mixture shall be analyzed, using either, a chromatograph or, a simple oxygen analyzer.

4.4.4 *Flammable/oxidizing/inert gas mixtures*

Mixtures containing flammable and oxidizing gases at flammable concentrations shall only be manufactured under controlled conditions, normally at low pressure. Flammability limits can vary significantly with change of pressure and temperature. This standard does not cover the preparation of such mixtures, in such cases careful analysis, using other data, is necessary.

4.5 Procedure

The reaction chamber and its accessories shall be cleaned prior to any test to avoid the effect of any impurity, particularly moisture, resulting from any previous combustion, or exposure to the atmosphere.

Care shall be taken when carrying out flammability tests to ensure that the explosive range is avoided. This can be achieved by commencing the experimental work at "safe" concentrations of flammable gas in air ("Safe" = lower than the expected lower flammable limit). Subsequently the initial gas concentration may be slowly increased until ignition occurs.