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Second edition
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Coating powders —

Part 4: Calculation of lower explosion limit

Poudres pour revêtement —

Partie 4: Calcul de la limite inférieure d'explosivité

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and vanishes*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 139, *Paints and varnishes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 8130-4:1992) and ISO 8130-4 Technical Corrigendum 1:1993, which have been technically revised.

The main changes are as follows:

— the scope has been modified to differentiate between calculation and an estimation of the lower explosion limit;

— the definition on lower explosion limit (3.1) has been clarified for coating powders and the short term LEL has been introduced;

— the SI unit for the lower explosion limit has been corrected;

— the test report (Clause 8) shall note whether the lower explosion limit was calculated or estimated;

— the bibliography contains two new references;

— the text has been editorially revised and the normative references have been updated;

— some text has been moved from the scope to the introduction.

A list of all parts in the ISO 8130 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Reliable methods for the measurement of the lower explosion limit or the gross calorific value require the use of special apparatus which may not be readily available.

A method for determining the explosion indices of combustible dusts in air is given in ISO 6184-1. This method is, however, very intricate and requires considerable expertise.

The lower explosion limit can also be estimated by summation of the gross calorific value of the individual constituents of the coating powder. It is an estimation since it is not possible to know or obtain the gross calorific value of the constituent.

The calculation method leads to lower explosion limits which have been proved in practice to be satisfactory when applied to coating application plants.

NOTE A comparison with a direct method e.g. EN 14034-3[2] for determining the lower explosion limit is encouraged.

Coating powders —

Part 4: Calculation of lower explosion limit

1 Scope

This document specifies a method for the calculation of the lower explosion limit of a coating powder, i.e. the minimum concentration of the coating powder in air which will form an explosive mixture. It is based on the measurement of the gross calorific value of the product, as determined by the method described in ISO 1928.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 1928, *Coal and coke — Determination of gross calorific value*

ISO 8130-14, *Coating powders — Part 14: Vocabulary*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8130-14 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
lower explosion limit
LEL
minimum concentration of coating powder as a mixture of powder and air, below which an explosion is not possible

Note 1 to entry: The lower explosion limit is expressed as grams per cubic metre ($g \cdot m^{-3}$).

4 Principle

The lower explosion limit of a coating powder is calculated by measuring the gross calorific value via the heat of combustion of 1 g of product, using Formula (1).

An estimation of the lower explosion limit can be made, starting with Formula (2), by multiplying the gross calorific value of each combustible constituent by the mass present in 1 g of product.

5 Sampling

Take a representative sample of the product to be tested as specified in ISO 15528, for use as specified in ISO 1928.

6 Determination of gross calorific value

Either measure the gross calorific value H_0 of the product under test by the method described in ISO 1928, or calculate it by summation of the gross calorific values of the combustible constituents of the product as specified in Clause 7.

NOTE 1 With powders that are not flammable, such as those of the poly(vinyl chloride) type, the calculation method can nevertheless give a value for the lower explosion limit in air. Thus, any underestimation of an explosion risk is effectively avoided.

NOTE 2 The calculation used in this document is based on the following assumptions:

a) that material exists in the form of a powder dispersion;

b) that there is complete combustion of the material to the highest oxidation level;

c) that there is an adiabatic type of reaction;

d) that the flame temperature for the composition with which the minimum concentration for explosion in air is attained is 1 000 °C.

7 Calculation of the lower explosion limit

Calculate the lower explosion limit, LEL, in grams per cubic metre ($g \cdot m^{-3}$), using Formula (1):

$$A + \frac{B}{H_0} \tag{1}$$

where

A is a constant equal to –2,5 g/m^3;

B is a constant equal to $1{,}24 \times 10^6$ J/m^3;

H_0 is the gross calorific value of the coating powder, in joules per gram, as per Clause 6.

To estimate the gross calorific value H_0 of the product under test from those of its combustible constituents, multiply the gross calorific value of each combustible constituent by the mass present in 1 g of the product and then summate.

The gross calorific value H_0 is then given by Formula (2):

$$H_0 = \sum_{i=1}^{i=n} c_i \; H_i \tag{2}$$

where

n is the number of combustible constituents;

c_i $c_i$is the mass fraction of the ith constituent;

H_i is the gross calorific value of the ith constituent.

Report the result to the nearest whole number.

8 Test report

The test report shall contain at least the following information:

a) all details necessary to identify the product tested;

b) a reference to this document, i.e. ISO 8130-4:2021;

c) the results of the test as indicated in Clause 7;

d) a note whether the result is based on a calculation or an estimation via the gross calorific value of the product or individual constituents, respectively;

e) any deviation from the test method specified;

f) any unusual features (anomalies) observed during the test.

g) the date of the test.

Bibliography

[1] ISO 6184-1, *Explosion protection systems — Part 1: Determination of explosion indices of combustible dusts in air*

[2] EN 14034-3+A1, *Determination of explosion characteristics of dust clouds — Part 3: Determination of the lower explosion limit LEL of dust clouds*

[3] SCHÖNEWALD I. *Staub-Reinhaltung der Luft*, Vol. 31 (1971), No. 9, pp. 376–378.

[4] MEYER, B. Farbe + Lack, **84** (1978), pp. 75–76.