SLOVENSKI STANDARD
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Dolo ļ evanje smrtne toksi ļ nosti dima

Determination of the lethal toxic potency of fire effluents

Détermination du pouvoir toxique létal des effluents du feu

Ta slovenski standard je istoveten z: **ISO 13344:1996**

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INTERNATIONAL STANDARD

ISO 13344

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Reference number
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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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 13344 was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 3, *Toxic hazards in fire*.

Annexes A and B of this International Standard are for information only.

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Introduction

The pyrolysis or combustion of every combustible material produces a fire effluent atmosphere which, in sufficiently high concentration, is toxic. It is, therefore, desirable to establish a standard test method for the determination of the toxic potency of such fire effluents.

It is further desirable, in view of worldwide resistance to the exposure of animals in standard tests, that this method should not make mandatory the use of such animals in its procedures. The mandatory portion of this standard test does not, therefore, specify the use of animal exposures. It only refers to animal exposure data already reported in the literature, with calculations being employed to express test results as they would have been obtained had animals actually been employed.

For those cases in which confirmation of test results using animal exposures can be justifiably permitted, an optional procedure to do so is presented in annex A.

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Determination of the lethal toxic potency of fire effluents

1 Scope

1.1 This International Standard provides a means for estimating the lethal toxic potency of the fire effluents produced from a material while exposed to the specific combustion conditions of a laboratory fire model. The lethal toxic potency values are specifically related to the fire model selected, the exposure scenario and the material evaluated.

1.2 Lethal toxic potency values associated with 30-min exposures of rats are predicted using calculations which employ combustion atmosphere analytical data for carbon monoxide (CO), carbon dioxide (CO_2), oxygen (O_2) (vitiation) and, if present, hydrogen cyanide (HCN), hydrogen chloride (HCl), hydrogen bromide (HBr) and other toxicants which have been demonstrated to be appropriate. If the fire effluent toxic potency cannot be attributed to the toxicants analyzed, this is an indication that other toxicants or factors must be considered.

1.3 This International Standard is intended to be used to measure and describe the toxic potency of fire effluent atmospheres produced from materials, products or assemblies under controlled laboratory conditions and should not be used to describe or appraise the toxic hazard or risk of materials, products or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire hazard assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.

1.4 This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/TR 9122-3:1993, *Toxicity testing of fire effluents — Part 3: Methods for the analysis of gases and vapours in fire effluents.*

ISO/TR 9122-4:1993, *Toxicity testing of fire effluents — Part 4: The fire model (furnaces and combustion apparatus used in small-scale testing).*

ISO/TR 9122-5:1993, *Toxicity testing of fire effluents — Part 5: Prediction of toxic effects of fire effluents.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 carboxyhaemoglobin saturation: Percentage of blood haemoglobin converted to carboxyhaemoglobin from the reversible reaction with inhaled carbon monoxide.

3.2 concentration–time curve: Plot of the concentration of a gaseous toxicant as a function of time.

3.3 $C \cdot t$ product: Concentration–time product, expressed in parts per million minute (ppm·min) obtained by integration of the area under a concentration–time curve.

3.4 exposure dose: $C \cdot t$ product of a gaseous toxicant available for inhalation.

3.5 fire model: Laboratory combustion device and the conditions under which it is operated.

3.6 fractional effective dose (FED): Ratio of the $C \cdot t$ product for a gaseous toxicant produced in a given test to that $C \cdot t$ product of the toxicant which has been statistically determined from independent experimental data to produce an effect (lethality) in 50 % of test animals within a specified exposure and post-exposure time. Since time values in this ratio mathematically cancel, the FED is also simply the ratio of the average concentration of a gaseous toxicant to its LC_{50} value for the same exposure time. When not used with reference to a specific toxicant, the term FED represents the summation of FEDs for individual toxicants in a combustion atmosphere.

3.7 LC_{50}; lethal concentration 50 %: Concentration of gas or smoke statistically calculated from concentration–response data to produce lethality in 50 % of test animals within a specified exposure and post-exposure time.

NOTE — This is a measure of lethal toxic potency.

3.8 predicted LC_{50}: LC_{50} calculated from combustion atmosphere analytical data according to the method of this International Standard.

3.9 mass charge concentration: Amount of a test specimen placed in a combustion chamber per unit exposure volume or total air flow, expressed in grams per cubic metre.

3.10 mass loss concentration: Amount of a test specimen consumed during combustion per unit exposure volume or total air flow, expressed in grams per cubic metre.

3.11 toxic hazard: Potential for physiological harm from toxic products of combustion.

4 Principle

4.1 This method subjects a test specimen to the combustion conditions of a specific laboratory fire model. Concentrations of the major gaseous toxicants in the fire effluent atmosphere are monitored over a 30-min period, with $C \cdot t$ products for each being determined from integration of the areas under the respective concentration–time plots. The $C \cdot t$ product data, along with either the mass charge or the mass loss of the test specimen during the test, are then used in calculations to predict the 30-min LC_{50} of the test specimen. If considered necessary, the predicted LC_{50} may then be experimentally confirmed as precisely as toxicologically relevant (annex A). Confirmation assures that the monitored toxicants account for the observed toxic effects.

4.2 The strategy employed in this method for quantification of fire effluent toxic potency represents utilization of the latest in state-of-the-art understanding of the prediction of the toxic effects of fire effluents as reported in ISO/TR 9122-5. It employs methodology for the calculation of toxic potencies from combustion product analytical

data without the exposure of experimental animals. Such methodology is based on extensive experimentation using exposure of rats to the common fire gases, both singly and in combinations. Expressed mathematically, the principle is shown in equation (1):

$$\text{FED} = \sum_{i=1}^{n} \int_{t_0}^{t} \frac{C_i}{(C \cdot t)_i} \, \mathrm{d}t \qquad \ldots (1)$$

where

C_i is the concentration of the toxic component, i, expressed in parts per million (ppm);

$(C \cdot t)_i$ is the concentration–time product, expressed in parts per million minute (ppm·min) of the specific exposure dose required to produce the toxicological effect.

When, as in this test method, the time values of 30 min numerically cancel, the FED becomes simply the ratio of the average concentration of a gaseous toxicant to its LC_{50} value for the same exposure time. When the FED is equal to 1, the mixture of gaseous toxicants should be lethal to 50 % of exposed animals.

5 Significance and use

5.1 This test method has been designed to provide data for use in the assessment of toxic fire hazard as a means for the evaluation of materials and products and to assist research and development. The data are not, in themselves, an indication of toxic hazard, or relative toxic hazard, nor are they to be used in the absence of toxic hazard assessment in the regulation of products of commerce.

5.2 The method is used to predict the LC_{50} of fire effluents produced upon exposure of a material or product to fire. Experimental confirmation may be needed to determine whether the major gaseous toxicants can account for the observed toxic effects, as well as for the lethal toxic potency (see annex A).

5.3 Predicted LC_{50} values determined in this test method are associated only with the fire model used.

5.4 This test method does not attempt to address the toxicological significance of changes in particulate/aerosol size, fire effluent transport, distribution or deposition, or changes in the concentration of any fire effluent constituent as a function of time as may occur in a real fire.

5.5 The propensity for fire effluents from any material to have the same effects on humans in fire situations can only be inferred to the extent that the rat is correlated with the human as a biological system.

5.6 This test method does not assess incapacitation. Incapacitation may be inferred from lethal toxic potency values.

5.7 This test method does not quantitatively address sensory and upper respiratory tract irritation.

6 Apparatus requirements

6.1 The fire model

6.1.1 The fire model, or laboratory combustion device, and the conditions under which it is operated, shall be chosen so as to have demonstrated relevance to one or more of the specific classes or stages of fires identified in ISO/TR 9122-4.