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FTIR analysis of fire effluents in cone calorimeter tests

Analyse par FTIR des effluents du feu dans les essais au calorimètre à cône

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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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

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.

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Introduction

The composition of the effluent from an enclosure fire is determined by the combustible items in the enclosure, such as interior furnishings and wall linings, and the fire conditions within the enclosure. To represent any product involved in any fire scenario, the ideal fire test specimen is the complete item, and the ideal test is one conducted in an enclosure of appropriate size. Unfortunately, real-scale testing of commercial products is not generally economically feasible. This document describes an indicative approach for obtaining gas yields under specific fire conditions. It involves the use of a small-scale combustor in which a small test specimen is exposed to a pre-defined radiative heat flux. The test specimen should be representative of the finished product

This document provides a method for continuous quantification of gases (i.e. time-resolved gas analysis) emitted from a test specimen exposed to irradiance in a cone calorimeter, after extraction of effluent gas to a FTIR gas analyser. It produces data as the gas volume fraction (µL/L) or gas yield (mg/kg) during the test period. Data generated allow a better understanding of gas emissions during cone calorimeter tests, which can be useful for Fire Safety Engineering and for material development. Some examples of FTIR analysers used with cone calorimeters are presented in Table A.1.

The cone calorimeter uses a well-ventilated physical fire model, so results are only relevant for this scenario. Toxicity assessment for materials or products are not covered in this document and interpretation of data is covered separately in ISO 13571 or ISO 13344.

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1 Scope

This document specifies a method for determining the kinetics and yields of gaseous emissions from a specimen exposed to radiant heat in a cone calorimeter. Gas yields are determined by exposing small representative specimens to an external heat flux with or without spark ignition. The concentrations of specific gases in the effluent (smoke) are measured. In combination with calculated masses of gases, their yields from the specimen mass, mass loss or mass loss rate can be determined. This document uses Fourier-Transform Infrared (FTIR) spectroscopy as described in ISO 19702, with additional information on the test apparatus and gas analyser suitable for this specific application.

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 13943, *Fire safety — Vocabulary*

ISO 5660-1:2015, *Reaction-to-fire tests — Heat release, smoke production and mass loss rate — Part 1: Heat release rate (cone calorimeter method) and smoke production rate (dynamic measurement)*

ISO 19702, *Guidance for sampling and analysis of toxic gases and vapours in fire effluents using Fourier Transform Infrared (FTIR) spectroscopy*

ISO 12828-1, *Validation method for fire gas analysis — Part 1: Limits of detection and quantification*

ISO 12828-2, *Validation method for fire gas analysis — Part 2: Intralaboratory validation of quantification methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943, ISO 5660-1, ISO 19702, ISO 12828-1 and ISO 12828-2 apply.

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

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

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

4 Symbols

Symbol	Designations	Unit
Δm	total mass loss of the test specimen	g
$\dot{m}_g$	mass flow rate of sampled gas species of interest	g s^{-1}
m_g	total mass produced of sampled gas species of interest	g
m_{te}	mass at test end	g
M_g	molecular weight of gas of interest	g mol^{-1}
t	is the time from ignition(t_i) to extinction(t_e)	s

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