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Fire safety engineering — Selection of design occupant behavioural scenarios

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National foreword

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Fire safety engineering — Selection of design occupant behavioural scenarios

Ingénierie de la sécurité incendie — Sélection de scénarios de dimensionnement du comportement des occupants

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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.

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 on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 92, *Fire safety*, Subcommittee SC 4, *Fire safety engineering*.

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Introduction

In a fire safety engineering assessment, the ability of occupants to escape safely or find a designated place of refuge is evaluated for each design fire scenario, taking account of the occupants expected to be present in the building or other structure.

The purpose of this Technical Specification is to outline a general methodology for selecting design fire scenarios for the specific fire safety objective of life safety of the occupants, and then developing the occupant behavioural scenarios for which those design fire scenarios will be tested. ISO 16733-1 provides general guidance on the selection of design fire scenarios.

Since each design fire scenario might require several different occupant behavioural scenarios, the number of possible design occupant behavioural scenarios in any built environment (a building, structure or transportation vehicle) can be very large, and it is not possible to quantify them all. This large set of possibilities needs to be reduced to a manageably small set of occupant behavioural scenarios that are amenable to analysis. In a deterministic assessment, which is implicitly envisioned in this Technical Specification, a manageable number of design occupant behavioural scenarios is selected. For a full quantitative risk assessment, see ISO 16732-1.

The characterization of an occupant behavioural scenario involves a description of the initial occupant distribution and the number and other characteristics of the population, including their reaction and response capabilities. The occupant behavioural scenarios will be specifically determined for each design fire scenario, which itself includes the interaction with the proposed fire protection features for the built environment. The possible consequences of each fire scenario for each occupant behavioural scenario need to be considered.

Following selection of the design occupant behavioural scenarios, it is necessary to describe the assumed characteristics of the occupant behaviour on which the scenario quantification will be based. These assumed occupant behaviour characteristics are referred to as “the design occupant behaviour”. Design occupant behaviours are usually characterised in terms of pre-travel activity delay times (response and reaction times) and occupant movement speeds. The design occupant behaviour needs to be appropriate to the life safety objective of the fire safety engineering analysis and has to result in a design solution that is conservative.

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Fire safety engineering — Selection of design occupant behavioural scenarios

1 Scope

This Technical Specification describes a methodology for the selection of design occupant behavioural scenarios that are severe but credible for use in deterministic fire safety engineering analyses of any built environment including buildings, structures, or transportation vehicles.

Occupant behavioural scenarios are linked to design fire scenarios. Guidance on the selection of design fire scenarios and design fires is covered in ISO 16733-1. The steps in ISO 16733-1 are followed in this Technical Specification with life safety of the occupants as the single fire safety objective under consideration.

ISO/TR 16738 provides information on methods for the quantification of the different aspects of human evacuation behaviour in a design context. One part of that process involves the selection of occupant behavioural scenarios. This Technical Specification provides guidance for that aspect of the evaluation of an egress design.

This Technical Specification addresses behaviours that occur after fire ignition and does not deal with behaviours that influence fire ignition.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 13571:2012, *Life-threatening components of fire — Guidelines for the estimation of time to compromised tenability in fires*

ISO 13943, *Fire safety — Vocabulary*

ISO 16733-1:2015, *Fire safety engineering — Selection of design fire scenarios and design fires — Part 1: Selection of design fire scenarios*

ISO/TR 16738, *Fire-safety engineering — Technical information on methods for evaluating behaviour and movement of people.*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13943, ISO/TR 16738 and the following apply.

NOTE Some of the definitions have been updated to reflect the current understanding of the terms as employed in fire safety engineering. Some are duplicated here for the convenience of users of this document.

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3.1
ASET
available safe escape time
for an individual occupant, the calculated time interval between the time of ignition and the time at which conditions become such that the occupant is estimated to be incapacitated, i.e. unable to take effective action to escape to a safe refuge or place of safety

Note 1 to entry: The time of ignition may be known, e.g. in the case of a fire model or a fire test, or it may be assumed, e.g. it may be based upon an estimate working back from the time of detection. The basis on which the time of ignition is determined needs to be stated.

Note 2 to entry: This definition equates incapacitation with failure to escape. Other criteria for ASET are possible. If an alternate criterion is selected, it needs to be stated.

Note 3 to entry: Each occupant can have a different value of ASET, depending on that occupant's personal characteristics.

[SOURCE: ISO 13943:2008, 4.20, modified]

3.2
built environment
building or other structure

EXAMPLE Off-shore platforms; civil engineering works, such as tunnels, bridges, and mines; and means of transportation, such as motor vehicles and marine vessels.

Note 1 to entry: ISO 6707-1 contains a number of terms and definitions for concepts related to the built environment.

[SOURCE: ISO 13943:2008, 4.26]

3.3
design fire
quantitative description of assumed fire characteristics within the *design fire scenario* (3.4)

Note 1 to entry: It is, typically, an idealized description of the variation with time of important fire variables, such as heat release rate, flame spread rate, smoke production rate, toxic gas yields, and temperature.

[SOURCE: ISO 13943:2008, 4.64]

3.4
design fire scenario
specific *fire scenario* (3.7) on which a deterministic fire safety engineering analysis is conducted

Note 1 to entry: As the number of possible fire scenarios can be very large, it is necessary to select the most important scenarios (the design fire scenarios) for analysis. The selection of design fire scenarios is tailored to the fire-safety design objectives and accounts for the likelihood and consequences of potential scenarios.

[SOURCE: ISO 13943:2008, 4.65]

3.5
design occupant behaviour
quantitative description of occupant behavioural characteristics within the *design occupant behavioural scenario* (3.6)

Note 1 to entry: It is, typically, an idealized description of the time needed for evacuation or refuge, comprising components for recognition, response, and travel. The actual variables include delay time, travel distance, and travel speed.

EXAMPLE Young, intoxicated people in a stadium might delay longer before beginning to evacuate than those who are not intoxicated; older people in a nursing home may travel more slowly than other mobile adults would; intoxicated people may have more difficulty with decision-making and, as a result, might take more time to make exit choices.

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3.6
design occupant behavioural scenario
specific occupant behavioural scenario on which a deterministic fire safety engineering analysis will be conducted

3.7
fire scenario
qualitative description of the course of a fire with respect to time, identifying key events that characterise the studied fire and differentiate it from other possible fires

Note 1 to entry: It typically defines the ignition and fire growth processes, the fully developed fire stage, the fire decay stage, and the environment and systems that impact on the course of the fire.

[SOURCE: ISO 13943:2008, 4.129]

3.8
occupant behavioural scenario
qualitative description of occupant behaviour and response over time, including the number of occupants and the physical and cognitive characteristics that affect their decision-making and actions in response to fire cues, identifying key characteristics that differentiate members from other occupants

Note 1 to entry: It typically describes the number and other characteristics and capabilities of group members that would impact the decision-making and behavioural processes (i.e. elderly occupants might be less likely to hear an alarm and may move more slowly than younger occupants; staff may recognize and react to an alarm more quickly and engage in rescue activities before evacuating themselves).

3.9
pre-travel activity time
PTAT
for an individual occupant, the interval between the time at which a warning of a fire is given and the time at which the first move is made by that occupant towards an exit

Note 1 to entry: This consists of two components: *recognition time* (3.10) and *response time* (3.11).

Note 2 to entry: For groups of occupants, the following two phases can be recognized:

— pre-travel activity time of the first occupants to move;

— pre-travel activity time distribution between the first and last occupants to move.

[SOURCE: ISO/TR 16738:2009, 3.9]

3.10
recognition time
interval between the time at which a warning of a fire is given and the first response to the warning

[SOURCE: ISO/TR 16738:2009, 3.10]

Note 1 to entry: This concept is thoroughly discussed in ISO/TR 16738:2009, Annex B.

3.11
response time
interval between the time at which the first response to the event occurs and the time at which travel begins to a *safe location* (3.13)

[SOURCE: ISO/TR 16738:2009, 3.11]

Note 1 to entry: This concept is thoroughly discussed ISO/TR 16738:2009, Annex B.

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