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Fire safety engineering — Procedures and requirements for verification and validation of calculation methods —

Part 1: General

Ingénierie de la sécurité incendie — Procédures et exigences pour la vérification et la validation des méthodes de calcul —

Partie 1: Généralités

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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*.

This document cancels and replaces ISO 16730:2008, which has been technically revised. The original title *Fire safety engineering — Assessment, verification and validation of calculation methods* has been replaced by *Fire safety engineering — Procedures and requirements for verification and validation of calculation methods — Part 1: General*.

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Introduction

The objective of fire safety engineering is to assist in the achievement of an acceptable predicted level of fire safety. Part of this work involves the use of calculation methods to

— predict the course of events potentially occurring in case of a fire or as a consequence of a fire, and

— evaluate the ability of fire protection measures to mitigate the adverse effects of a fire on people, property, the environment and other objectives.

The main principles necessary for establishing credibility of these calculation methods are verification and validation. This International Standard addresses the procedures for verification and validation of calculation methods for fire safety engineering in general.

Potential users of calculation methods and those who are asked to accept the results need to be assured that the calculation methods provide sufficiently accurate predictions of the course and consequences of the fire for the specific application planned. To provide this assurance, the calculation methods chosen need to be verified for mathematical accuracy and validated for capability to reproduce the phenomena. A rigorous verification and validation process is a key element of quality assurance.

There is no fixed requirement of accuracy that is applicable to all calculation methods. The accuracy level depends on the purposes for which a calculation method is to be used. Not all calculation methods need to demonstrate high accuracy as long as the error, uncertainty and limits of applicability of the calculation methods are known.

This International Standard focuses on the predictive accuracy of calculation methods. However, other factors such as ease of use, relevance, completeness and status of development play an important role in assessing the most appropriate method to use for a particular application. The assessment of the suitability of a calculation method for a special purpose within the field of fire safety engineering is supported by the use of quality assurance methodology for the proof of the requirements being fulfilled. Guidance for establishing metrics for measuring the attributes of the relevant quality characteristics is outlined in brief in this International Standard.

This International Standard contains elements that are intended, in part or in whole, to be used by

a) developers of calculation methods (individuals or organizations who perform development activities, including requirement analysis, design and testing of components) – to document the usefulness of a particular calculation method, perhaps for specific applications. Part of the calculation method development includes identification of precision and limits of applicability, and independent testing,

b) developers of calculation methods (individuals or organizations who maintain computer models, supply computer models and for those who evaluate computer model quality as part of quality assurance and quality control) – to document the software development process to assure users that appropriate development techniques are followed to ensure quality of the application tools,

c) users of calculation methods (individuals or organizations who use calculation methods to perform an analysis) - to assure themselves that they are using an appropriate method for a particular application and that it provides adequate accuracy,

d) developers of performance codes and standards - to determine whether a calculation method is appropriate for a given application,

e) approving bodies/officials (individuals or organizations who review or approve the use of assessment methods and tools) - to ensure that the calculation methods submitted show clearly that the calculation method is used within its applicability limits and has an acceptable level of accuracy, and

f) educators - to demonstrate the application and acceptability of calculation methods being taught.

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Users of this International Standard should be appropriately qualified and competent in the fields of fire safety engineering and risk assessment. It is important that users understand the parameters within which specific methodologies may be used.

General principles are described in ISO 23932, which provides a performance-based methodology for engineers to assess the level of fire safety for new or existing built environments. Fire safety is evaluated through an engineered approach based on the quantification of the behaviour of fire and based on knowledge of the consequences of such behaviour on life safety, property and the environment. ISO 23932 provides the process (necessary steps) and essential elements to design a robust performance-based fire safety programme.

ISO 23932 is supported by a set of fire safety engineering International Standards available on the methods and data needed for the steps in a fire safety engineering design summarized in ISO 23932:2009, Clause 4 and shown in Figure 1 (taken from ISO 23932:2009, Clause 4). This set of International Standards is referred to as the *Global fire safety engineering analysis and information system*. This global approach and system of standards provides an awareness of the interrelationships between fire evaluations when using the set of fire safety engineering International Standards. The set includes ISO 16733-1[1)], ISO 16732-1, ISO 16734, ISO 16735, ISO 16736, ISO 16737, ISO/TS 24679, ISO 16730-1, ISO 29761[2)], ISO/TS 13447, and other supporting technical reports that provide examples of and guidance on the application of these standards.

Each International Standard supporting the global fire safety engineering analysis and information system includes language in the introduction to tie the standard to the steps in the fire safety engineering design process outlined in ISO 23932. ISO 23932 requires that calculation methods used in scenario-based evaluations of trial designs (ISO 23932:2009, Clause 11) be verified and validated. Pursuant to the requirements of ISO 23932, this International Standard provides the procedures and requirements for the verification and validation of fire calculation methods. This step in the fire safety engineering process is shown as a highlighted box in Figure 1 below and described in ISO 23932.

1) To be published.

2) To be published.

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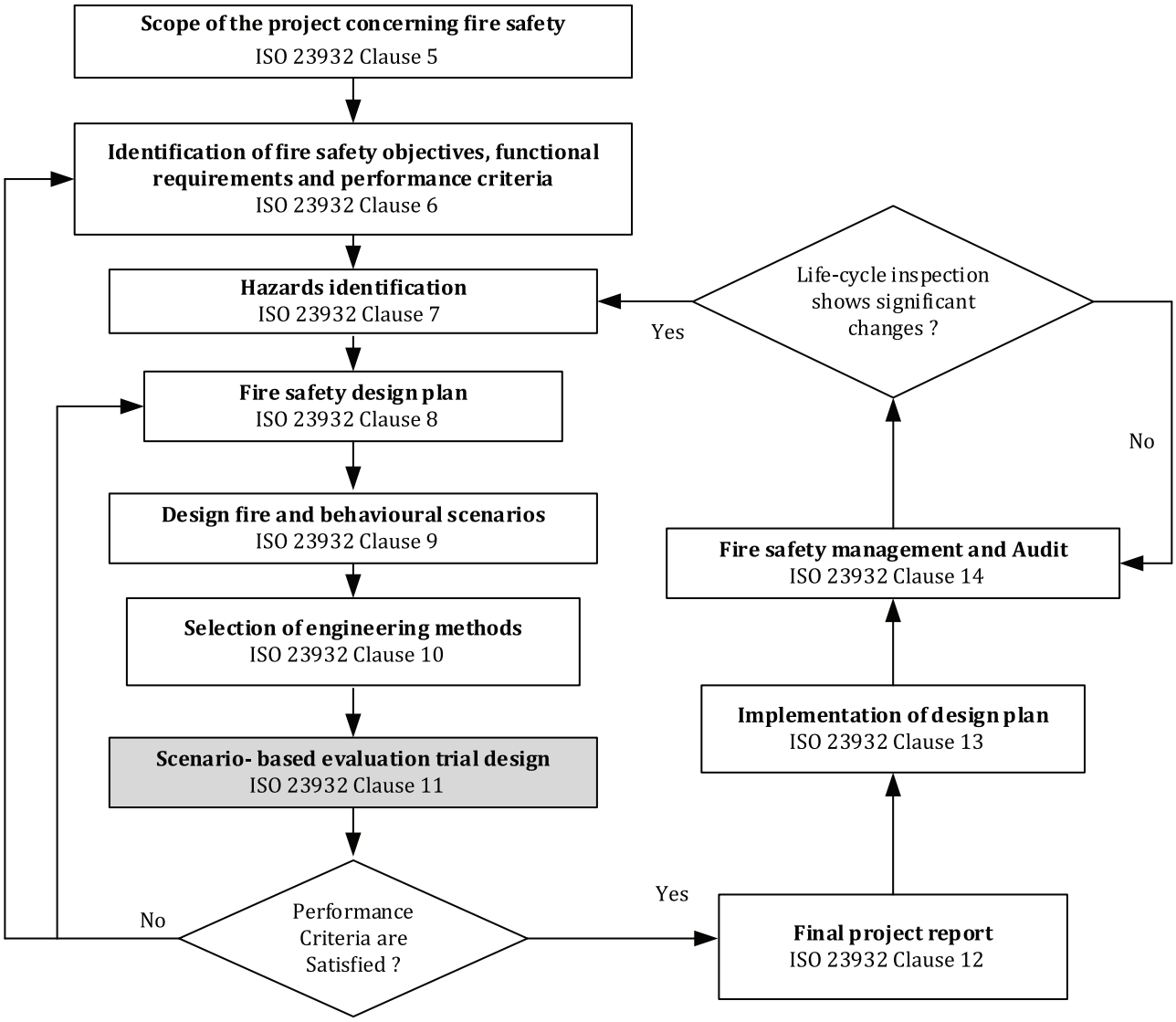


Figure 1 — Flow chart illustrating the fire safety engineering design process (from ISO 23932:2009)

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Fire safety engineering — Procedures and requirements for verification and validation of calculation methods —

Part 1: General

1 Scope

This International Standard establishes a framework for the verification and validation of all types of calculation methods used as tools for fire safety engineering by specifying specific procedures and requirements for the purpose. It does not address specific fire models, but it is applicable to analytical models, algebraic correlations and complex numerical models, which are addressed as calculation methods in the context of this International Standard.

This International Standard includes

— a process to determine that the relevant equations and calculation methods are implemented correctly (verification) and that the calculation method being considered is an accurate representation of the real world (validation),

— requirements for documentation to demonstrate the adequacy of the scientific and technical basis of a calculation method,

— requirements for data against which a calculation method's predicted results are checked, and

— guidance on use of this International Standard by developers and/or users of calculation methods, and by those assessing the results obtained by using calculation methods.

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 23932, *Fire safety engineering — General principles*

ISO 13943, *Fire safety — Vocabulary*

ISO/IEC 25000, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Guide to SQuaRE*

ISO/IEC 25010:2011, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — System and software quality models*

ISO/IEC 25040:2011, *Systems and software engineering — Systems and software Quality Requirements and Evaluation (SQuaRE) — Evaluation process*

3 Terms and definitions

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

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3.1
accuracy
degree of exactness actually possessed by an approximation, measurement, etc.

Note 1 to entry: Accuracy includes *error* (3.9) and *uncertainty* (3.23).

3.2
calculation method
mathematical procedure used to predict fire-related phenomena

Note 1 to entry: Calculation methods may address the behaviour of people as well as objects or fire; may be probabilistic as well as deterministic; and may be algebraic formulae as well as complex computer models.

3.3
calibration
⟨of a model⟩ process of adjusting modelling parameters in a computational model for the purpose of improving agreement with experimental data

3.4
computer model
computerized model
operational computer program that implements a conceptual model

3.5
conceptual model
description composed of all the information, mathematical modelling data and mathematical equations that describe the (physical) system or process of interest

3.6
default value
standard setting or state to be taken by the program if no alternate setting or state is initiated by the system or the user

3.7
deterministic model
calculation method that uses science-based mathematical expressions to produce the same result each time the method is exercised with the same set of input data values

3.8
engineering judgement
process exercised by a professional who is qualified by way of education, experience and recognized skills to complement, supplement, accept or reject elements of a quantitative analysis

3.9
error
recognizable deficiency in any phase or activity of calculation that is not due to lack of knowledge

3.10
fire model
representation of a system or process related to fire development, including fire dynamics and fire impacts

3.11
mathematical model
sets of equations that describe the behaviour of a physical system

3.12
measure
variable to which a value is assigned as the result of measurement

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