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Fire safety engineering — Requirements governing algebraic formulae —

Part 1: General requirements

Ingénierie de la sécurité incendie — Exigences régissant les équations algébriques —
Partie 1: Exigences générales

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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.

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This document was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 4, *Fire safety engineering.*

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A list of all parts in the ISO 24678 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.

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Introduction

The ISO 24678 series is intended to be used by fire safety practitioners involved with fire safety engineering calculation methods. Examples include fire safety engineers; authorities having jurisdiction such as: territorial authority officials, fire service personnel, code enforcers and code developers. It is expected that users of this document are appropriately qualified and competent in the field of fire safety engineering. It is particularly important that users understand the parameters within which particular methodologies may be used.

Algebraic formulae conforming to the requirements of this document are used with other engineering calculation methods during fire safety design. Such design is preceded by the establishment of a context, including the fire safety goals and objectives to be met, as well as performance criteria when a trial fire safety design is subject to specified design fire scenarios. Engineering calculation methods are used to determine if these performance criteria are met by a particular design and if not, how the design needs to be modified. The subjects of engineering calculations include the fire-safe design of entirely new built environments, such as buildings, ships or vehicles as well as the assessment of the fire safety of existing built environments.

The algebraic formulae discussed in this document can be useful for estimating the consequences of design fire scenarios. Such formulae are valuable for allowing the practitioner to quickly determine how a proposed fire safety design needs to be modified to meet the performance criteria and to compare among multiple trial designs. Detailed numerical calculations can be delayed until final design documentation. Examples of areas where algebraic formulae have been applicable include determination of heat transfer, both convective and radiant, from fire plumes, prediction of ceiling jet flow behaviours governing detector response, calculation of smoke transport through vent openings and analysis of compartment fire hazards such as smoke filling and flashover. However, the simple models often have stringent limitations and are less likely to include the effects of multiple phenomena occurring in the design scenario.

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ISO 23932-1 is supported by a set of fire safety engineering documents available on the methods and data needed for the steps in a fire safety engineering design summarized in Figure 1 (taken from ISO 23932-1:2018, Clause 4). This set of documents is referred to as the Global Fire Safety Engineering Analysis and Information System. This global approach and system of documents provides an awareness of the interrelationships between fire evaluations when using the set of fire safety engineering documents. The set includes ISO 16730-1, ISO 16732-1, ISO 16733-1, ISO 16734, ISO 16735, ISO 16736, ISO 16737, ISO/TS 13447, ISO 24678, ISO/TS 24679, ISO/TS 29761 and other supporting technical reports that provide examples of and guidance on the application of these documents.

Each document supporting the Global Fire Safety Engineering Analysis and Information System includes language in the introduction to tie said document to the steps in the fire safety engineering design process outlined in ISO 23932-1. ISO 23932-1 requires that engineering methods are selected properly to predict the fire consequences of specific scenarios and scenario elements (ISO 23932-1:2018, Clause 10). Pursuant to the requirements of ISO 23932-1, this document provides the requirement governing algebraic formulae for fire safety engineering. This step in the fire safety engineering process is shown as a highlighted box in Figure 1 and described in ISO 23932-1.

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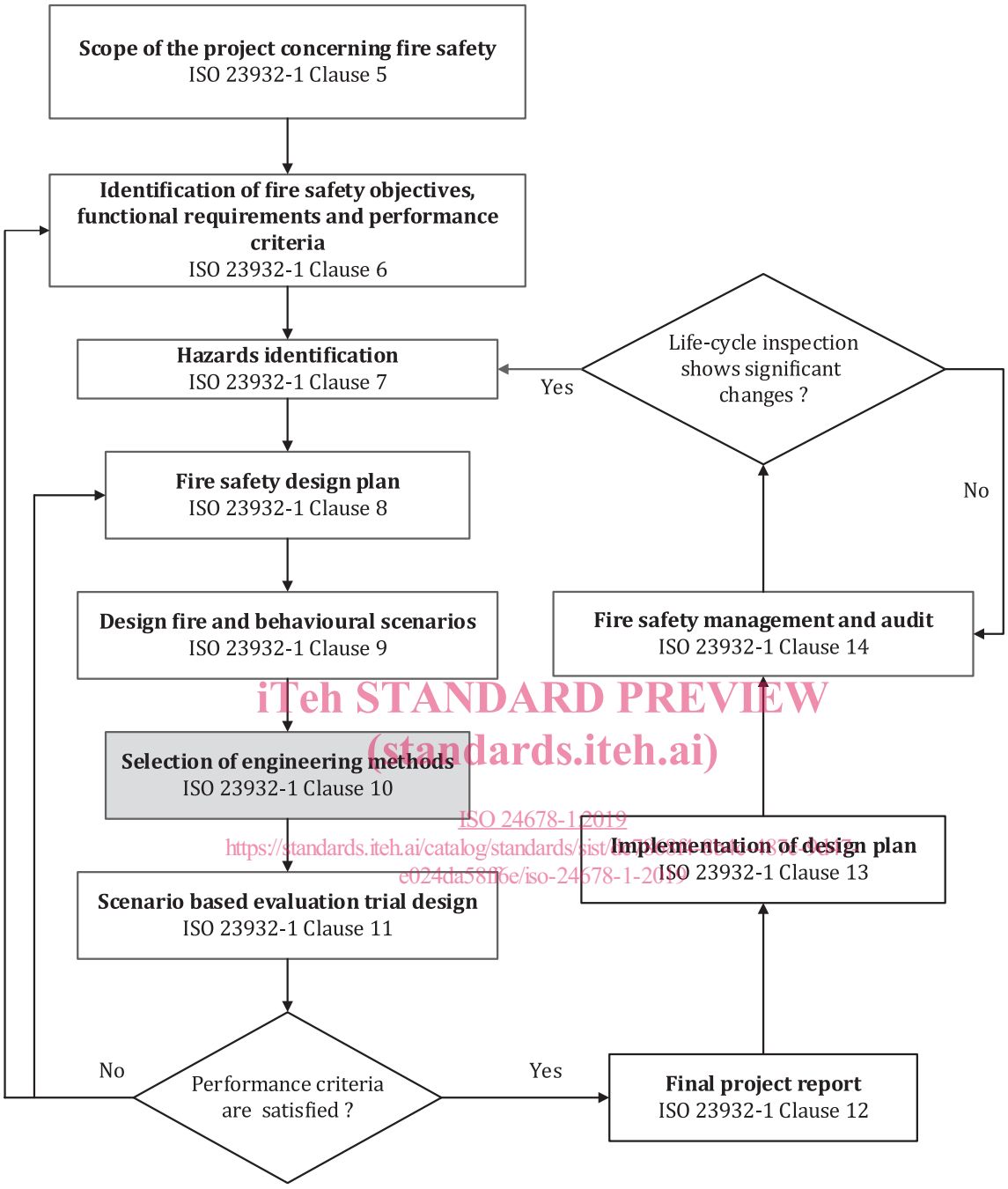

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Figure 1 — Fire-safety engineering process: Design, implementation and maintenance flowchart (from ISO 23932-1:2018)

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Fire safety engineering — Requirements governing algebraic formulae —

Part 1: General requirements

1 Scope

This document provides requirements to govern the application of explicit algebraic formulae sets to the calculation of fire phenomena. This document is an implementation of the general requirements provided in ISO 16730-1 for the case of fire dynamics calculations involving sets of explicit algebraic formulae.

This document is arranged in the form of a template, where specific information relevant to algebraic formulae are provided to satisfy the following types of general requirements:

a) Requirements governing description of physical phenomena;

b) Requirements governing calculation process;

c) Requirements governing limitations;

d) Requirements governing input parameters;

e) Requirements governing domain of applicability.

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2 Normative references

The following documents are referred to in 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 5725-1, *Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions*

ISO 16730-1, *Fire safety engineering — Procedures and requirements for verification and validation of calculation methods — Part 1: General*

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

3 Terms and definitions

No terms and definitions are listed in this document.

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/

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4 Requirements governing description of physical phenomena

4.1 Fire phenomena to be considered in calculation

Fire phenomena to be considered in the calculation shall be clearly identified, including those characteristics inferred by association with calculated quantities. Many relationships require consideration of the environment, and taking individual components out of context may lead to improper or inadequate analysis.

4.2 Scenario elements

Scenario elements as determined by ISO 16733-1, to which specific formulae apply, shall be clearly identified.

4.3 Interactions between phenomena

Fire is a complex thermo-physical-chemical phenomenon that can be highly transient. Interactions between phenomena should be considered. Specific examples are given in separate parts of the ISO 24678 series.

5 Requirements governing calculation process

5.1 Selection of an appropriate method

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If there are multiple methods to calculate a necessary quantity, explanations on the selection of the appropriate method shall be given in the documentation.

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5.2 Procedure

The procedure to be followed in performing calculations shall be described through a set of algebraic formulae.

5.3 Separate clause

Each formula shall be presented in a separate clause containing a phrase that describes the input and output of the formula, as well as explanatory notes and limitations unique to the formula being presented.

5.4 Definition of variables

Each variable in the formula set shall be clearly defined, along with appropriate SI units, although formula versions with dimensionless coefficients are preferred.

5.5 Scientific basis

The scientific basis for the formula set shall be provided through reference to recognized handbooks, the peer-reviewed scientific literature or through derivations, as appropriate.

5.6 Examples

Examples shall demonstrate how the formula set is evaluated using values for all input parameters consistent with the requirements in Clause 7.

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6 Requirements governing limitations

6.1 Quantitative and/or qualitative limits on application

Limits on direct application of the algebraic formula set to calculate output parameters shall be provided in a manner consistent with the scenario elements described in 4.2. At the least, a qualitative statement of limitation shall be given, for example, by an engineering judgement.

6.2 Limits on the use in a numerical method

Limits on the use of the algebraic formulae shall be provided if the formulae are solved by a numerical method.

7 Requirements governing input parameters

7.1 Identification of input parameters

Input parameters for the set of algebraic formulae shall be identified clearly.

7.2 Sources of input parameters

Sources of input parameters shall be identified or provided explicitly within the document. If the fire test data is required, available testing methods shall be identified.

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7.3 Valid range of input parameters

The valid ranges of input parameters shall be listed as specified in ISO 16730-1.

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7.4 Consistency with other part of assessment

Data used by calculation methods or produced by them should be consistent with all other calculations used in the fire hazard / risk assessment process.

8 Requirements governing domain of applicability

Collections of experimental data or any other qualified source shall be identified to establish the domain of applicability of the formula set. These data shall have a defined level of quality, e.g. repeatability and reproducibility as specified in ISO 5725-1, assessed through a documented/standardized procedure.

The domain of applicability of the algebraic formulae shall be determined through comparison with the experimental data or results from qualified sources. Potential sources of errors that limit the use of algebraic formulae to the specific scenarios given in Clause 4 shall be identified.

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