

---

---

**Fire safety engineering — Selection  
of design fire scenarios and design  
fires —**

**Part 1:  
Selection of design fire scenarios**

*Ingénierie de la sécurité incendie — Sélection de scénarios d'incendie  
et de feux de dimensionnement —*

*Partie 1: Sélection de scénarios d'incendie de dimensionnement*

get full document from [standards.iteh.ai](https://standards.iteh.ai)



# Sample Document

get full document from [standards.iteh.ai](https://standards.iteh.ai)



## **COPYRIGHT PROTECTED DOCUMENT**

© ISO 2015, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
[copyright@iso.org](mailto:copyright@iso.org)  
[www.iso.org](http://www.iso.org)

# Contents

Page

|                                                                                          |           |
|------------------------------------------------------------------------------------------|-----------|
| <b>Foreword</b> .....                                                                    | <b>iv</b> |
| <b>Introduction</b> .....                                                                | <b>v</b>  |
| <b>1 Scope</b> .....                                                                     | <b>1</b>  |
| <b>2 Normative references</b> .....                                                      | <b>1</b>  |
| <b>3 Terms and definitions</b> .....                                                     | <b>1</b>  |
| <b>4 Symbols and abbreviated terms</b> .....                                             | <b>2</b>  |
| <b>5 Fire safety engineering applications</b> .....                                      | <b>3</b>  |
| 5.1 Fire safety engineering process.....                                                 | 3         |
| 5.1.1 Establish project scope.....                                                       | 3         |
| 5.1.2 Identify fire safety objectives.....                                               | 4         |
| 5.1.3 Determine functional requirements.....                                             | 4         |
| 5.1.4 Identify performance criteria.....                                                 | 4         |
| 5.1.5 Hazard identification.....                                                         | 4         |
| 5.1.6 Fire safety design plan.....                                                       | 4         |
| 5.2 The role of design fire scenarios in fire safety design.....                         | 4         |
| 5.3 The role of design fires in fire safety design.....                                  | 5         |
| <b>6 Design fire scenarios</b> .....                                                     | <b>6</b>  |
| 6.1 Characteristics of fire scenarios.....                                               | 6         |
| 6.2 Identification of fire scenarios.....                                                | 6         |
| 6.2.1 General.....                                                                       | 6         |
| 6.2.2 Step 1 — Identify the specific safety challenges.....                              | 8         |
| 6.2.3 Step 2 — Location of fire.....                                                     | 9         |
| 6.2.4 Step 3 — Type of fire.....                                                         | 10        |
| 6.2.5 Step 4 — Potential complicating hazards leading to other fire scenarios.....       | 11        |
| 6.2.6 Step 5 — Systems and features impacting on fire.....                               | 11        |
| 6.2.7 Step 6 — Occupant actions impacting on fire.....                                   | 12        |
| 6.3 Step 7 — Selection of design fire scenarios.....                                     | 12        |
| 6.3.1 General.....                                                                       | 12        |
| 6.3.2 Combining scenarios into scenario clusters.....                                    | 12        |
| 6.3.3 Caution on exclusion of scenarios believed to have negligible risk.....            | 12        |
| 6.3.4 Demonstrating that the scenario structure is complete.....                         | 13        |
| 6.3.5 Scenario selection procedure based on level of analysis.....                       | 13        |
| 6.3.6 Selection of design fire scenarios for deterministic analysis.....                 | 13        |
| 6.4 Step 8 — Modify scenario selection based on system availability and reliability..... | 14        |
| 6.5 Step 9 — Final selection and documentation.....                                      | 15        |
| <b>Annex A (informative) Data for development of design fire scenarios</b> .....         | <b>16</b> |
| <b>Annex B (informative) Example of a set of explicit fire scenarios</b> .....           | <b>18</b> |
| <b>Annex C (informative) Design fires</b> .....                                          | <b>21</b> |
| <b>Bibliography</b> .....                                                                | <b>30</b> |

## 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. [www.iso.org/directives](http://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. [www.iso.org/patents](http://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 first edition cancels and replaces ISO/TS 16733:2006, which has been technically revised.

ISO 16733 consists of the following parts, under the general title, *Fire safety engineering — Selection of design fire scenarios and design fires*:

— *Part 1: Selection of design fire scenarios*

## Introduction

Selection of the fire scenarios requiring analysis is critical in fire safety engineering. The number of possible fire scenarios in any built environment (a building or other structure) can be very large and it is not possible to quantify them all. It is necessary to reduce this large set of possibilities to a small set of design fire scenarios that is amenable to analysis.

The characterization of a fire scenario involves a description of fire initiation, the growth phase, the fully-developed phase and extinction together with likely smoke and fire spread routes. This includes the interaction with the proposed fire protection features for the built environment. It is necessary to consider the possible consequences of each fire scenario.

This part of ISO 16733 introduces a methodology for the selection of design fire scenarios that is tailored to the fire-safety design objectives. There can be several fire safety objectives being addressed, including safety of life (for occupants and rescue personnel), conservation of property, protection of the environment and preservation of heritage. A different set of design fire scenarios can be required to assess the adequacy of a proposed design for each objective.

Following selection of the design fire scenarios, it is necessary to describe the assumed characteristics of the fire on which the scenario quantification are based. These assumed fire characteristics are referred to as “the design fire”. It is important that the design fire be appropriate to the objectives of the fire-safety engineering analysis and that they result in a design solution that is commensurate with credible worst case scenarios considered.

Users of this part of ISO 16733 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.

ISO 23932 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, heritage 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 ISO fire safety engineering 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](#). This system of standards provides an awareness of the interrelationships between fire evaluations when using the set of ISO fire safety engineering standards.

Each International Standard includes language in the introductory material of the standard to tie the standard to the steps in the fire safety engineering design process outlined in ISO 23932. Selection of design fire scenarios form part of compliance with ISO 23932, and all the requirements of ISO 23932 apply to any application of this part of ISO 16733. For example, ISO 23932:2009, 9.2 generally describes the procedure for identifying and selecting fire scenarios (see highlighted box in [Figure 1](#)). [Clause 6](#) describes, in detail, the approaches for identifying and selecting design fire scenarios.

# Sample Document

get full document from [standards.iteh.ai](https://standards.iteh.ai)

# Fire safety engineering — Selection of design fire scenarios and design fires —

## Part 1: Selection of design fire scenarios

### 1 Scope

This part of ISO 16733 describes a methodology for the selection of design fire scenarios that are credible but conservative for use in fire safety engineering analyses of any built environment, including buildings, structures or transportation systems. Following the procedures given in this part of ISO 16733, a manageable number of design fire scenarios is selected using a qualitative or semi-quantitative approach. For a full quantitative approach using risk assessment, the reader is directed to ISO 16732-1.

### 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 13943, *Fire safety — Vocabulary*

ISO 16732-1, *Fire safety engineering — Fire risk assessment — Part 1: General*

ISO 23932:2009, *Fire safety engineering — General principles*

### 3 Terms and definitions

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

#### 3.1

##### **design fire**

quantitative description of assumed fire characteristics within a design fire scenario

Note 1 to entry: Typically an idealized description of the variation with time of important fire variables, such as heat release rate and toxic species yields, along with other important input data for modelling such as the fire load density.

#### 3.2

##### **design fire scenario**

specific fire scenario on which a deterministic fire safety engineering analysis will be 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.

### 3.3

#### **fire scenario**

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

Note 1 to entry: The fire scenario description typically includes the ignition and fire growth processes, the fully developed fire stage, the fire decay stage, and the environment and systems that will impact on the course of the fire. Unlike deterministic fire analysis, where fire scenarios are individually selected and used as design fire scenarios, in fire risk assessment, fire scenarios are used as *representative fire scenarios* (3.4) within *fire scenario clusters* (3.5).

### 3.4

#### **fire scenario, representative**

specific *fire scenario* (3.3) selected from a *fire scenario cluster* (3.5) such that the consequence of the representative fire scenario can be used as a reasonable estimate of the average consequence of scenarios in the fire scenario cluster

### 3.5

#### **fire scenario cluster**

subset of *fire scenarios* (3.3), usually defined as part of a complete partitioning of the universe of possible fire scenarios

Note 1 to entry: The subset is usually defined so that the calculation of fire risk as the sum over all fire scenario clusters of fire scenario cluster frequency multiplied by *representative fire scenario* (3.4) consequence does not impose an undue calculation burden.

### 3.6

#### **target**

person, object or environment intended to be protected from the effects of fire and its effluents (smoke, corrosive gas, etc.) and/or fire suppression effluents

## 4 Symbols and abbreviated terms

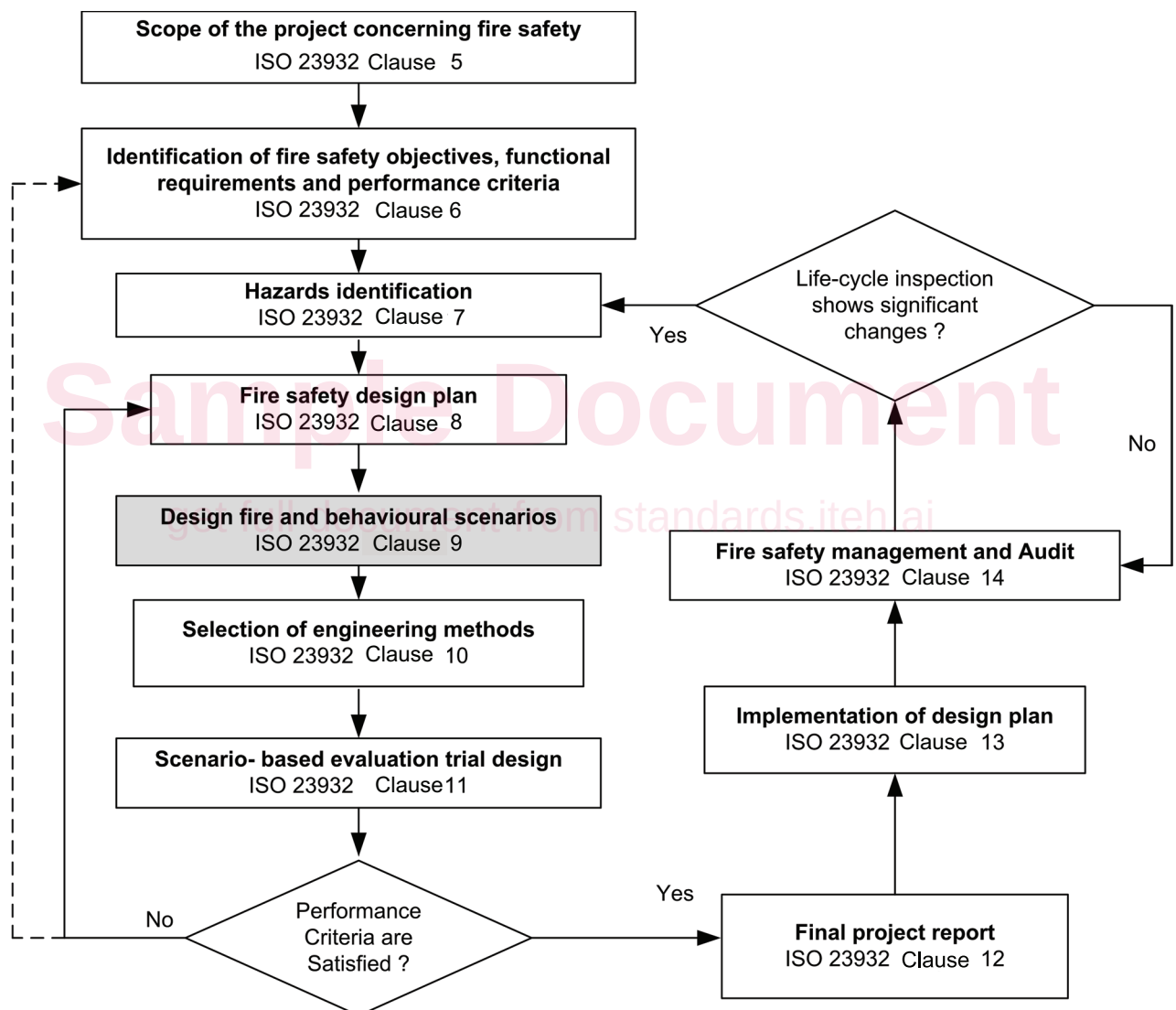
|                        |                                                                                                            |
|------------------------|------------------------------------------------------------------------------------------------------------|
| $A$                    | area of an opening, m <sup>2</sup>                                                                         |
| $h$                    | height of an opening, m                                                                                    |
| $\dot{m}_f$            | rate of mass loss of fuel, kg/s                                                                            |
| $\dot{m}_{\text{air}}$ | rate of entry of air into the enclosure, kg/s                                                              |
| $\dot{Q}$              | rate of heat release, kW                                                                                   |
| $\dot{Q}_0$            | reference rate of heat release, kW                                                                         |
| $r$                    | stoichiometric air requirement for complete combustion of fuel, expressed as the mass ratio of air to fuel |
| $t$                    | time, s                                                                                                    |
| $t_g$                  | time required to reach the reference rate of heat release, $\dot{Q}_0$ s                                   |

## 5 Fire safety engineering applications

### 5.1 Fire safety engineering process

ISO 23932 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, heritage and the environment. ISO 23932 provides the process (necessary steps) and essential elements to design a robust performance-based fire safety programme.

This part of ISO 16733 provides guidance for developing design fire scenarios in ISO 23932:2009, 9.2. This step in the fire safety engineering process is shown as a highlighted box in [Figure 1](#).



**Figure 1 — Flow chart illustrating the fire safety design process and selection of design fire scenarios**  
(Source: ISO 23932:2009)

#### 5.1.1 Establish project scope

A preliminary plan shall contain information describing the purpose and function of each part of the design, and its intended fixtures, furnishings, decorations, equipment and combustible products that are planned to be installed, stored or used in the built environment. When this type of detailed