TECHNICAL REPORT

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External exposure of roofs to fire —

Part 3: Commentary

Exposition des toitures à un feu extérieur —

Partie 3: Commentaire

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Foreword

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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 2, *Fire containment*.

ISO 12468 consists of the following parts, under the general title *External exposure of roofs to fire*:

— *Part 1: Test method*

— *Part 2: Classification of roofs*

— *Part 3: Commentary*

Introduction

This part of ISO 12468 describes the background used in the development and ongoing revision of ISO 12468-1:2013 and ISO 12468-2. Guidance is provided on the use of the test method and classification methods.

External exposure of roofs to fire —

Part 3:
Commentary

1 Scope

This part of ISO 12468 provides background and guidance on the use and limitations of the external fire exposure to roofs test method, the classification system, and the application of the data obtained. This part of ISO 12468 is designed to be of assistance to code officials, fire safety engineers, designers of buildings, and other persons responsible for the safety of persons in and around buildings.

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 12468-1:2013, *External exposure of roofs to fire — Part 1: Test method*

3 ISO 12468-1, test method

In the development of the test method, an attempt was made to evaluate as many of the potential sources of external fire exposure a roof system could be subjected to as possible. Once identified, the test method attempted to define tests that simulated the identified possible exposure conditions, while at the same time, utilizing tests that already exist and are described in national test methods.

The ultimate goal of the test method development was to create an international test procedure which incorporated the most desirable elements of the existing test methods that could be used in national regulations and replace the wide variety of test methods that exist in national regulations.

The following are the three levels of fire exposure for roofs defined in ISO 12468–1:2013:

— Level A: A large burning brand falling onto the roof from an adjacent building. Level A considers the effect of wind and radiant heat.

— Level B: A medium burning brand coming from a fire in a neighbourhood and falling onto the roof. Level B considers the effect of wind but without additional radiant heat.

— Level C: A small burning brand transported by the wind from a remote fire and falling onto the roof. Level C considers the effect of the wind but without additional radiant heat.

The following presentation starts with a summary background description of some fire scenarios, relevant for test methods regarding external fire exposure to roofs. Then the decisive evaluation parameters for different classification systems, based on test measurements and observations, are identified.

4 Fire scenarios

Figures 1 to 6 show different types of external fire exposure to a roof.

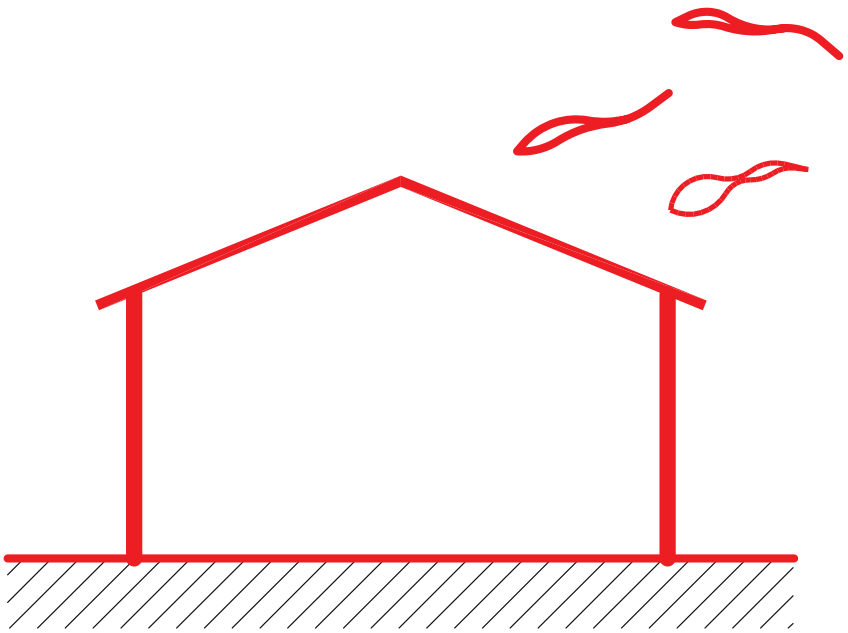


Figure 1 — Flying brand from a remote building or from environmental vegetation

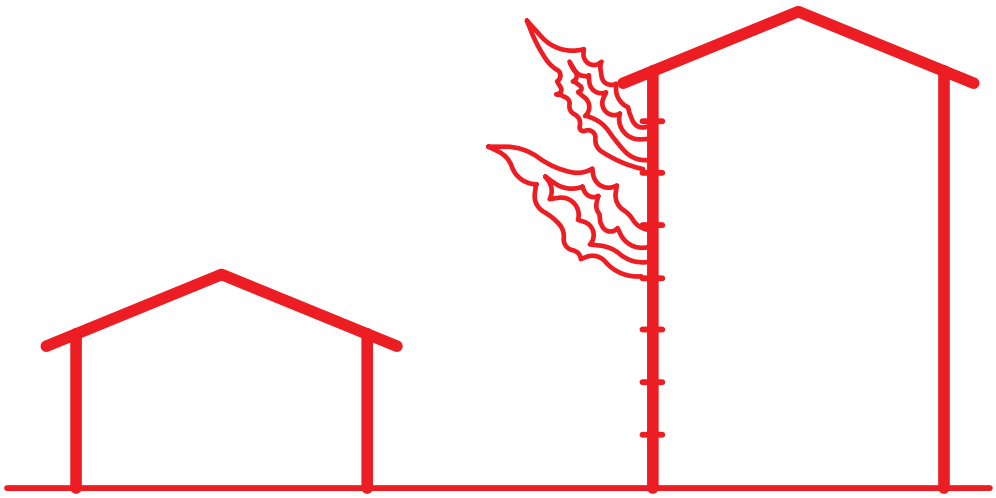


Figure 2 — Radiation exposure from a fire in a nearby building

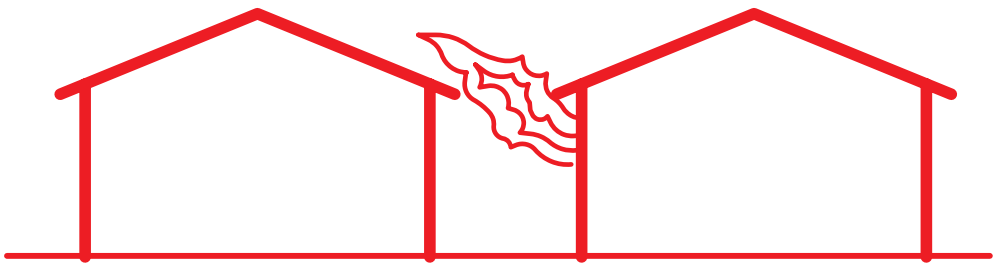


Figure 3 — Direct flame exposure together with radiation exposure from a fire in a nearby building in a dense small house area

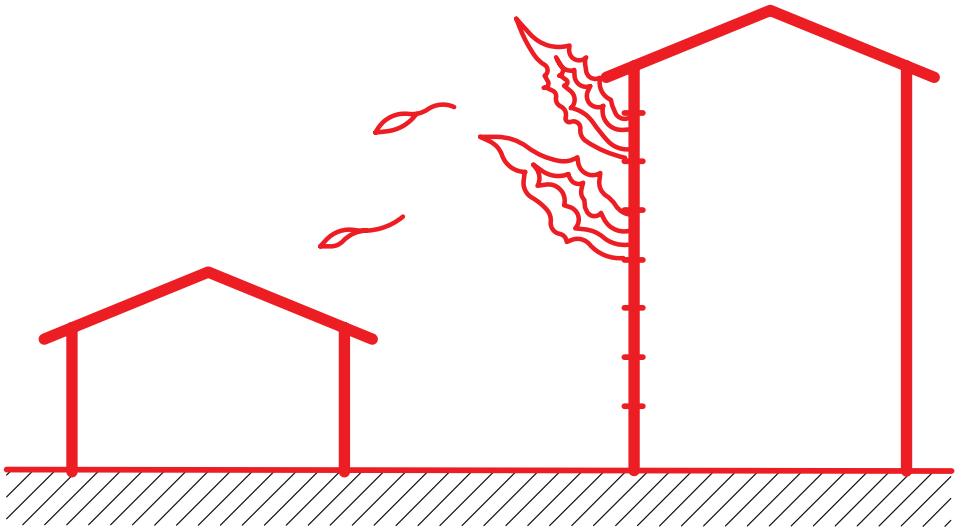


Figure 4 — Combined exposure by flying brand and radiation from a nearby building

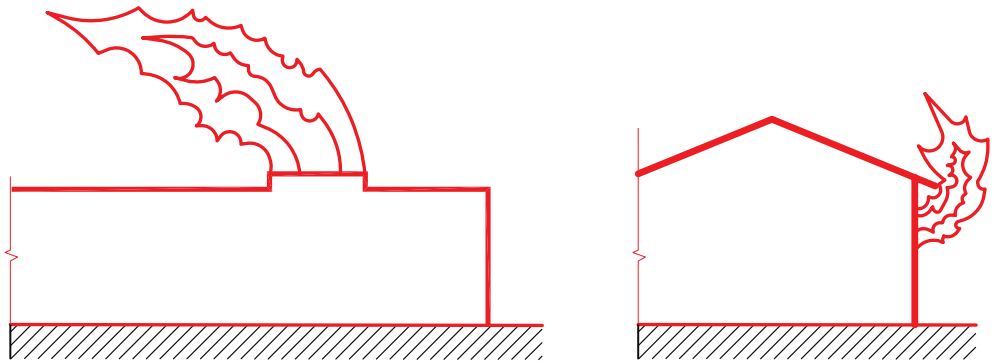


Figure 5 — Radiation exposure, with or without a simultaneous flame contact, from flames emerging through a roof opening for fire venting or through a window opening in a compartment below the roof

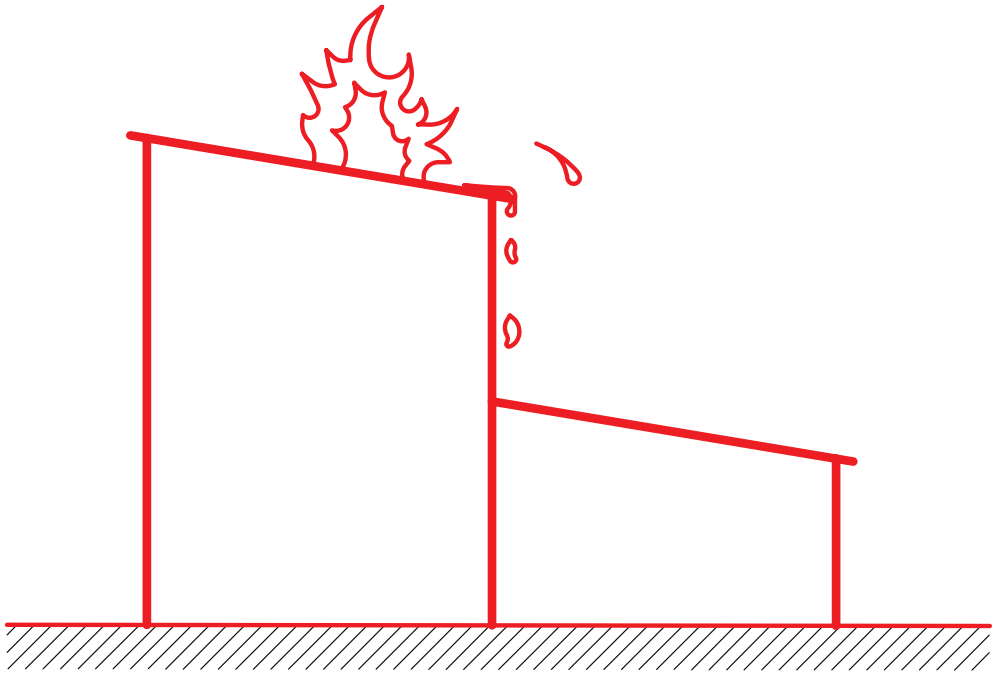


Figure 6 — Exposure by dripping melted material, flaming or not, together with sparks and flying brand, orginating from an external fire on the roof of a higher part of the building

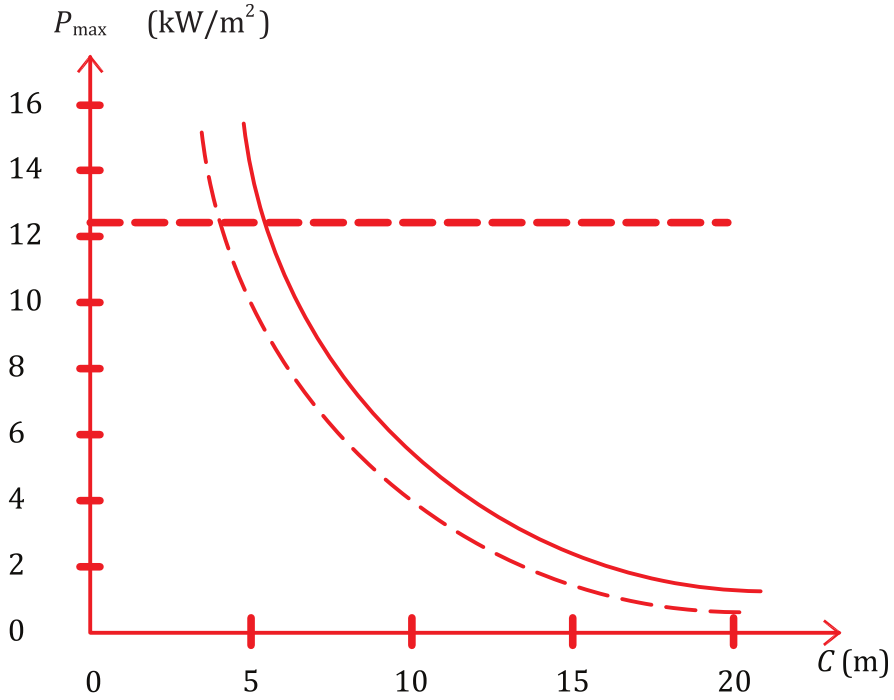
From the different types of external fire exposure shown in Figures 1 to 6, Level A of ISO 12468-1:2013 may relate to Figure 4, and Level B and Level C of ISO 12468-1:2013 may relate to Figure 1. Among the national standard test methods, the German test may simulate external fire exposure represented in Figure 6, the UK and French tests simulate exposure represented in Figure 4, the Scandinavian test and the North American Class C burning brand test simulate exposure represented in Figure 1, and the North American "intermittent flame test" exposure is represented by Figures 3 and 5.

The following brand sizes used in ISO 12468-1:2013 approximate the brands used in the North American roof fire test:

— Level A approximates the Class B brand described in ASTM E108 or ULC S107 (North American tests).

— Level B is a smaller brand than the Class B brand but is larger than the Class C brand described in ASTM E108 or ULC S107 (North American tests). Level B was added to the test standard in 2012 to address the needs of the regulatory requirements in Japan.

— Level C approximates the Class C brand described in ASTM E108 or ULC S107 (North American tests).



Key

[a] Maximum heat flux exposure (ISO 12468–1, Level A).

Figure 7 — Level of radiation exposure to roof from nearby fire exposure as represented by Figure 4

Figure 7 gives a representative illustration of the level of the radiation exposure to a roof of a building from a fire in a nearby building as represented by Figure 4, relevant for the test method ISO 12468-1, Level A. The curves are showing the calculated maximum radiation at the base of the roof with a specified pitch as a function of the distance between the two buildings. The radiation exposure is caused by a fully developed compartment fire, comprising one compartment (dash-line curve) or two adjacent compartments (full-line curve) and having a size characteristic of fires in a multi-storey office building or dwelling-house. For comparison, the figure also includes the level of the maximum total heat flux to which the test specimen shall be exposed according to the test method ISO 12468-1, Level A.

The calculated maximum radiation (P_{max}) to the base of a roof on a building from a fire in a nearby building as a function of the distance (C) between the two buildings is plotted in Figure 7. The thermal exposure from the nearby building is characterized by a fully developed fire in a compartment with the opening factor $A\sqrt{h}/A_{tot}$ = 0,06 $m^{1/2}$ and surrounding structures of aerated concrete with the density 500 kg · m^{-3}. The fire load density is 170 MJ · m^{-2} surrounding area. The area of the window openings of the compartment facing on to the exposed roof is 5 × 1,5 m^2. The pitch of the roof is 30° and the base of the roof is located at the same level as the lower edge of the window openings of the compartment(s) in fire. The dash-line curve refers to a fire in one compartment and the full-line curve to a fire simultaneously in two adjacent compartments.

5 Evaluation parameters

Measurements and observations, prescribed in the test method ISO 12468-1, enable the following evaluation parameters to be used in the classification systems described in ISO 12468-2:

a) maximum length of external fire spread in any direction related to a defined measuring zone;

b) occurrence of any burning material (flaming droplets or debris) falling from the exposed surface, within a prescribed period of time, if any;

c) time of fire penetration, within a prescribed period of time, as defined.

Combining the performance criteria prescribed in ISO 12468-1:2013 and the measurements and observations specified in the test methods points out the following performance parameters to be applied as obligatory in the classification system.

— **fire penetration**, determined by measurements and observations according to ISO 12468-1:2013, 11.3;

— **fire spread** over the external surface of the roof, expressed by the maximum length upwards and downwards according to ISO 12468-1:2013, 11.2;

— **flaming droplets or debris** falling from the exposed surface over the eaves, determined by observations according to ISO 12468-1:2013, 11.2.2.

6 ISO 12468-2, classification of roofs

Six classifications have been established for roof systems, two based on the Level A exposure conditions, two based on the Level B exposure conditions, and two based on the Level C exposure conditions in ISO 12468-1:2013.

The classes are described as follows:

Test	**Level A**		**Level B**		**Level C**	
Test Result	Large brand, radiation, and wind		Medium brand and wind		Small brand and wind	
Class	A1	A2	B1	B2	C1	C2
Fire penetration of openings	None	None within 15 min	None within 30 min	None within 15 min	None within 30 min	None within 15 min
External fire spread	Does not reach the limits of the measuring zone within 30 min	Does not reach the limits of the measuring zone within 15 min	Does not reach the limits of the measuring zone within 30 min	Does not reach the limits of the measuring zone within 15 min	Does not reach the limits of the measuring zone within 30 min	Does not reach the limits of the measuring zone within 15 min
Falling or flaming droplets or debris	None within 30 min	None within 15 min	None within 30 min	None within 15 min	None within 30 min	None within 15 min

The classification system was developed to address the needs of countries' building regulatory systems (building codes).

The system is flexible enough to permit the regulation of roofs exposed to an external fire exposure of varying degrees of severity and varying degrees of expected performance. The most fire resistant roofs are classified as Class A1; the least fire resistant roofs are classified as Class C2.

Bibliography

[1] ISO 12468-2, *External exposure of roofs to fire — Part 2: Classification of roofs*

[2] ISO 13943, *Fire safety — Vocabulary*

[3] ASTM E108, *Standard Test Method for Fire Tests of Roof Coverings*

[4] CAN/ULC-S107, Methods of Fire Tests of Roof Coverings

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