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**Reaction to fire test for sandwich  
panel building systems —  
Intermediate-scale box test**

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

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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](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 (see [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 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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 92, *Fire safety*, Subcommittee SC 1, *Fire initiation and growth*.

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](http://www.iso.org/members.html).

## Introduction

This document is intended to provide a test method for describing the fire behaviour of a sandwich panel product under fire conditions by simulating such fire conditions in a box made of sandwich panels under controlled laboratory conditions.

This test method may be used for comparing the reaction-to-fire properties of sandwich panel products. ISO 13784-1 and ISO 13784-2 are used to give a more realistic end-use assessment of the performance of sandwich panels, including self-standing capability during fire.

Examples of specimen drawings are provided in [Annex A](#).

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# Reaction to fire test for sandwich panel building systems — Intermediate-scale box test

## 1 Scope

This document specifies a method of testing the reaction-to-fire properties of an intermediate-scale, box-shaped structure made up of sandwich panels. This test method is a screening method intended for use by producers to reduce the burden of testing in ISO 13784-1, especially with respect to the occurrence of flashover.

This test method is not applicable to determining self-standing capability during fire, which is instead examined using ISO 13784-1 or ISO 13784-2.

This method is not intended to evaluate the reaction-to-fire performance of facades, or the fire resistance of a product, which can be tested by other means.

## 2 Normative references

The following documents are referred to in the 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 13943, *Fire safety — Vocabulary*

ISO 13784-1, *Reaction to fire test for sandwich panel building systems — Part 1: Small room test*

## 3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

## 4 Principle

The reaction to fire performance of a sandwich panel assembly is assessed when exposed to flames impinging directly on the internal corner of a small box-shaped sandwich panel assembly. The different kinds of flame spread, for example within the internal core, on the surface or through joints, and through ignited combustible gases and falling debris or melting droplets of the sandwich panel assembly, are assessed to allow the following possible fire hazards to be determined:

- a) the contribution of the system to fire development before and after flashover;
- b) the development of smoke and fire gases generated from the specimen box made of sandwich panels.

## 5 Types of systems

### 5.1 General

The test method applies to the following two types of structures which are representative of those used in practice, both in construction and materials.

### 5.2 Type A: frame-supported structures

For these types of structures, sandwich panel systems are mechanically fixed to the outside or the inside of a structural framework, normally steel. The ceiling/roof may be built traditionally or with sandwich panel systems.

When using a frame, the deformation of the frame can influence the fire behaviour of the sandwich panels. The test recommends that the frame be protected in practice according to relevant fire resistance requirements. Protection can be obtained by means of insulating boards or coatings.

### 5.3 Type B: free-standing structures

Sandwich panel systems are assembled together to provide a room or enclosure which does not depend for its stability on any other structural framework, e.g. cold stores, or food or clean rooms. These rooms are normally situated inside a building.

## 6 Test specimen

The test specimen used shall consist of the requisite number of panels specified in the test method to be performed. In all cases, the test specimen shall be representative of that used in practice, both in construction and materials. All constructional details of joints, fixings, etc., shall be reproduced and positioned in the test specimen as in practice. The test specimen should be built by those suitably qualified in the construction of this type of structure.

NOTE 1 If, in practice, ceiling panels are different from wall panels, a test can be performed with the correct combination of wall and ceiling panels.

If the sandwich panel building system is intended to be used with decorative paint or film facings, these shall be present on the test specimen.

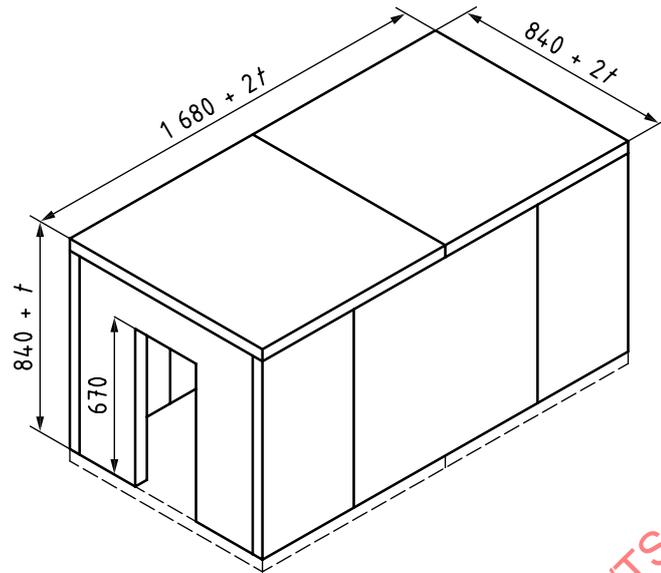
## 7 Test method

### 7.1 Constructing the test specimen (box-shaped)

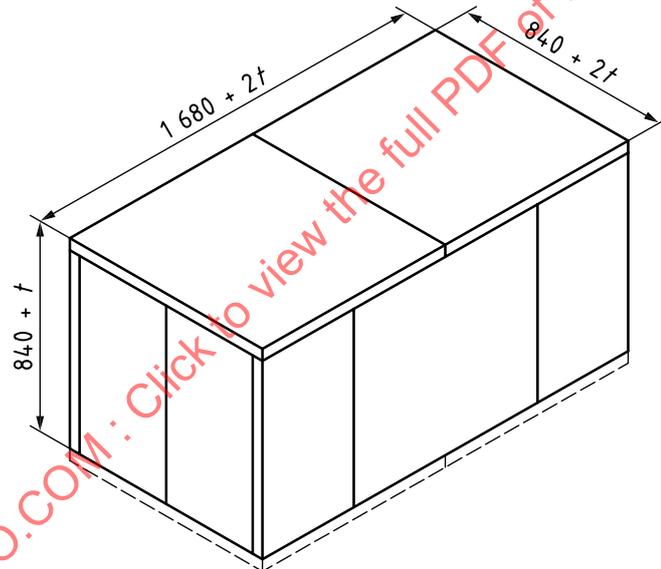
The shape of the specimen and the number of joints and their locations shall be as shown in [Figure 1](#). However, the number of joints may be increased around the opening according to the actual construction method. The internal dimensions of the specimen shall be as follows.

- 1) Depth: 1 680 mm ± 10 mm
- 2) Width: 840 mm ± 10 mm
- 3) Height: 840 mm ± 10 mm
- 4) Width of opening: 300 mm ± 10 mm
- 5) Height of opening: 670 mm ± 10 mm

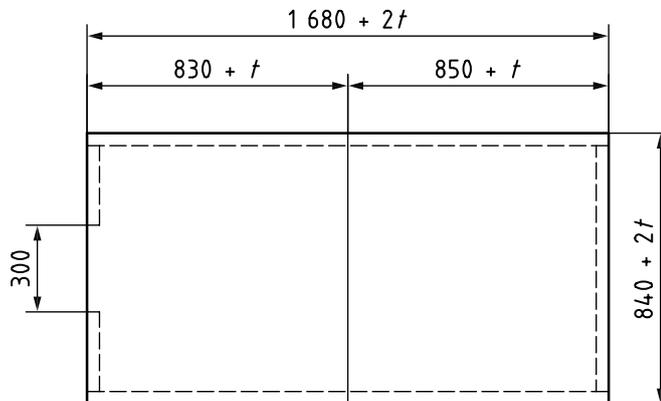
Dimensions in millimetres



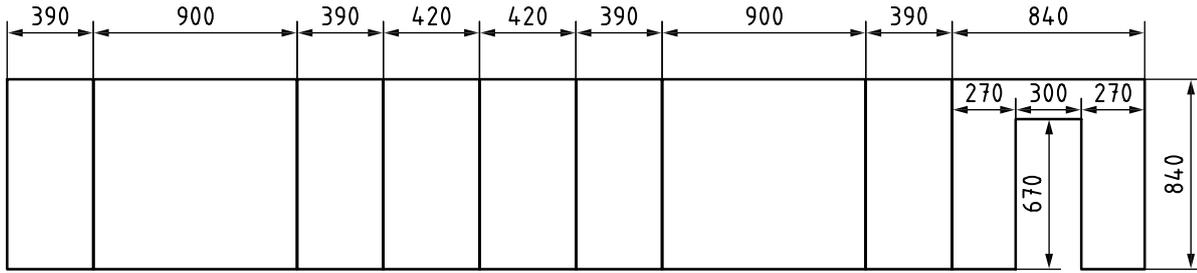
a) Isometric drawing (front)



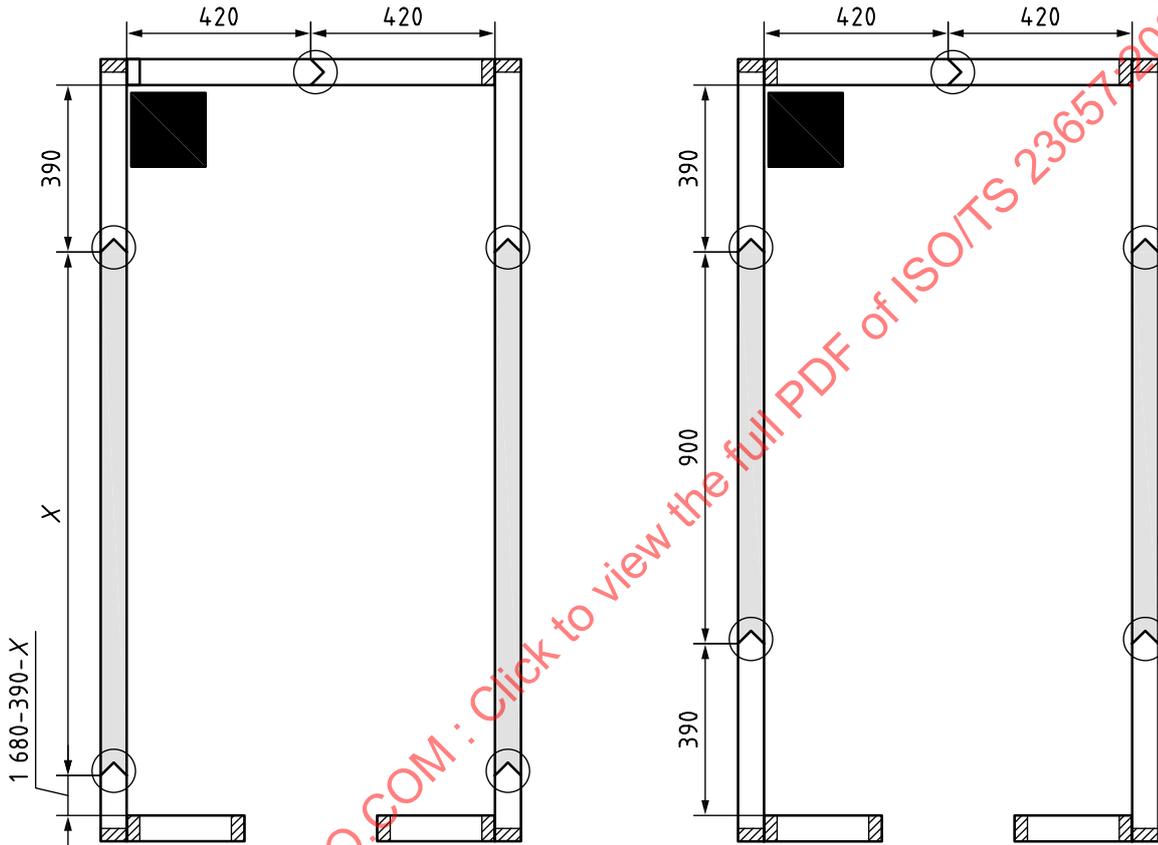
b) Isometric drawing (rear)



c) Reflected ceiling plan (opening on the left side)



d) Wall development view seen from inside (example)



e) Panel layout (rule)

f) Panel layout (example)

**Key**

*t* thickness of a sandwich panel

**Figure 1 — Example of test specimen**

Information on the test specimen shown in [Figure 1 a\)](#) through [Figure 1 d\)](#) represents a standard situation. There can be some variance on the panel width prescribed by the specimen suppliers when it is impossible to follow the standard situation in [Figure 1 a\)](#) through [Figure 1 d\)](#) exactly.

[Figure 1 e\)](#) shows the rule of panel layout, while in [Figure 1 f\)](#) shows an example of panel layout.

## 7.2 Constructing the enclosure around the test specimen

### 7.2.1 General

An enclosure as shown in [Figure 2](#) shall be provided around the specimen to prevent the diffusion of the combustion product and heat.

### 7.2.2 The walls and ceiling of the enclosure

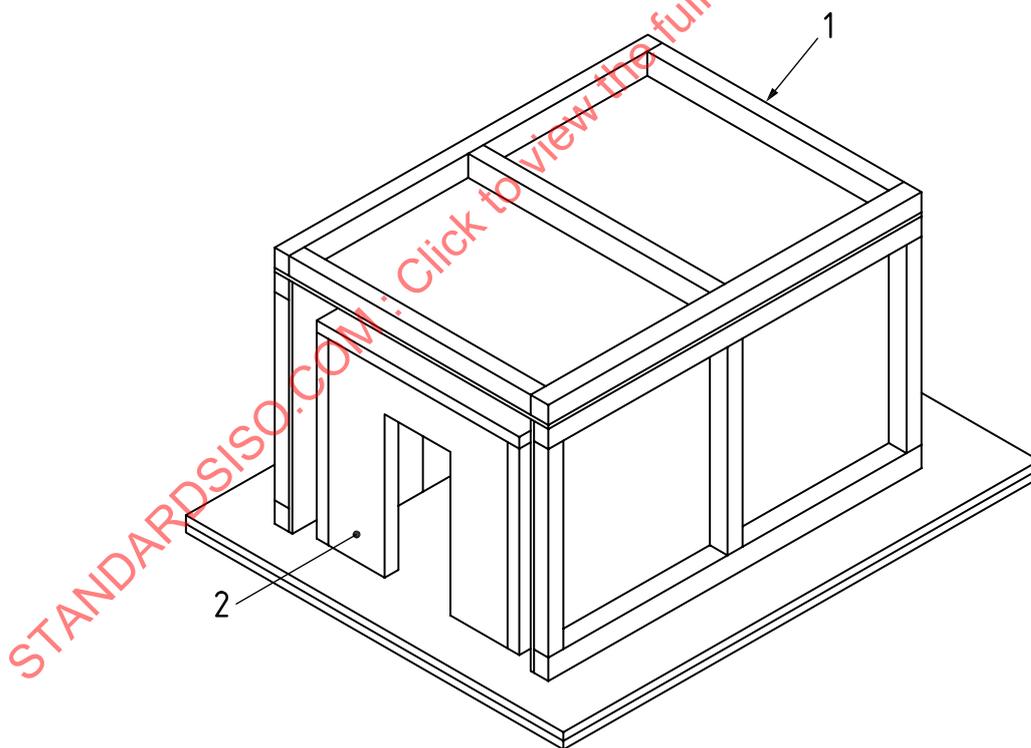
The walls and ceiling of the enclosure shall be as follows.

- a) The walls and ceiling of the enclosure shall be composed of the 12 mm thick 0,8 calcium silicate boards and used in testing after being fully dried. The walls and ceiling shall be reinforced with steel or another non-combustible material from the outside to prevent collapse during testing.
- b) The walls and ceiling of the enclosure shall be such that every internal surface of the enclosure will be  $50 \text{ mm} \pm 10 \text{ mm}$  from the outermost surface of the sandwich panel.

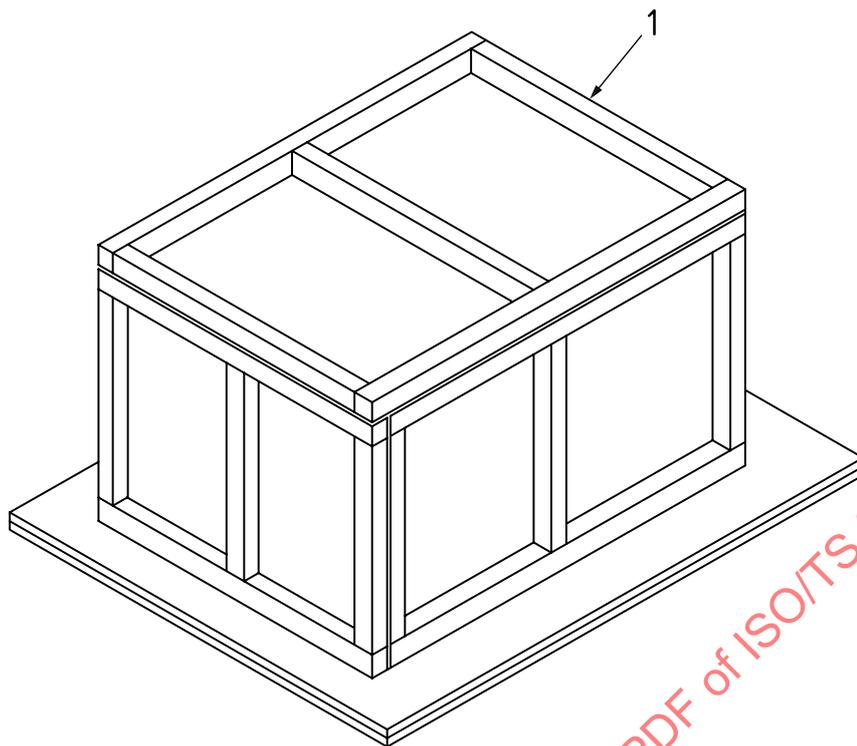
### 7.2.3 The floor of the enclosure

The floor of the enclosure shall be composed of the two 25 mm thick 0,5 calcium silicate boards and used in testing after being fully dried.

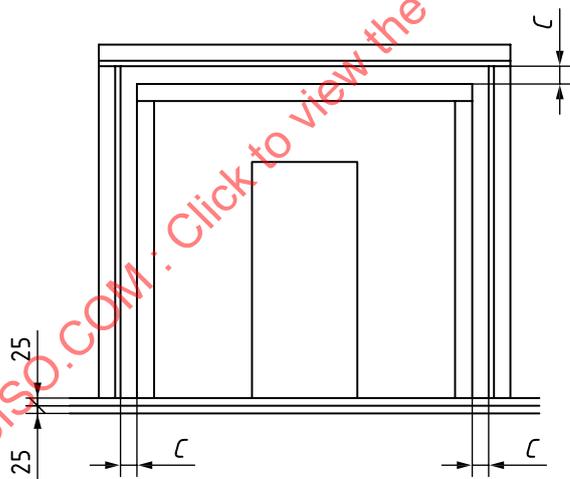
Dimensions in millimetres



a) Isometric drawing (front)



b) Isometric drawing (rear)



c) Front view

**Key**

- 1 enclosure
- 2 test specimen
- C 50 mm ± 10 mm

**Figure 2 — Test specimen and enclosure**

## 8 Ignition source

### 8.1 Structure

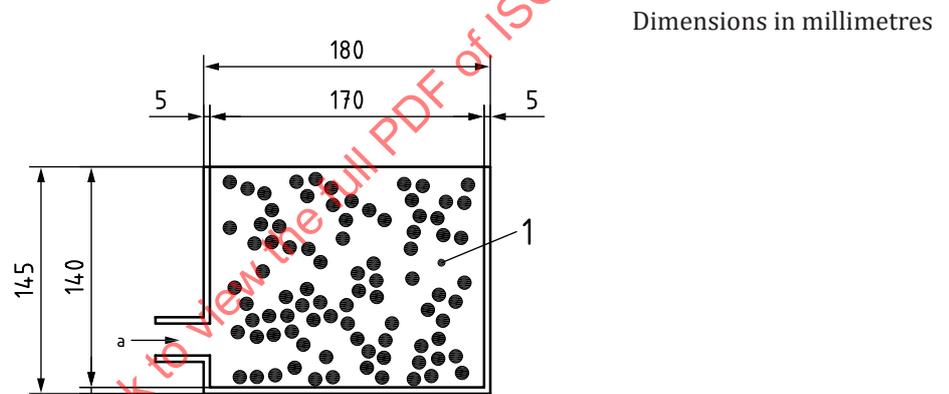
The ignition source shall be a propane gas burner as shown in [Figure 3](#), and the opening shall measure 170 mm × 170 mm and 145 mm in height. The gas burner shall be one filled with ceramic balls, each of 10 mm or under in diameter, to ensure the release of constant gas.

### 8.2 Position

The gas burner shall be installed as shown in [Figure 4](#). The gas burner shall be placed so that its top surface is level with the upper surface of the floor of the enclosure. Protection may be provided around the opening in the floor where the gas burner is placed.

### 8.3 Burner power output

The burner power output shall be determined within a rate of 15 kW in the first 10 min and 30 kW in the subsequent 10 min.



#### Key

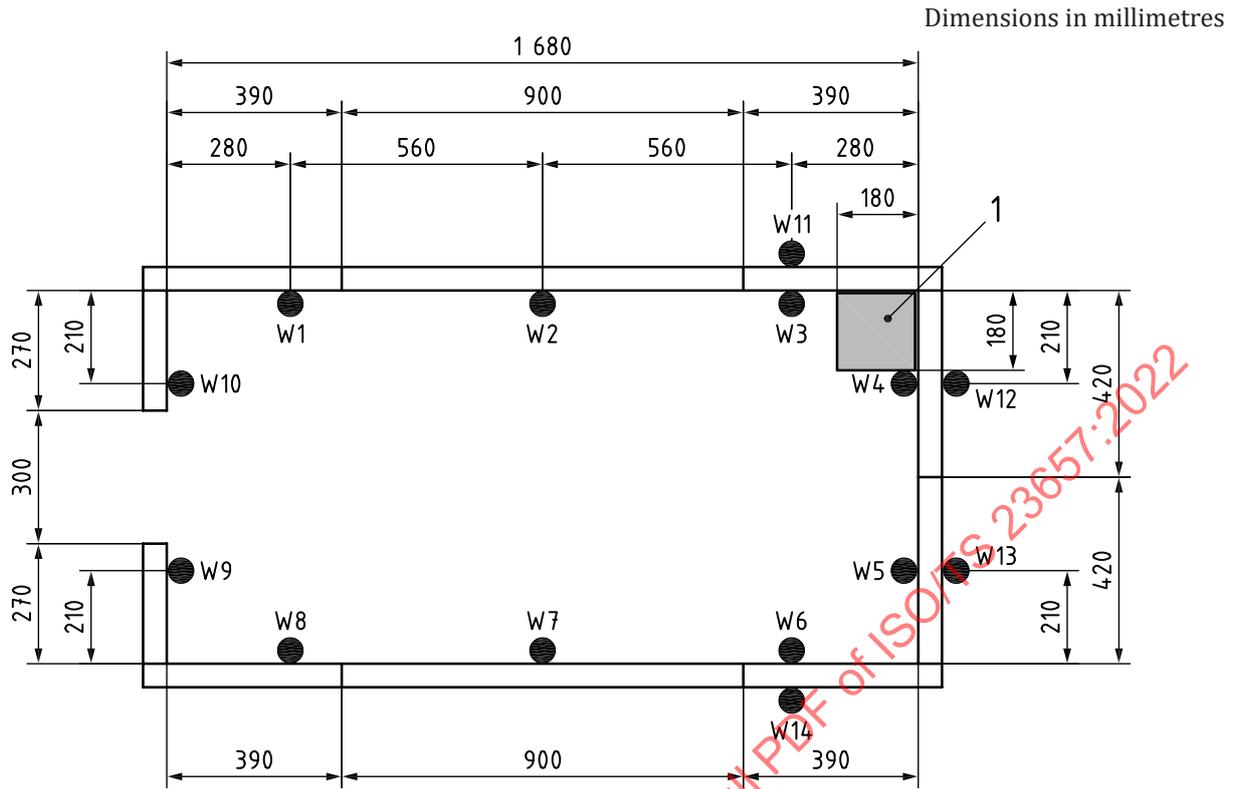
- 1 interior filled with ceramic balls
- a Gas entry.

Figure 3 — Burner

## 9 Instrumentation

### 9.1 Thermocouples

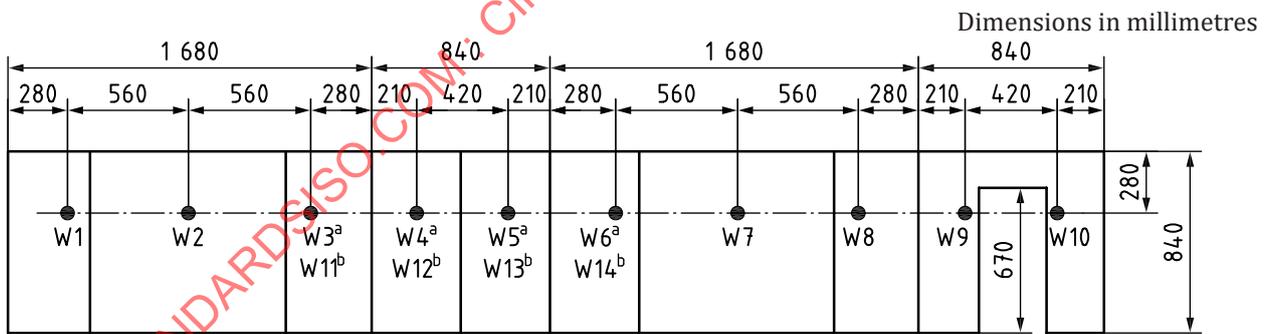
Thermocouples shall be placed on the surface of the specimen at the positions shown in [Figures 4](#) and [5](#) to measure the surface temperature of the specimen during the test.



**Key**

- positions where thermocouples are pasted
- 1 burner

**Figure 4 — Installation positions of thermocouples (wall surface temperature)**



**Key**

- positions where thermocouples are pasted
- NOTE There are 17 thermocouple positions, including W1 to W14 and C1 to C3. W11 to W14 are outside the box, while the rest are inside.
- a Inside.
  - b Outside.

**Figure 5 — Installation positions of thermocouples (wall surface temperature with wall development view seen from inside)**

## 9.2 Additional equipment

### 9.2.1 Data recorder

A chart recorder or data logger capable of recording and storing input data from the thermocouples at intervals not exceeding 10 s shall be provided. The data recorder shall be capable of providing a hard copy of the data.

### 9.2.2 Timing device

A clock with 1 s divisions or an equivalent timing device shall be provided.

### 9.2.3 Heat and smoke release measurement

Heat and smoke release shall be measured in accordance with ISO 13784-1.

## 10 Test procedure

### 10.1 Initial conditions

Before starting the test, the initial conditions shall be as follows.

- a) The temperature in the test facility at the start of the test shall be between 10 °C and 30 °C.
- b) The horizontal wind speed measured at a horizontal distance of approximately 1 m from the centre of the opening of the box shaped specimen shall not exceed 0,5 (m·s<sup>-1</sup>).
- c) The burner shall be in contact with the corner wall. The surface area of the burner opening shall be clean.

### 10.2 Test

- a) Start all recording and measuring devices and record data for at least 2 min prior to the burner being ignited.
- b) Ignite the burner. Adjust the burner to the output level given in 8.3 within 10 s of ignition of the burner. Continuously adjust the exhaust capacity so that all of the combustion products are collected.
- c) A photographic and/or video recording shall be made of the test. A clock shall appear in all photographic records, giving time to the nearest 1 s.
- d) During the test, record the following observations, including the time when they occur:
  - 1) ignition of the specimen;
  - 2) the spread of flame on the surface, internal or external, of the panels (if any);
  - 3) openings, cracks, damage or gaps appearing in the specimen;
  - 4) opening joints and flaming from joints;
  - 5) delamination, falling debris, flaming droplets;
  - 6) smoke or flames outside of the room through joints;
  - 7) smoke intensity and colour (visual);
  - 8) indications of flame spread through core of specimen i.e. discoloration of facing panels;

- 9) flames emerging through the doorway;
  - 10) flashover;
  - 11) collapse of the structure.
- e) End the test after 25 min. The test may need to be terminated earlier if structural collapse or other conditions develop that are potentially dangerous to the laboratory staff. Observation should be continued until all signs of visual combustion have ceased.
- f) Note the extent of damage of the product after the test. Damage shall be clearly reported, e.g. the extent of delamination and/or joint openings, extent and depth of char (and possibly scorching), cracking, shrinkage, etc.
- g) Record any other unusual behaviour.

## 11 Precision

The precision of this test method has not been determined. Results of a planned inter-laboratory test series will be included when available.

## 12 Test report

The test report shall contain the following information:

- a) a reference to this document, i.e. ISO/TS 23657:2022;
- b) the name and the address of the testing laboratory;
- c) the date and the identification number of the report;
- d) the name and the address of the sponsor;
- e) the purpose of the test;
- f) the method of sampling;
- g) the name and the address of the manufacturer or supplier of the product;
- h) the name or other identification marks and description of the product;
- i) construction and installation details of the product:
  - 1) drawings,
  - 2) descriptions,
  - 3) assembly instructions,
  - 4) specification of included materials,
  - 5) details of the joints and fixings;
- j) the date of supply of the product;
- k) the date of test;
- l) the test method used (free-standing room or frame-supported room construction) and a reference to this test method;
- m) conditioning of the test specimen, environmental data during the test (temperature, atmospheric pressure, relative humidity, etc.);

- n) deviations from the test method, if any;
- o) test results:
  - 1) temperatures within the core of the sandwich panel as a function of time, in a graph,
  - 2) maximum temperatures,
  - 3) illustration (e.g. by pictures) and description of the fire damage,
  - 4) observations during and after the test,
  - 5) time/volume flow in the exhaust duct,
  - 6) time/rate of total heat release and time/heat release from the burner,
  - 7) time/production of carbon monoxide at reference temperature and pressure,
  - 8) time/production of carbon dioxide at reference temperature and pressure,
  - 9) time/production of light-obscuring smoke at actual duct flow temperature,
  - 10) any unusual features observed;
- p) the designation of the product according to criteria expressed in official standards or regulations, where appropriate.

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