BS 8414-2:2015

BSI Standards Publication

Fire performance of external cladding systems –

Part 2: Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 14, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 8414 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 April 2015. It was prepared by Technical Committee FSH/21, *Reaction to Fire Tests*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 8414 supersedes BS 8414-2:2005, which is withdrawn.

Relationship with other publications

BS 8414 is published in two parts:

- Part 1: *Test method for non-loadbearing external cladding systems applied to the masonry face of a building*; and
- Part 2: *Test method for non-loadbearing external cladding systems fixed to and supported by a structural steel frame*.

Information about this document

This British standard was developed from BRE Fire Note 9 [1], following a recommendation by the then House of Commons Environment, Transport and Regional Affairs Committee [2] on the potential risk of fire spread in buildings via external cladding systems.

This is a full revision of the standard, and introduces the following principal changes:

- clarification and rewording of a number of requirements to align both parts of the standard (BS 8414-1 and BS 8414-2);
- removal of the option for using alternative fuel sources.

Hazard warnings

WARNING. This British standard calls for the use of substances and/or procedures that might be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Use of this document

It has been assumed in the preparation of this part of BS 8414 that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its methods are expressed as a set of instructions, a description, or in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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1 Scope

This British standard provides a test method for determining the fire performance characteristics of non-loadbearing external cladding systems, such as curtain walling, glazed elements, infill panels and insulated composite panels, fixed to and supported by a structural steel frame when exposed to an external fire under controlled conditions. The fire exposure is representative of an external fire source or a fully-developed (post-flashover) fire in a room, venting through an opening such as a window aperture that exposes the cladding to the effects of external flames, or from an external fire source.

This British Standard does not apply to non-loadbearing external rainscreen overcladding systems or external wall insulation systems applied to the face of a building, the fire testing of which are covered in BS 8414-1.

This British Standard does not cover exposure to radiant heat from a fire in an adjacent building.

NOTE Performance Criteria and Classification methodology of the external fire performance can be found in references such as Report BR 135: Fire performance of external thermal insulation for walls of multi-storey buildings [3].

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.

BS EN 60584-1:2013, *Thermocouples* – Part 1: *EMF specifications and tolerances*

BS EN ISO 13943, *Fire safety – Vocabulary*

3 Terms and definitions

For the purposes of this British Standard the terms and definitions given in BS EN ISO 13943 and the following apply.

3.1 collapse
any part of the cladding system which falls away and becomes detached

3.2 damaged area
total of those surface areas which have been affected permanently by fire under specified conditions

[SOURCE: BS EN ISO 13943]

NOTE 1 Area is expressed in square metres.

NOTE 2 Users of this term should specify the types of damage to be considered. This includes loss of material, deformation, softening, melting, charring, combustion, pyrolysis or chemical attack.

3.3 external cladding system
complete cladding assembly

NOTE 1 This includes, for example, sheeting rails, fixings, cavities, insulation and membranes, coatings, flashings or joints.

NOTE 2 The limits of the cladding system are taken to be from the external weathering surface to the internal finished face of the structural frame.

3.4 face of the building
external plane of a continuous external wall of the building (usually of masonry construction), to which the cladding system is applied

3.5 level 1 height
2 500 mm above the top of the combustion chamber opening in the test apparatus

3.6 level 2 height
5 000 mm above the top of the combustion chamber opening in the test apparatus

3.7 start temperature *TS*
mean temperature of the thermocouples at level 1 height during the 5 min prior to ignition of the heat source

3.8 start time *TS*
time when the temperature recorded by any external thermocouple at level 1 height equals or exceeds a 200 °C temperature rise above *TS* and remains above this value for at least 30 s

4 Principle

The test method simulates a fully developed fire in a room abutting the face of a building and venting through an aperture. In this test, the external cladding system is fixed to, and supported by, a structural steel frame, so as to simulate the face of a building in the form of a main face together with a perpendicular side wing, with the cladding system attached in the manner specified by the test sponsor. At the base of the vertical system, an opening is provided through which the fire can vent.

The extent of damage caused to the external cladding system is evaluated, particularly the ability of the external cladding system to resist the propagation of the fire upwards or penetration through the system. Any falling debris and fire penetration is recorded.

5 Test apparatus

5.1 General

The test apparatus shall utilize a vertical structural steel test frame (**5.2**), representative of a structural steel framed building, with a vertical main test wall and a vertical return wall (wing) (**5.4**) at a 90° angle to, and at one side of the main test wall. The main wall shall be provided with a combustion chamber (**5.5**). The test facility shall be capable of enduring the effects of the test procedure without itself suffering undue damage or distortion.

NOTE An example of a typical test apparatus is shown in Figure 1.

5.2 Structural steel test frame

The structural steel test frame shall be designed and constructed to withstand the expected loading imposed by the system under test and any subsequent distortions that can occur during the test programme.

NOTE 1 A specifically designed test frame might be needed.

NOTE 2 Annex B shows a typical structural steel test frame. The test specimen installation might need modification of, or additions to, an existing base test frame.

5.3 Main test apparatus wall

The main test apparatus wall onto which the test specimen is applied shall be:

a) vertical, extending at least 6 000 mm above the top of the combustion chamber opening; and

b) at least 2 600 mm wide.

5.4 Return wall (wing)

The return test apparatus (wing) wall onto which the test specimen is applied shall be:

a) vertical, of the same height as the main test wall;

b) at least 1 500 mm wide; and

c) perpendicular to the main test apparatus wall and allow a distance of (260 ±100) mm from the side of the opening of the combustion chamber to the finished face of the test specimen under test (see Figure 1).

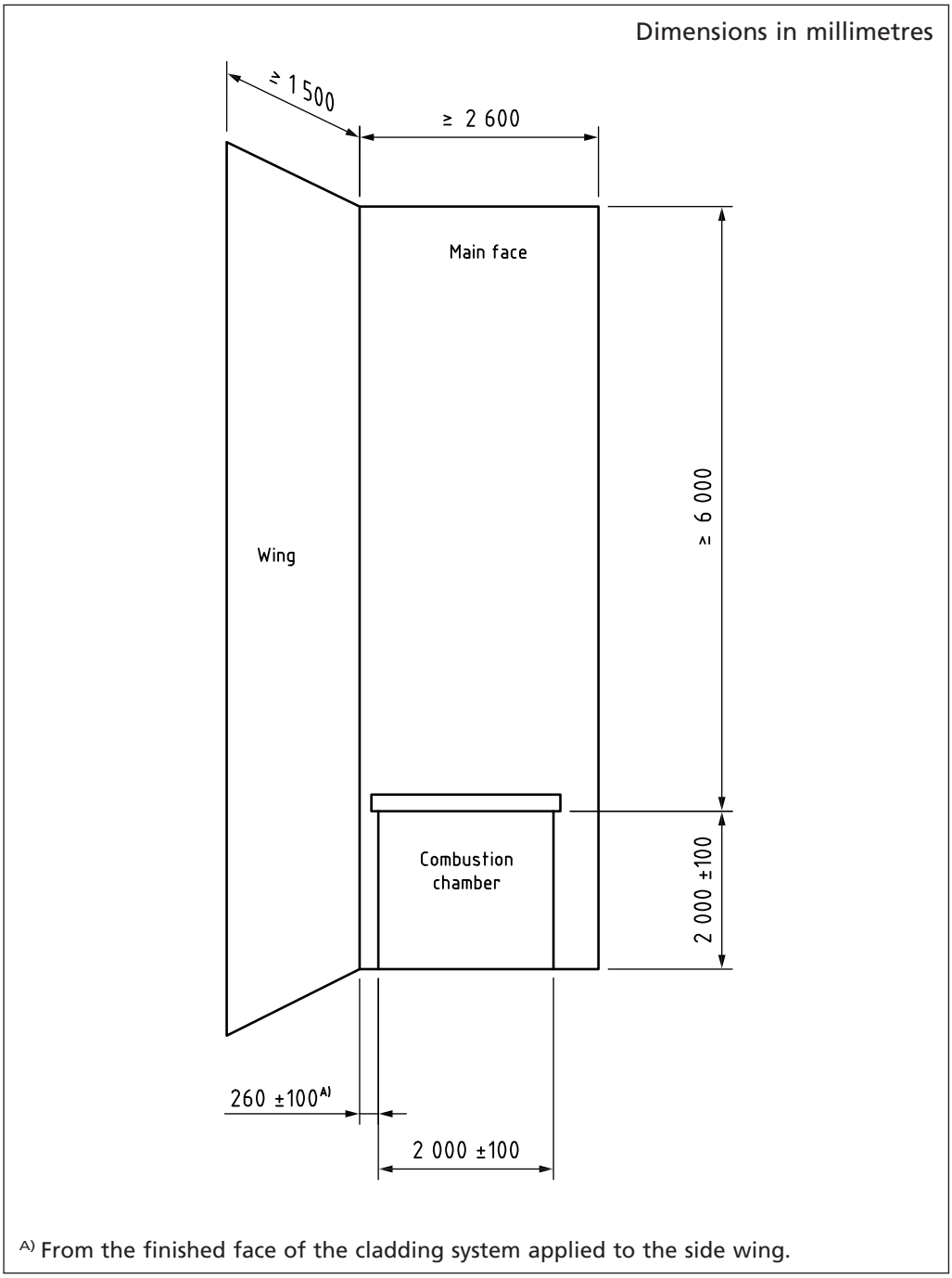
5.5 Combustion chamber

The combustion chamber shall be positioned at the base of the main vertical test wall such that the fire can project through the opening at the base of the main vertical test wall. The top of the chamber opening shall be (2 000 ±100) mm above the base of the test facility and shall be (2 000 ±100) mm wide. The combustion chamber shall be capable of enduring the effects of the test procedure without itself suffering undue damage or distortion. The chamber shall be constructed in accordance with the dimensions shown in Figure A.1, including the provision of a robust lintel across the head of the chamber opening and a suitable solid platform to support the heat source. A suitable timber crib heat source (**5.6**) shall be installed within the combustion chamber.

5.6 Timer crib heat source

The timber crib heat source shall be as specified in Annex A.

Figure 1 **Schematic of test apparatus**



5.7 Thermocouples

5.7.1 General

All thermocouples shall conform to BS EN 60584-1:2013, Type K (Chromel/Alumel). The thermocouples shall be mineral insulated and have a 1.5 mm (nominal) diameter with insulated junctions. At each specified level, temperatures shall be monitored using thermocouples positioned in accordance with **5.7.2** to **5.7.3**.

5.7.2 External thermocouples

5.7.2.1 General

External thermocouples shall be positioned to a tolerance of ±10 mm with the hot junction positioned (50 ±5) mm in front of the face of the test specimen.

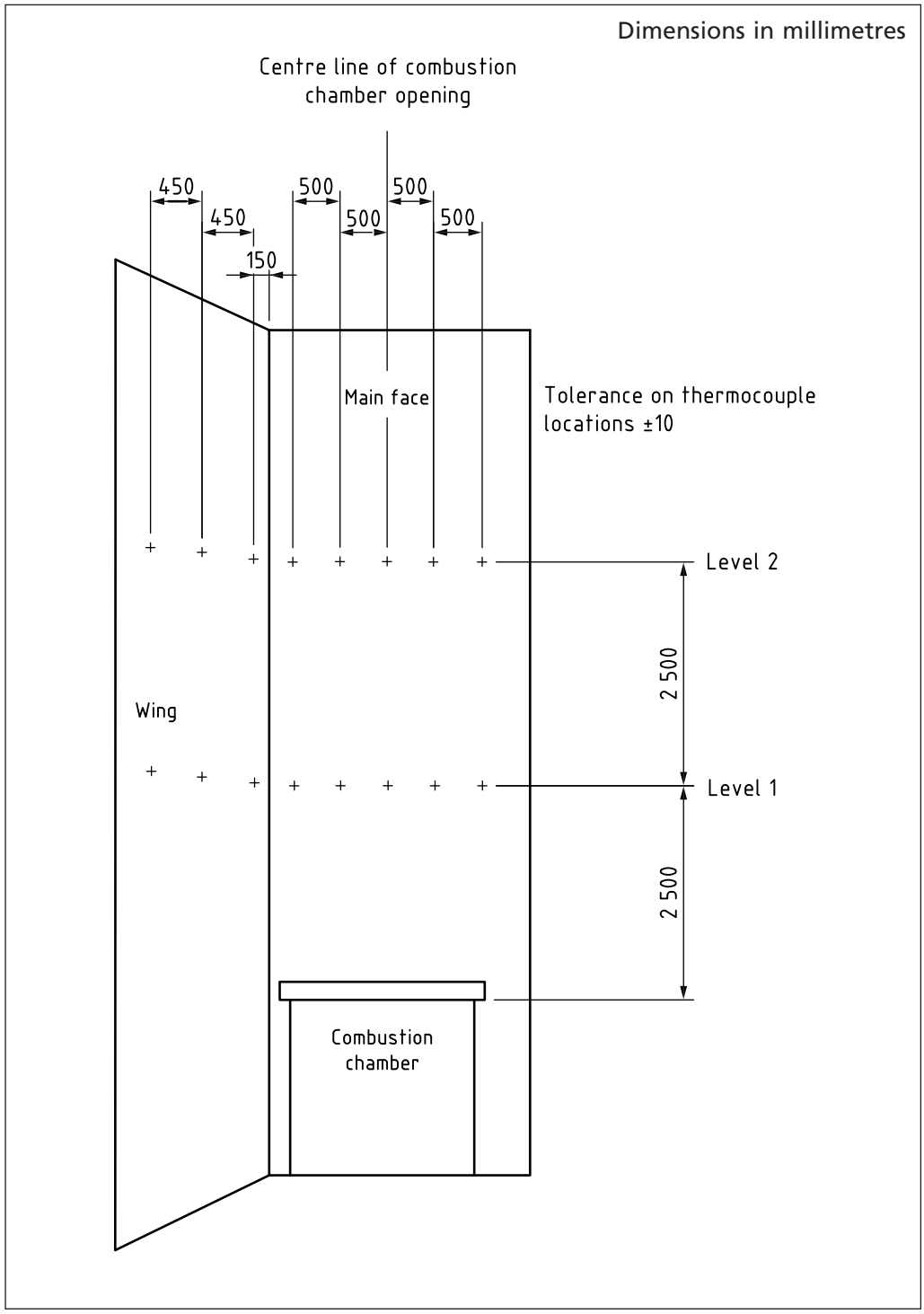
5.7.2.2 External thermocouples at levels 1 and 2

External thermocouples on the test specimen shall be located as follows (see also Figure 2).

a) Thermocouples shall be positioned in front of the main test wall face on the centre line and at 500 mm and 1 000 mm each side of the centre line of the combustion chamber (five locations).

b) Thermocouples shall be positioned in front of the wing test wall face, at 150 mm, 600 mm and 1 050 mm from the finished face of the main test wall face (three locations).

Figure 2 **Location of thermocouples for a cladding test**



5.7.3 Internal thermocouples

5.7.3.1 General

Internal thermocouples shall be positioned at level 2 only to a tolerance of ±10 mm. They shall be positioned at the mid-depth of each layer or cavity within the test specimen with a depth ≥10 mm.

5.7.3.2 Internal thermocouples location

Internal thermocouples at level 2 of the test specimen shall be located as follows (see also Figure 2).

a) Thermocouples shall be positioned within each layer of the main test wall face on the centre line and at 500 mm and 1000 mm each side of the centre line of the combustion chamber (five locations).

b) Thermocouples shall be positioned within each layer of the wing test wall face, at 150 mm, 600 mm and 1 050 mm from the finished face of the main test wall face (three locations).

5.8 Data acquisition system

A data acquisition system capable of recording data at minimum intervals of 10 s shall be connected to the instruments.

5.9 Audio visual equipment

A continuous audio-visual record of the condition of the full height of the test faces shall be taken throughout the period of the test. Both the external and internal faces of the test specimen shall be monitored.

NOTE Four cameras should be used to cover the full height of both faces, both internally and externally.

5.10 Environmental test condition monitoring equipment

Equipment for monitoring wind speed, such as an anemometer, shall have an accuracy of ±0.5 m/s for measuring the ambient air velocity.

5.11 Timing device

The timing device used, such as a clock, shall have an accuracy of greater than 5 s/h.

6 Test specimen

6.1 General

The test specimen shall include all relevant components assembled and installed in accordance with the manufacturer's instructions.

6.2 Dimensions of the test specimen

NOTE The maximum thickness of the system is effectively limited only by the relevant frame design. See Annex B.

The test specimen shall extend horizontally from the finished corner of the test sample, at least 2 400 mm on the main test face and at least 1 200 mm on the wing. The system shall extend from the base of the test apparatus to a height of at least 6 000 mm above the top of the combustion chamber opening on both faces. The test specimen shall not obstruct the combustion chamber opening.

If the external cladding system does not offer any protection to openings in practice, the interface between the test specimen and the combustion chamber shall also remain unprotected.

Edge detailing and terminations shall also be representative of end use design.

If horizontal joints are incorporated into the external wall cladding system, the test specimen shall incorporate horizontal joints at intervals specified by the manufacturer, with at least one joint placed (2 400 ±100) mm above the combustion chamber opening.

If vertical joints are incorporated into the external wall cladding system, the test specimen shall incorporate vertical joints at intervals specified by the manufacturer, with a joint extending upwards on the centre line of the combustion chamber opening, with a tolerance of ±100 mm.

7 Conditioning

After application of the test specimen to the test apparatus, it shall be left for a period of time which is sufficient for all components to cure in accordance with the test sponsor's installation specifications.

The test apparatus shall be protected from adverse environmental conditions such as water, windload and ambient temperatures outside the range -5 °C to +40 °C during the application, curing and test period.

8 Procedure

8.1 Environmental test conditions

The ambient temperature at the start of the test shall be within the range (20 ±15) °C.

The test shall not be conducted during fog or precipitation.

The air velocity at level 2 when measured (1 000 ±10) mm forward from the centre line of the combustion chamber opening.in any direction shall be less than 2 m/s at the start of the test.

8.2 Data acquisition

The data acquisition and audio visual records shall commence at least 5 min prior to ignition of the fuel source.

8.3 Fuel source

At least 5 min after the start of the data acquisition, the fuel source shall be ignited, as described in Annex A.

8.4 Test observations

The times of significant events such as the change of flaming conditions and any change in the mechanical behaviour of the cladding system shall be recorded, especially the detachment of any part of the cladding system (whether flaming or otherwise) or any fire penetrations through fire stops incorporated within the cladding system.

8.5 Test duration

The test duration shall be a maximum of 60 min. The heat source shall be extinguished 30 min after ignition (see **A.2.4**). Data and audio visual records shall continue to be recorded for 60 min after ignition of the fuel source unless all visual flaming has ceased and the measured temperatures have been decreasing for a period of 10 min.

8.6 Early test termination criteria

The test shall be terminated if:

a) flame spread extends above the test apparatus at any time during the test duration (see **8.5**); or

b) there is a risk to the safety of personnel or impending damage to equipment.

9 Post-test examination

The cladding system shall be examined when cooled (within 24 h of the test) for damage, such as spalling, melting, deformation and delamination, but not smoke staining or discolouration, ensuring that the following features are included and recorded in the examination (some dismantling of the system might be necessary):

a) extent of flame spread over the surface of the cladding system (both vertically and horizontally);

b) extent of flame spread and/or damaged areas within any intermediate layers (both vertically and horizontally);

c) estimate of any flame spread and/or damaged areas within the cavity, if present (both vertically and horizontally);

d) extent to which the external face of the cladding system has burnt away or become detached;

e) details of any collapse or partial collapse of the cladding system (see **3.1**).

10 Test report

The test report shall include the following information:

a) details of this British standard, i.e. BS 8414-2:2015;

b) the test date;

c) details of the test sponsor;

d) a full description of the test specimen, together with details of materials and components used and fixing details;

e) details of the apparatus used, including full details of the test frame with a complete description of the installation and fixing methods used to install the system;

f) the environmental test conditions;

g) a record of visual observations made during the test including flaming and mechanical response supplemented by suitable photographic records (see **8.4**);

h) temperature profiles recorded at each level during the test;

NOTE When plotting the temperature profiles, the origin of the time axis should be the start time, TS.

i) details of the results of the test, including post-test examination, as described in Clause **9**.

Annex A (normative) Timber crib source

A.1 Apparatus

A.1.1 *Softwood sticks*, of *Pinus silvestris*. They shall be sawn and of square section of side (50 ±2) mm and lengths of (1 500 ±5) mm and (1 000 ±5) mm. The density of the wood shall be 0.40 kg/dm^3 to 0.65 kg/dm^3. At the time of test, the softwood shall have a moisture content in the range of 10% to 15% by mass.

A.1.2 *16 strips of low density fibreboard*, having nominal dimensions of (25 × 12 × 1 000) mm.

A.2 Procedure

A.2.1 Construct a timber crib nominally 1 500 mm × 1 000 mm in plane and 1 000 mm high of softwood sticks.

Construct the crib of alternate layers of long and short sticks, with the first layer consisting of 10 long sticks of 1 500 mm. The next layer shall consist of 15 short sticks evenly distributed to cover an area of 1 500 mm × 1 000 mm.

Repeat this process to give a total of 20 layers of sticks giving it a nominal height of 1 000 mm. In total, use 150 short sticks and 100 long sticks.

A.2.2 Construct the crib on a solid platform positioned (400 ±50) mm above the floor of the combustion chamber. Locate the crib centrally in the combustion chamber and displaced (100 ±10) mm from the back wall of the chamber (see Figure A.1).

A.2.3 Ignite the crib using 16 strips of low density fibreboard. Soak the strips uniformly for a minimum of 5 min with 5 L of white spirit. Not more than 5 min before ignition, insert 14 strips into the spaces between the timber sticks in the second layer of the crib (i.e. 50 mm above the platform) allowing approximately 30 mm to project from the front of the crib. Place the remaining two strips horizontally across the 14 projected strip ends. Ignite only these two horizontal strips across their full length.

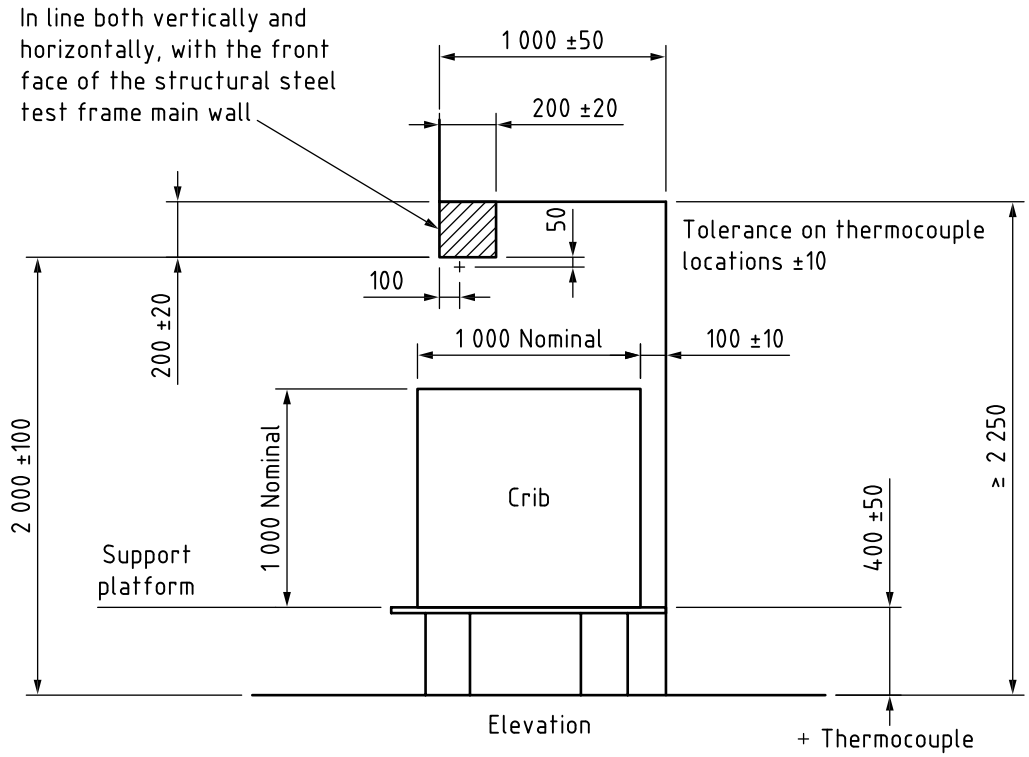
NOTE This heat source releases a nominal total heat output of 4 500 MJ over 30 min at a peak rate of (3 ±0.5) MW.

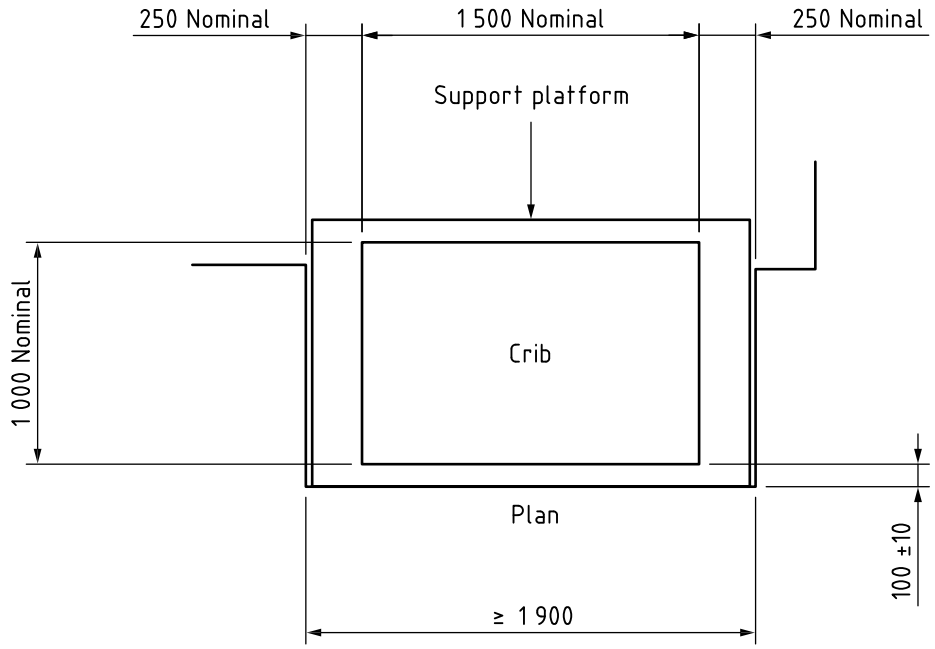
A.2.4 When the crib is to be extinguished 30 min after ignition, care shall be taken to ensure that the minimum extinguishing agent is used, to reduce impact on any burning of the cladding system.

NOTE It has been found that dispersion and damping of the heat source is suitable.

Figure A.1 **Side elevation and plan of the combustion chamber and position of crib (fire load)**

Dimensions in millimetres





Key

Lintel

Annex B (informative)

An example of a structural steel test frame

Table B.1 gives details of a typical structural steel test frame.

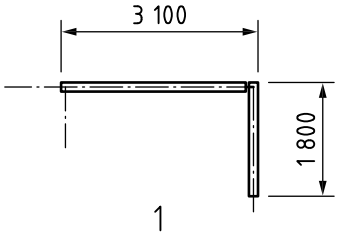
Figure B.1 is a typical test frame design.

Table B.1 **Section details**

Section reference	Nominal detail	Mass per unit length Kg/m
A	254 × 146 × 11 universal beam	37.0
B	150 × 150 × 6.3 steel hollow section	28.3
C	127 × 64 × 9 pre-formed channel	14.9
D	80 × 80 × 6 rolled steel angle	9.63

Figure B.1 **Example of a steel test frame**

All dimensions are nominal



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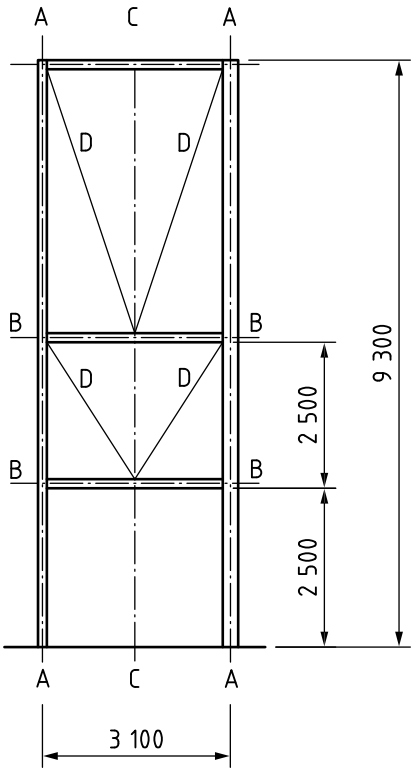

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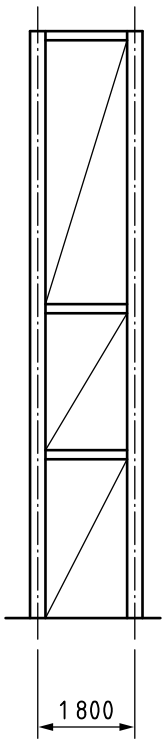

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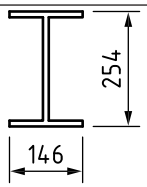
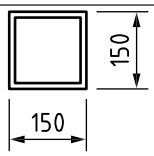
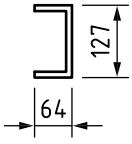


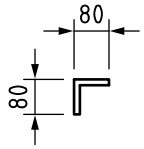
Section A



Section B



Section C



Section D

Key

1 Plan
2 Front elevation
3 Side elevation

NOTE Details of the steel sections are given in Table B.1.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 8414-1, *Fire performance of external cladding systems – Part 1: Test method for non-loadbearing external cladding systems applied to the masonry face of a building.*

Other publications

[1] BUILDING RESEARCH ESTABLISHMENT. Fire Note 9: *Assessing the fire performance of external cladding systems: a test method.* London: Construction Research Communications, 1999.

[2] GREAT BRITAIN. Parliament. House of Commons Environment, Transport and Regional Affairs Committee (BENNETT, A.F.). 1st report, session 1999-00. *Potential risk of fire spread in buildings via external cladding systems – Report and proceedings of the Committee.* House of Commons papers 1999-00 109. January 2000. London: The Stationery Office.

[3] BUILDING RESEARCH ESTABLISHMENT. Report BR 135: *Fire performance of external thermal insulation for walls of multi-storey buildings.* London: Construction Research Communications, 1999.

Further reading

GREAT BRITAIN. *Approved Document B to Part B of schedule 1 to the Building Regulations*, 2004. London: The Stationery Office.

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