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Fire performance of external cladding systems —

Part 1: Test method for non-loadbearing external cladding systems applied to the face of the building

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Committees responsible for this British Standard

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Architectural and Specialist Door Manufacturers
Association of Building Component Manufacturers Ltd.
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Contents

Foreword

This British Standard has been prepared by a joint working group from Technical Committees FSH/21/7 and FSH/22/7 under the direction of FSH/22.

This British Standard was developed from an existing industry standard, BRE Fire Note 9 [published by the Building Research Establish (BRE)] [1], following a recommendation by the then House of Commons Environment, Transport and Regional Affairs Committee. This recommendation was contained within the committee's first report on the potential risk of fire spread in buildings via external cladding systems, which was published on 14 December 1999 (HC109) [2].

This part of BS 8414 has been produced to provide a test method for assessing the fire performance of non-loadbearing external cladding systems, rainscreen overcladding systems and external wall insulation systems at full-scale when applied to the face of a building and exposed to an external fire under controlled conditions. The fire exposure conditions have been developed to be 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.

Further parts of this standard will be developed to cover the fire testing of curtain walling systems and systems that include glass panels.

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

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 13 and a back cover.

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1 Scope

This British Standard describes a method of assessing the behaviour of non-loadbearing external cladding systems, rainscreen overcladding systems and external wall insulation systems when applied to the face of a building and 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.

This British Standard does not cover the performance of glazed window openings or the detailing at such openings which are covered by separate tests. This British Standard does not apply to curtain walling systems or systems that include glass panels, the fire testing of which will be covered by further parts of this standard.

2 Terms and definitions

For the purposes of this British Standard the following terms and definitions apply.

2.1
external cladding system
complete cladding assembly, including, for example, sheeting rails, fixings, cavities, insulation and weathering membranes or coatings

2.2
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

2.3
level 1
height 2 500 mm above the top of the combustion chamber opening in the test apparatus

2.4
level 2
height 5 000 mm above the top of the combustion chamber opening in the test apparatus

2.5
start temperature, T_s
mean temperature of the thermocouples at level 1 during the 5 min prior to ignition of the heat source

2.6
start time, t_s
time when the temperature recorded by any external thermocouple at level 1 equals or exceeds a 200 °C temperature rise above T_s and remains above this value for at least 30 s

3 Principle

The external cladding system is applied to a vertical external masonry surface simulating the external face of a building in the form of a main face together with a return wing. The cladding system is applied in the manner specified by the test sponsor or vendor of the system. At the base of the main vertical masonry wall an opening is provided through which the fire can vent. A fully developed fire in a room abutting the external face of a building venting through a broken window is simulated. The extent of damage caused to the external cladding system, and in particular the ability for the external cladding system to resist the propagation of the fire upwards, is evaluated.

4 Test apparatus

4.1 Test facility

4.1.1 *General*

The test apparatus shall be representative of the face of a building and shall consist of a masonry, or masonry infill, structure with a vertical main test wall and a vertical return wall (wing) at 90° angles to, and at one side of the main test wall. The main wall shall be provided with a combustion chamber conforming to 4.1.4. The apparatus 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.

4.1.2 *Main test wall*, vertical, extending at least 6 000 mm above the top of the combustion chamber opening and at least 2 600 mm wide.

4.1.3 *Return wall (wing)*, vertical, of the same height as the main test wall and having a minimum width of 1 500 mm. The wing shall be constructed perpendicular to the main test wall at a distance of (250 ± 10) mm from the side of the opening to the combustion chamber (see Figure 1).

4.1.4 *Combustion chamber*, 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 opening shall be (2 000 ± 100) mm high and (2 000 ± 100) mm wide. The combustion chamber shall have a volume of at least 4.275 m^3 and shall have internal dimensions of at least 1 900 mm wide, 1 000 mm deep and 2 250 mm high. A suitable heat source as specified in **4.1.5** shall be installed within the combustion chamber.

4.1.5 *Heat source*, conforming to the thermal performance requirements given in Annex A. The wooden crib described in Annex B has been found to meet the requirements of Annex A and can be used without conducting a calibration exercise. A calibration exercise shall be conducted in accordance with Annex A on all other heat sources such as gas burners.

4.2 Thermocouples

4.2.1 *General*

All thermocouples shall be Type K (Chromel/Alumel) mineral insulated 1.5 mm (nominal) diameter thermocouples with insulated junctions. At each specified level, temperatures shall be monitored using thermocouples placed in accordance with **4.2.2** and **4.2.3**.

4.2.2 *External thermocouples*

4.2.2.1 *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 system under investigation.

4.2.2.2 *External thermocouples at level 1*, positioned:

— on the main face of the façade, in positions on the centre line and at distances of 500 mm and 1 000 mm each side of the centre line (five locations);

— on the wing, at distances of 150 mm, 600 mm and 1 050 mm from the finished face of the cladding systems on the main face (three locations) (see Figure 2).

Dimensions in millimetres

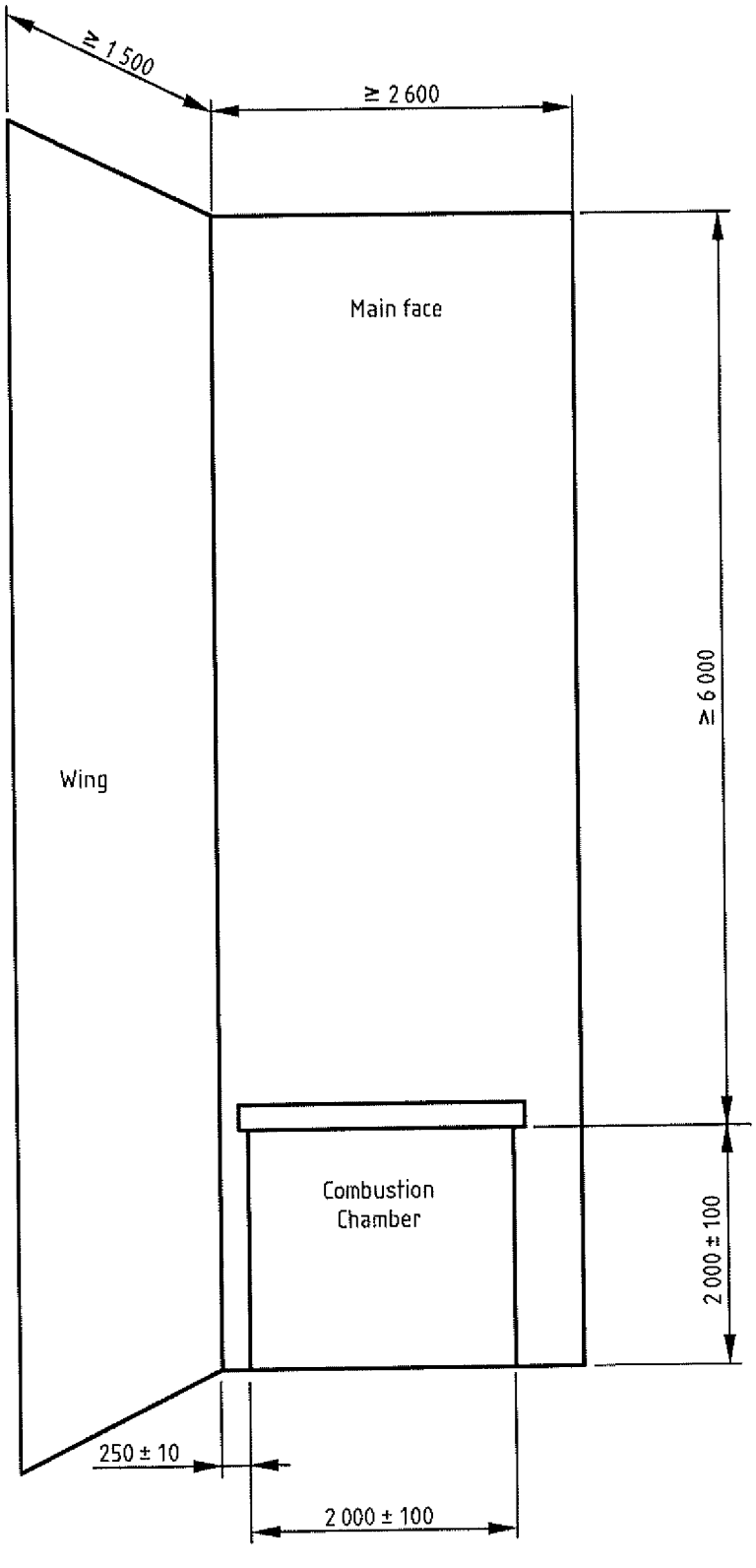

Figure 1 — An example of the test facility

Dimensions in millimetres

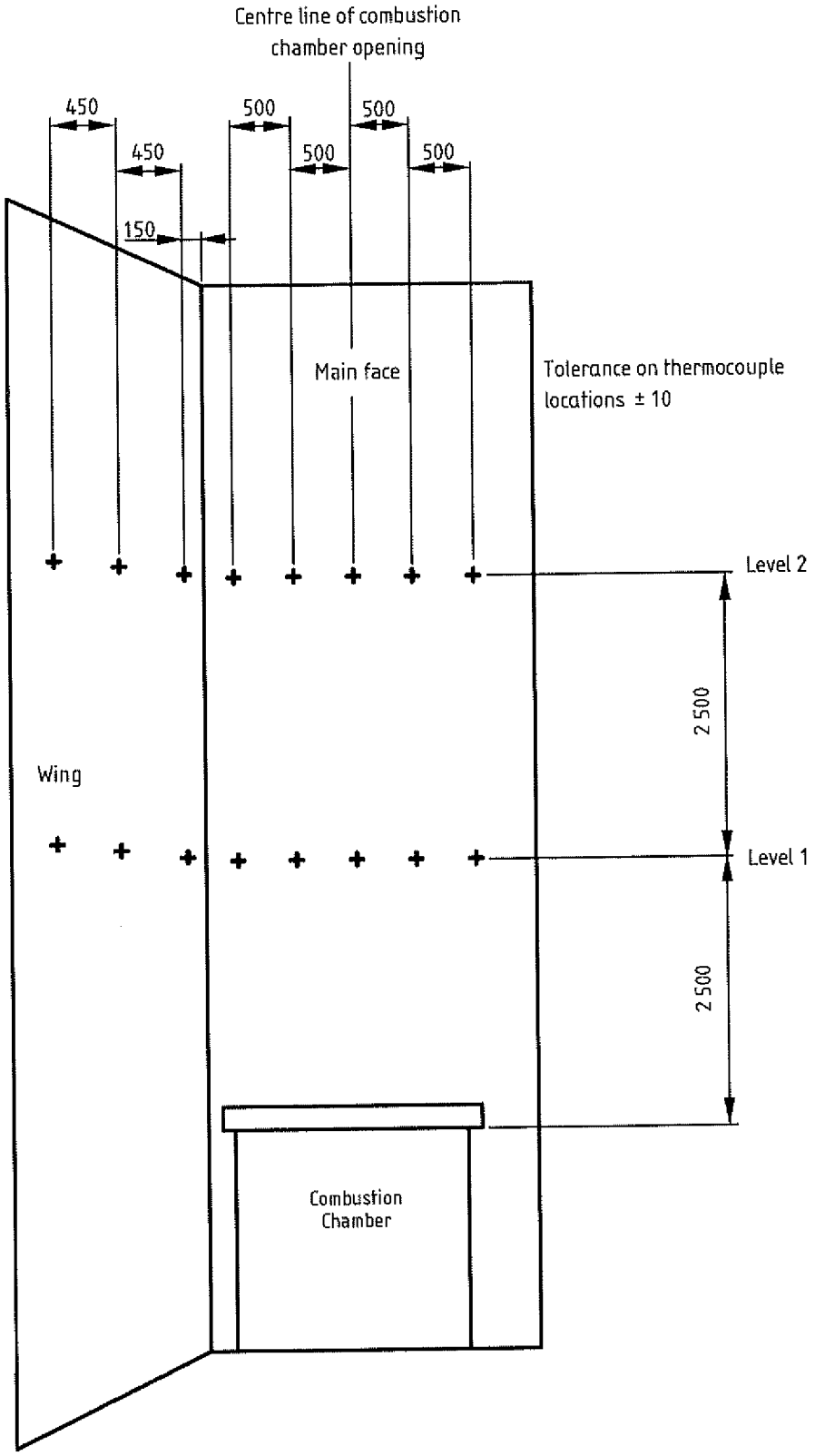

Figure 2 — Location of thermocouples for a cladding test

4.2.2.3 *External thermocouples at level 2,* positioned:

— on the main face of the façade, in positions on the centre line and at distances of 500 mm and 1 000 mm each side of the centre line (five locations);

— on the wing, at distances of 150 mm, 600 mm and 1 050 mm from the finished face of the cladding systems on the main face (three locations) (see Figure 2).

4.2.3 *Internal thermocouples,* positioned at level 2 to a tolerance of ±10 mm. They shall be positioned at the mid-depth of each combustible layer. Thermocouples shall not be used for layers less than 10 mm thick. If the system contains cavities, thermocouples shall also be positioned at the mid-width of each cavity.

The internal thermocouples at level 2 shall be positioned:

— on the centre line of the main test face and at distances of 500 mm and 1 000 mm each side of the centre line (five locations); and

— on the wing at distances of 150 mm, 600 mm and 1 050 mm from the finished face of the cladding systems on the main face (three locations).

4.3 *Data acquisition system,* capable of recording data at a minimum of 10 s intervals, to which instruments shall be connected.

4.4 *Audio visual equipment,* capable of providing a visual record of the condition of the full height of the test faces at a minimum of 5 min intervals.

NOTE It is recommended that two cameras be used to cover the full height of both faces.

4.5 *Ambient condition monitoring equipment,* such as an anemometer with an accuracy of ±0.5 m/s for measuring the ambient air velocity at a height of (3 000 ± 100) mm above the ground.

4.6 *Timing device,* such as a clock, with an accuracy higher than 5 s/h.

5 Test specimen

5.1 General

The external cladding system shall include all relevant components assembled and installed in accordance with the manufacturer's instructions.

5.2 Dimensions of the cladding system

The maximum depth of the cladding system to be evaluated shall be 200 mm. On the main test wall the cladding system shall extend at least 2 400 mm horizontally from the corner of the test apparatus between the main wall and the wing. It shall extend from the top of the combustion chamber opening to a height of not less than 6 000 mm above the combustion chamber opening.

NOTE 1 The cladding system may extend down to the ground level on each side of the combustion chamber opening.

The cladding system shall not obstruct the combustion chamber opening.

On the wing of the test face the cladding system shall extend at least 1 200 mm horizontally from the corner of the test apparatus between the main wall face and the wing. It shall extend from the ground level to a height of not less than 6 000 mm above the combustion chamber opening.

The detail at the corner of the cladding system between the main wall face and wing shall abut or be constructed in accordance with the manufacturer's instructions.

Exposed edges and the perimeter of the combustion chamber opening shall be protected in accordance with the manufacturer's instructions.

NOTE 2 This may include a window frame without any glazing.

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

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

If vertical joints are incorporated into the external wall cladding system, the cladding system 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.

6 Conditioning

After application of the cladding system to the test facility, it shall be left to stand for a period of time which is sufficient for all components to cure correctly as specified by the manufacturer. If the test facility is unshielded from external weather conditions, it and the cladding system shall be protected from weather effects after the cladding system has been applied to it and before testing.

7 Procedure

7.1 Establishment of ambient 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 in any direction shall be less than 2 m/s at the start of the test.

7.2 Data acquisition

Commence the data acquisition and audio visual records at least 5 min prior to ignition of the fuel source. If, prior to ignition, more than two thermocouples at any level or in any layer yield unsatisfactory data testing shall be stopped.

7.3 Fuel source

At least 5 min after the start of the data acquisition, ignite the fuel source in the same way as determined in the calibration procedure described in Annex A. If the timber crib described in Annex B is used as the heat source, ignition shall be as described in Annex B.

7.4 Test observations

Record the times of significant events such as the change of flaming conditions and any change in the mechanical behaviour of the cladding system, especially the detachment of any part of the cladding system.

The nominal duration of the burning of the heat source shall be 36 min. If any part of the cladding system is still burning 30 min after ignition of the heat source continue taking records for a maximum time of 60 min. Otherwise, terminate the test 30 min after the ignition of the heat source.

8 Post test examination

Examine the cladding system 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 may be necessary):

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

b) the extent of flame spread and damage within any intermediate layers (both vertically and horizontally);

c) an estimate of any flame spread and damage within the cavity, if present, (both vertically and horizontally);

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

e) the details of any collapse or partial collapse of the cladding system.

9 Test report

The test report shall include the following information:

a) the test date;

b) details of the test sponsor;

c) a full description of the cladding system, together with details of materials and components used;

d) details of the apparatus used;

e) details of the result of the test as described in Clause 8;

f) a record of visual observations made during the test including flaming and mechanical response supplemented by suitable photographic records (see 7.4);

g) ambient conditions;

h) the 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, t_s.

Annex A (normative)
Calibration of the heat source

A.1 Principle

A calibration exercise is carried out on a non-combustible façade of calcium silicate board nominally 12 mm thick with a density of (850 ± 50) kg/m^3 placed vertically against the external face of the main vertical test wall immediately above the opening.

A.2 Apparatus

A.2.1 *Thermocouples*

A.2.1.1 *General*

Thermocouples shall be Type K (Chromel/Alumel) mineral insulated 1.5 mm (nominal) diameter thermocouples with insulated junctions.

A.2.1.2 *Three thermocouples in the combustion chamber*, positioned (50 ± 10) mm below the top of the combustion chamber opening, (100 ± 10) mm behind the plane of the front face of the calibration boards. One thermocouple shall be positioned on the centre line of the combustion chamber opening, and the other two thermocouples shall be displaced (900 ± 10) mm either side of the centre line.

A.2.1.3 *Five thermocouples at level 1*, positioned to a tolerance of ±10 mm with the hot junction positioned (50 ± 5) mm in front of the face of the calibration boards at level 1. These shall be located on the centre line and at distances of 500 mm and 1 000 mm each side of the centre line (see Figure A.1)

A.2.2 *Three Gardon type total heat flux meters*, with nominal size of 2.5–5 cm, with a measuring range (0–100) kW/m^2, placed (1 000 ± 100) mm above the chamber opening. These shall be located on the vertical centre line of the combustion chamber opening and (500 ± 10) mm either side (see Figure A.1). The measuring element of the heat flux meter shall correspond to the face of the calibration board exposed to the heat source.

A.3 Procedure

A.3.1 *General*

Follow the test procedure in Clause 7.

A.3.2 *Temperature*

A.3.2.1 *Combustion chamber*

The temperature across the width of the combustion chamber opening shall be monitored by the three thermocouples located as shown in Figure A.1. The mean reading of the three thermocouples shall exceed a 600 °C temperature rise above the start temperature, T_s, over a continuous 20 min period. The variation between the mean temperature reading and any one thermocouple over the 20 min monitoring period shall not exceed ±20 °C.

A.3.2.2 *Level 1*

The mean temperature of thermocouples A, B and C shown on Figure A.1, at level 1 on the main face, shall exceed a temperature rise of 500 °C above T_s over a continuous 20 min period.

A.3.3 *Heat flux*

For fuel sources other than wood cribs, the mean heat flux measurement shall follow the profile exhibited in Figure A.2 and shall remain within the range of (45–95) kW/m^2 over a continuous 20 min period.

A.3.4 *Duration*

The nominal duration of the entire heating period shall be 36 min.

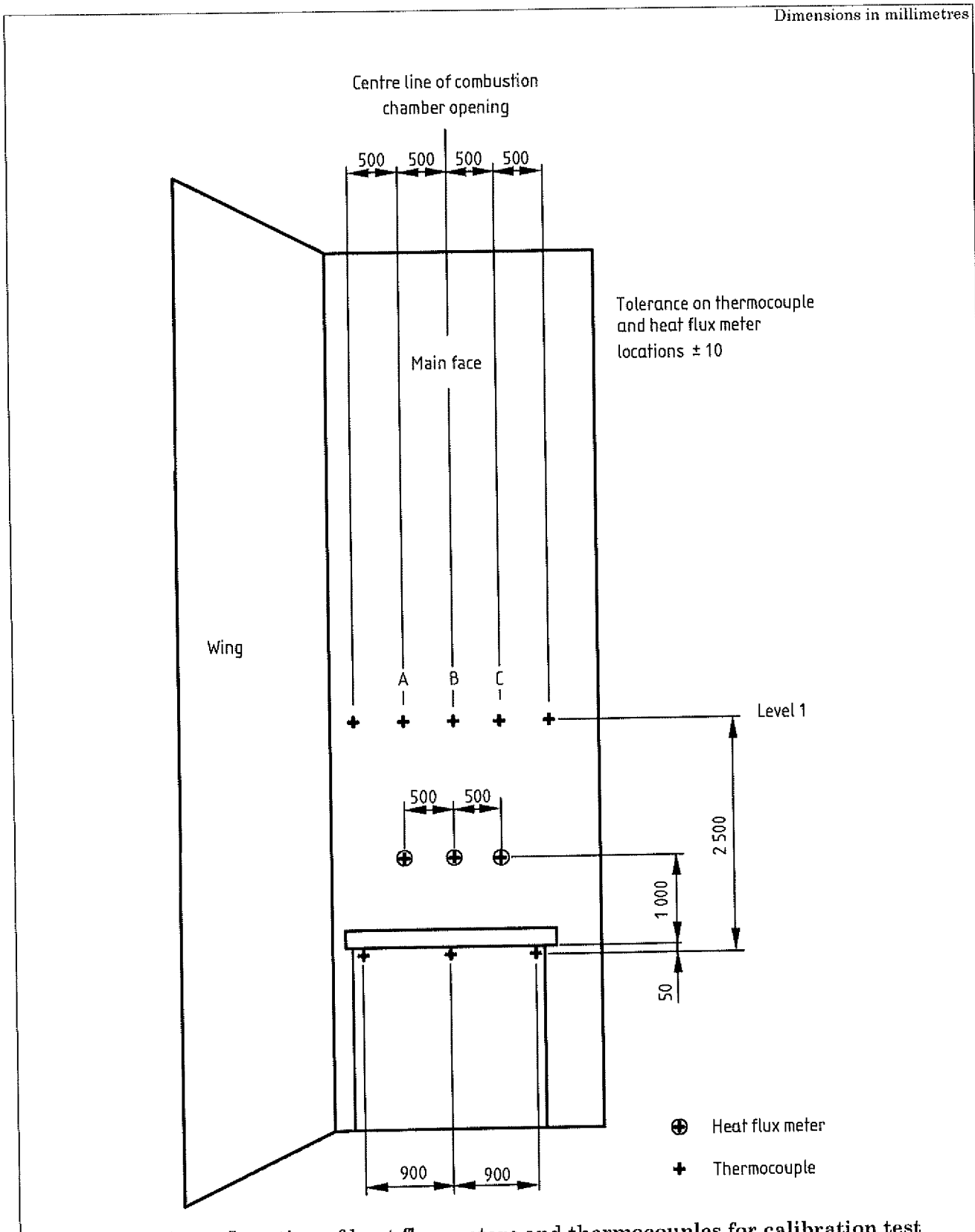

Figure A.1 — Location of heat flux meters and thermocouples for calibration test

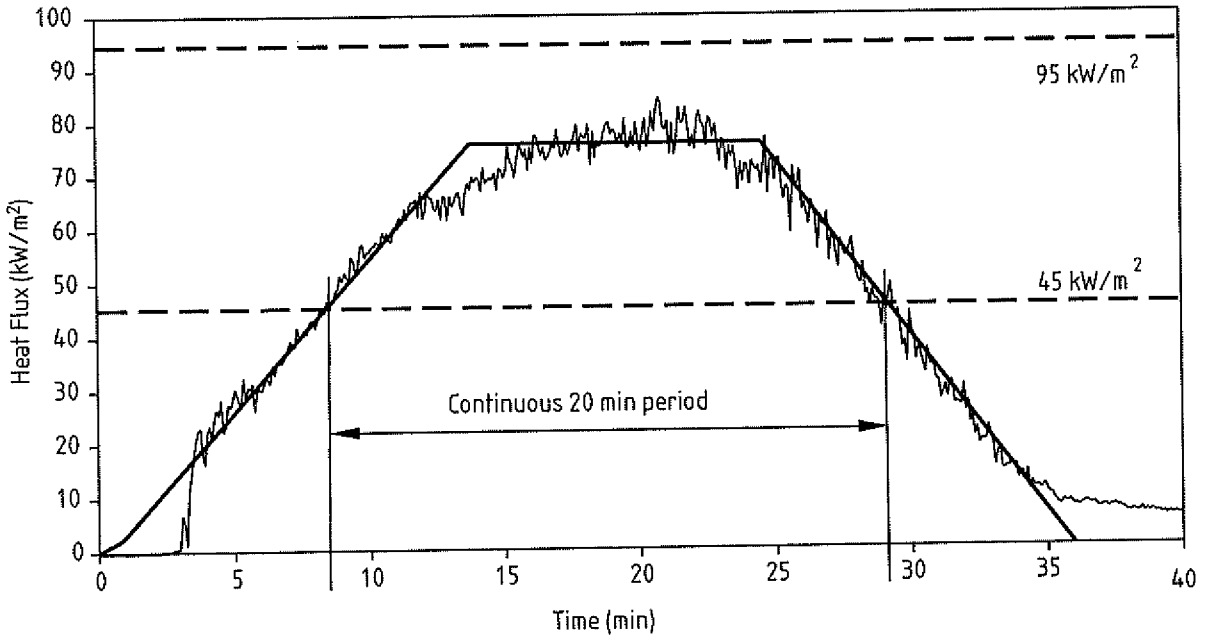

Figure A.2 — Mean heat flux time profile for fuels other than cribs

Annex B (normative)
Timber crib source

NOTE The heat source described in this Annex has been found to meet the criteria of Annex A and may be used without the need for any calibration exercise.

B.1 Apparatus

B.1.1 *Softwood sticks*, with nominal dimensions of 50 mm × 50 mm cross-section and nominal lengths of 1 500 mm and 1 000 mm. At the time of test the softwood shall have a moisture content in the range of 10 % to 16 % by mass.

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

B.2 Procedure

B.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 1 500 mm long sticks. 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.

B.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 B.1).

B.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.

Dimensions in millimetres

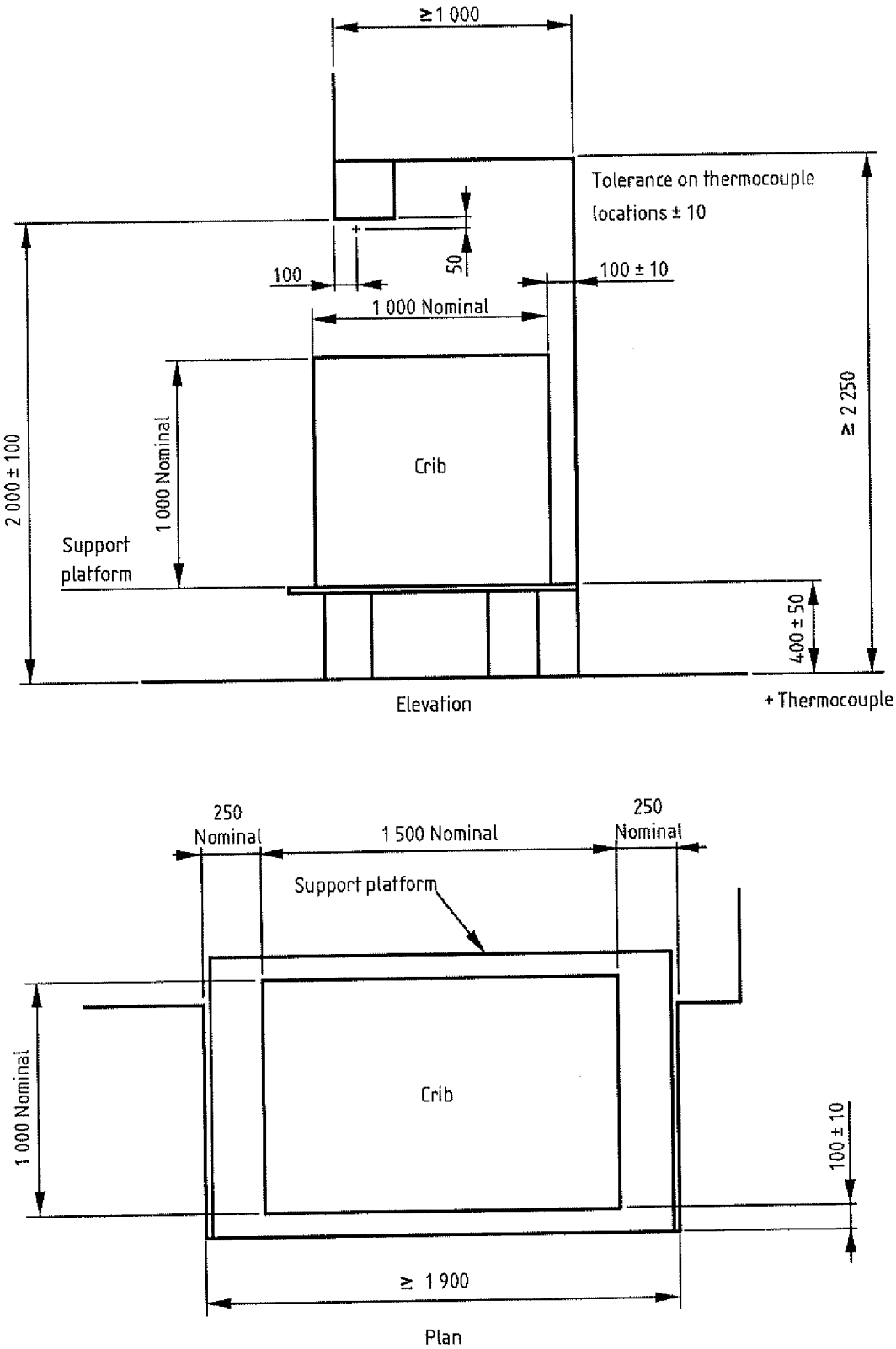

Figure B.1 — Elevation and plan of the combustion chamber

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[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.

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