BRITISH STANDARD

BS EN
717-2:1995
Incorporating
Corrigendum No. 1

Wood-based panels — Determination of formaldehyde release —

Part 2: Formaldehyde release by the gas analysis method

ICS 79.060.20

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This British Standard, having been prepared under the direction of the Technical Sector Board for Building and Civil Engineering, was published under the authority of the Standards Board and comes into effect on 15 March 1995

The following BSI references relate to the work on this standard:
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Amendments issued since publication

Amd. No.	Date	Comments
14072 Corrigendum No. 1	9 December 2002	Change to **7.4**

Contents

National foreword

This British Standard has been prepared under the direction of the Technical Sector Board for Building and Civil Engineering and is the English language version of EN 717-2:1994, *Wood-based panels — Determination of formaldehyde release* — Part 2: *Formaldehyde release by the gas analysis method*, including corrigendum July 2002, published by the European Committee for Standardization (CEN).

EN 717-2 was published as a result of international discussion in which the UK took an active part.

It is one of a series of standards specifying methods for determining formaldehyde release from wood-based panels. The other standards of this series are:

EN 120 *Wood-based panels — Determination of formaldehyde content — Extraction method called the perforator method.*

EN 717 *Wood-based panels — Determination of formaldehyde release — Part 1: Walk-in-chamber reference method.*

EN 717-3 *Wood-based panels — Determination of formaldehyde release — Part 3: Formaldehyde release by the flask method.*

There is no equivalent text to EN 717-2 in the British Standard for particleboard (BS 5669) or in the British Standard for fibreboards (BS 1142).

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 11 and a back cover.

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 717-2

November 1994

ICS 79.060.20

Incorporating corrigendum July 2002

Descriptors: Wood products, wooden boards, determination, release, formaldehyde, analysis methods, gas analysis

English version

Wood-based panels — Determination of formaldehyde release — Part 2: Formaldehyde release by the gas analysis method

Panneaux à base de bois —
Détermination du dégagement de formaldéhyde —
Partie 2: Dégagement de formaldéhyde par la méthode d'analyse de gas

Holzwerkstoff —
Bestimmung der Formaldehydabgabe —
Teil 2: Formaldehydabgabe nach der Gasanalyse-Methode

This European Standard was approved by CEN on 1994-11-24. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 112, Wood-based panels, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 1995, and conflicting national standards shall be withdrawn at the latest by May 1995.

The gas analysis method was developed during 1965 to 1973 by the European Federation of Associations of Particleboard Manufacturers FESYP. A summary appeared in 1969 under the title *FESYP Perforator Method, FESYP Gas Analysis Method* as Special Booklet 1/1969 of FESYP.

During the subsequent years this procedure was modified and improved in certain respects by the Wilhelm-Klauditz-Institut, Fraunhofer Working Group for Wood Research (WKI), Braunschweig. In September 1984 the gas analysis method became a German standard (DIN 52 368).

This standard is one of a series which specifies methods for determining formaldehyde potential in or formaldehyde release from wood-based panels. The other standards of this series are:

EN 120 *Wood-based panels — Determination of formaldehyde content — Extraction method called the perforator method.*

EN 717-1 *Wood-based panels — Determination of formaldehyde release — Part 1: Walk-in-chamber reference method.*

EN 717-3 *Wood-based panels — Determination of formaldehyde release — Part 3: Formaldehyde release by the flask method*[1)].

In accordance with the Common CEN/CENELEC Rules the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom

Contents

[1)] At present at the draft stage.

1 Scope

This European Standard describes a procedure for determination of accelerated formaldehyde release from wood-based panels.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard, only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 322 *Wood-based panels — Determination of moisture content.*

EN 326-1 *Wood-based panels — Sampling, cutting and inspection — Part 1: Sampling and cutting of test pieces and expression of test results.*

3 Principle

A test piece of known surface area is placed in a closed chamber in which the temperature, humidity, airflow and pressure are controlled to defined values. Formaldehyde released from the test piece mixes with the air in the chamber. This air is continually drawn from the chamber and passes through gas wash bottles, containing water, which absorbs the released formaldehyde. At the end of the test, the formaldehyde concentration is determined photometrically. The formaldehyde release is calculated from this concentration, the sampling time and the exposed area of the test piece and is expressed in milligrams per square meter and per hour (mg/m^2h).

4 Reagents

4.1 General

Reagents of recognized analytical purity and distilled or demineralized water (referred throughout the following text as distilled water) shall be used for the analysis.

4.2 Acetylacetone solution

4 ml acetylacetone are added to a 1 000 ml volumetric flask and made up to the mark with distilled water.

4.3 Ammonium acetate solution

200 g ammonium acetate are dissolved with distilled water in a 1 000 ml volumetric flask and made up to the mark.

NOTE Commercially prepared solutions may be used, provided it can be shown that they give an equivalent result.

5 Apparatus

5.1 The test apparatus (See Figure 1) comprises the following main components:

5.1.1 *Air filter* (1)

5.1.2 *Wash bottle*, 500 ml, containing ca. 400 ml distilled water (2).

5.1.3 *Desiccator*, 500 ml, containing silica gel (3).

5.1.4 *Air pump* (4).

5.1.5 *Needle value* (5).

5.1.6 Equipment for measuring rate of air flow through apparatus (6).

5.1.7 T*est chamber* (length: 555 mm, diameter: 96 mm, internal volume: 4 017 ml) with double casing of stainless steel or glass (7).

5.1.8 *Heating equipment of air* (e.g. copper coil inside the double casing) (8).

5.1.9 *Thermostat* (9).

5.1.10 *Magnetic valves* (10).

5.1.11 *Four pairs of wash bottles*, 100 ml (21).

5.1.12 *Pressure monitor* (22).

5.1.13 *Temperature monitor* (23).

5.2 Laboratory equipment

5.2.1 *Ventilated oven*, as described in EN 322.

5.2.2 Spectrophotometer with cells of 50 mm optical path length and capable of measuring absorbance at 412 mm.

5.2.3 *Water bath*, capable of maintaining a temperature of (40 ± 1) °C.

5.2.4 *Six volumetric flasks*, 100 ml (calibrated at 20 °C).

5.2.5 *Four volumetric flasks*, 250 ml (calibrated at 20 °C).

5.2.6 *Two volumetric flasks*, 1 000 ml (calibrated at 20 °C).

5.2.7 *Eight wash bottles*, 100 ml.

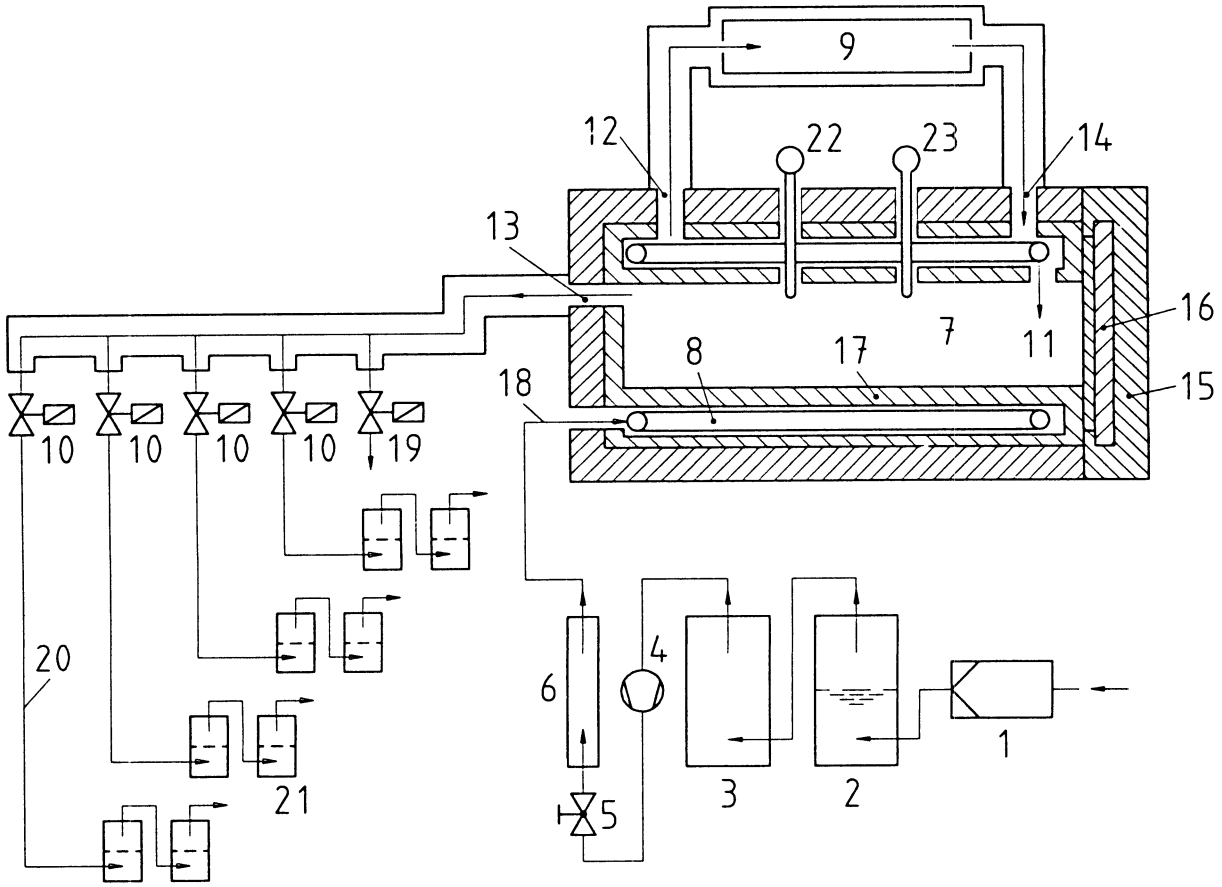
5.2.8 *Bulb pipettes*, 5 ml, 10 ml, 15 ml, 20 ml, 25 ml, 50 ml, 100 ml (calibrated at 20 °C).

5.2.9 *Five flasks*, 50 ml, (with stoppers).

5.2.10 *Microburrette*.

5.2.11 *Burette*, 50 ml, graduated in 0,05 ml (calibrated at 20 °C).

5.2.12 *Balance,* capable of measuring to 0,001 g.



1 Air filter
2 Wash bottle
3 Desiccator
4 Air pump
5 Needle valve
6 Equipment for measurement of air flow
7 Test chamber
8 Heating coil
9 Thermostat
10 Magnetic valves
11 Inlet of air (test chamber)
12 Heating medium (outlet)
13 Outlet of test air
14 Heating medium (inlet)
15 Insulation
16 Test chamber door
17 Double casing
18 Inlet of air (heating coil)
19 Magnetic valve for purging
20 Connecting tube
21 Pairs of wash bottles
22 Pressure monitor
23 Temperature monitor

Figure 1 — Gas analysis test apparatus

6 Test pieces

6.1 Selection of test pieces for production control

Sampling and cutting of the test pieces shall be in accordance with EN 326-1.

Test pieces are taken uniformly distributed over the width of the (cooled) board, but excluding a 500 mm wide strip at each end of the board as follows:

— for the determination of formaldehyde release, three test pieces of 400 mm × 50 mm × board thickness;

— for the determination of moisture content, five or six test pieces of 25 mm × 25 mm × board thickness.

All test pieces have to be placed in a hermetically sealed container immediately after cutting and stored at room temperature.

6.2 Selection of test pieces for other purposes

The procedure of taking test pieces (e.g. from boards already installed) shall be noted and described in the test report. The number and dimensions of the test pieces shall be as give in **6.1**.

6.3 Preparation of test pieces

The test pieces shall be edge sealed.

NOTE Three coats of polyurethane lacquer or self-adhesive aluminium tape have proved to be suitable.

7 Procedure

7.1 Number of determinations

Determinations shall always be made in duplicate using two different test pieces. If the individual values of a duplicate determination differ from each other by more than 0,5 mg/m^2 h then a third determination shall be made.

NOTE For internal inspection a single determination can be sufficient.

7.2 Determination of moisture content

Moisture content shall be determined according to EN 322 using a separate sample (see **6.1**).

7.3 Determination of formaldehyde release

Seal the edges of the test pieces in accordance with **6.3**.

Close the chamber (**5.1.7**) and pre-heat it to (60 ± 0,5) °C.

Connect two wash bottles (see **5.1.11**), each containing 20 ml to 80 ml distilled water, in series to the outlet of each magnetic valve (see **5.1.10**) using flexible tubing.

Place a test piece in the pre-heated test chamber. After closing the test chamber and starting the test, the test piece is uniformly exposed to practically formaldehyde free, heated air (60 ± 0,5) °C with a relative humidity of ≤ 3 %. Immediately set the air flow into the chamber to (60 ± 3) l/h, using the needle valve (**5.1.5**), and the air volume meter (**5.1.6**). This air is led into one of a series of pairs of wash bottles via a magnetic valve (**5.1.10**).

As the formaldehyde released from the test piece shall be determined at hourly intervals (up to 4 h from starting the test), a new series of wash bottles has to be connected up every hour. This exchange should be automatic.

Over the whole test period, the overpressure in the test chamber is monitored (**5.1.12**). An overpresure of 1 000 to 1 200 Pa shall be maintained over the entire test period.

Transfer the contents of each pair of wash bottles to a 250 ml volumetric flask (see **5.2.5**). Rinse the bottles and their associated tubing thoroughly and transfer the rinsings to the flask.

NOTE Care should be taken that the combined contents of the bottles and rinsings does not exceed 250 ml.

Make up the flask to the mark with distilled water and determine the formaldehyde content as specified in **7.4**

7.4 Determination of formaldehyde content of the aqueous solutions

7.4.1 *General*

The formaldehyde content of the aqueous solution from each 1 h sampling period shall be determined photometrically.

7.4.2 *Principle*

The determination is based on the Hantzsch reaction in which aqueous formaldehyde reacts with ammonium ions and acetylacetone to yield diacetyldihydrolutidine (DDL), DDL has an absorption maximum at 412 nm. The reaction is highly specific to formaldehyde.

NOTE Other suitable photometric procedures may also be used.

7.4.3 *Procedure*

10 ml are taken from the aqueous solution (**7.3**) with a pipette (**5.2.8**) and added to 10 ml acetylacetone solution (**4.2**) and 10 ml ammonium acetate solution (**4.3**) in a 50 ml flask (**5.2.9**). The flask is stoppered, shaken and warmed for 15 min in a water bath (**5.2.3**) at 40 °C. The solution is cooled to room temperature protected against the influence of light (about 1 h). The absorbance of this solution is determined at a wavelength of 412 nm against distilled water using a spectrophotometer (**5.2.2**). A blank value is determined in parallel with distilled water and taken into consideration in the determination of the gas analysis value.

7.4.4 *Calibration curve*

The calibration curve is produced from a standard formaldehyde solution, the concentration of which has been determined by iodometric titration. The calibration curve shall be checked at least once a week.

7.4.4.1 *Formaldehyde standard solution reagents:*

— standard iodine solution $c(I_2)$ = 0,05 mol/1;

— standard sodium thiosulfate solution $c(Na_2S_2O_3)$ 0,1 mol/1;

— standard sodium hydroxide solution c(NaOH) = 1 mol/1;

— standard sulfuric acid solution $c(H_2SO_4)$ = 1 mol/1;

— starch solution 1 % m/m.

The solutions shall be standardized before use.

About 1 g formaldehyde solution (concentration 35 % to 40 %) is diluted in a 1 000 ml volumetric flask (**5.2.6**) with distilled water and made up to the mark. The exact formaldehyde concentration of this solution is determined as follows:

20 ml of the formaldehyde standard solution is mixed with 25 ml iodine solution and 10 ml sodium hydroxide solution. After 15 min standing, protected from light, 15, ml of sulfuric acid solution is added. The surplus iodine is back-titrated with the thiosulfate solution. At the end of the titration some drops of starch solution are added as an indicator. A blank test with 20 ml distilled water is carried out in parallel.

The formaldehyde content is calculated by the following equation:

$$c(\mathrm{HCHO}) = (V_o - V) \times 15 \times c(Na_2S_2O_3) \times 1\,000/20 \quad (1)$$

where

c (HCHO) is the formaldehyde concentration, in milligrams per litre;

c ($Na_2S_2O_3$) is the thiousulfate concentration in mols per litre;

V is the volume of thiosulfate titration solution, in millimetres;

V_o is the volume of thiosulfate titration solution for the blank, in millilitres.

NOTE 1 ml 0,1 mol/1 thiosulfate solution corresponds to 1 ml 0,05 mol/1 iodine solution and 1,5 mg formaldehyde.

7.4.4.2 *Formaldehyde calibration solution*

Using the concentration determined in **7.4.4.1**, calculate the volume which will contain 3 mg formaldehyde. Transfer this volume, using a microburette, to a 1 000 ml volumetric flask and make up to the mark with distilled water. 1 ml of this calibration solution contains 3 μg formaldehyde.

7.4.4.3 *Determination of the calibration curve*

Pipette either zero, 5, 10, 20, 50 or 100 ml of formaldehyde calibration solution (**7.4.4.2**) in a 100 ml volumeric flask (**5.2.4**) and make up to the mark with distilled water. 10 ml of each dilution are analysed photometrically by the same procedure as described above (**7.4.3**). The absorbance values are plotted against the formaldehyde concentrations (1) (between 0 and 0,003 mg/ml) on the millimetre graph paper (see example in Figure 2). The slope (f) is either determined graphically, or calculated.

8 Expression of results

8.1 Gas analysis value

From each 1 h sampling period the gas analysis value G_i is determined and calculated by the following equation:

$$G_i = \frac{(A_S - A_B) \times f \times v}{F} \ [\mathrm{mg/m^2h}] \quad (2)$$

where

G_i is the formaldehyde content of the solution from each hourly sample in milligrams divided by the area of the exposed, unsealed surface;

i is the first, second, third or fourth hour;

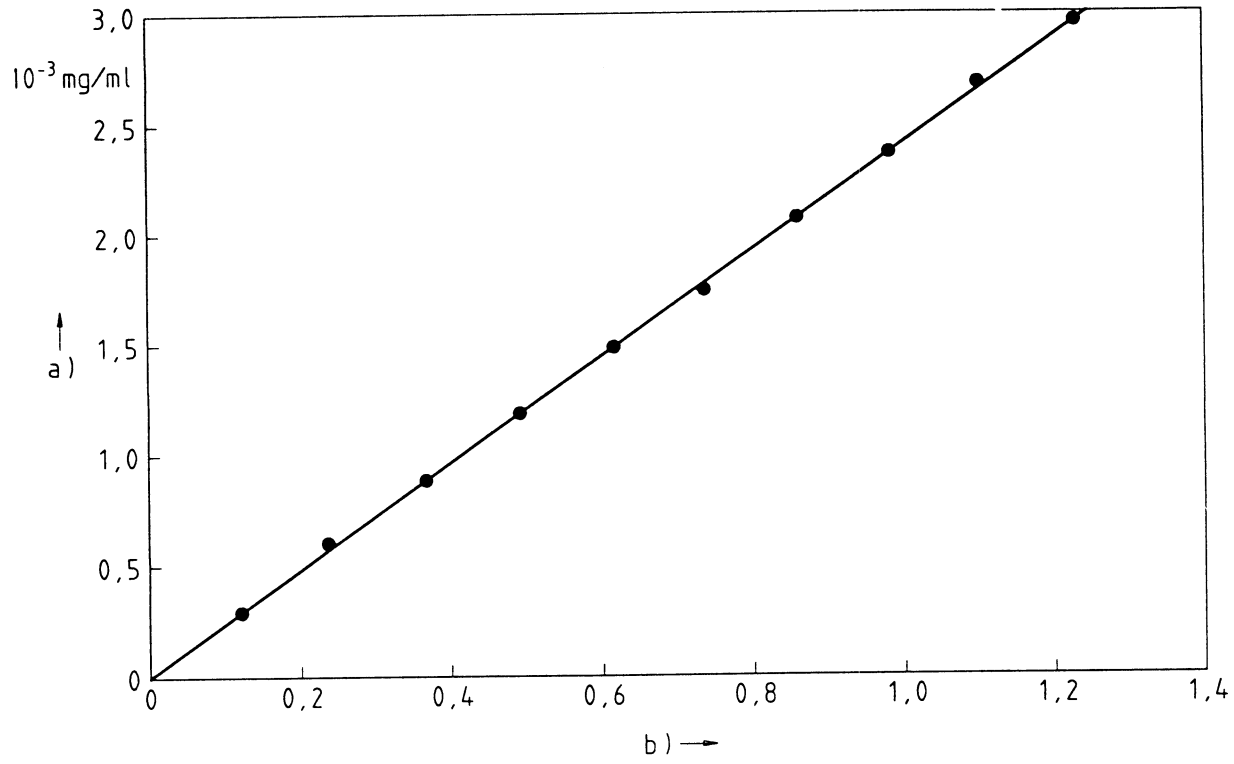
A_S is the absorbance of the solution from the wash bottles;

A_B is the absorbance of distilled water;

f is the slope of the calibration curve for standard formaldehyde solution, in milligrams per millilitre;

F is the combined area of the emitting (unsealed) surfaces, in square metres;

V is the volume of the volumetric flask, in millilitres.



$c = f \times (A_S - A_B)$

a) Concentration of the diluted calibration solution (c)

b) Absorbance ($A_S - A_B$)

Figure 2 — Example of a calibration curve for formaldehyde determined by acetylacetone method (path length 50 mm)

8.2 Calculation of results

As a rule the formaldehyde content of the liquid absorbent, taken during the first hour is lower than the content of the second hour, as the temperature of the test piece over the first hour does not reach 60 °C immediately. In this case the gas analysis value is calculated from the sum of the contents for hours 2 to 4 and is related to the surface area (F) of the test piece. If the maximum of formaldehyde content is reached during the first hour, the sum of all four hourly-samples is used for the calculation.

Consequently the average gas analysis value G_m of a test piece is calculated according to the appropriate equation:

$$G_m = \frac{G_2 + G_3 + G_4}{3} \quad \text{or} \qquad (3)$$

$$G_m = \frac{G_1 + G_2 + G_3 + G_4}{4}$$

where

G_m is the average gas analysis value of test piece, in milligrams formaldehyde per square metre and per hour.

The gas analysis value of the board is calculated from the G_m values of the test pieces.

8.3 Moisture content

See EN 322.

9 Test report

The test report shall be issued in accordance with EN 326-1 and shall contain the following additional information:

a) if appropriate and known, position (e.g. ceiling, floor, wall) and condition (e.g. moisture content, surface cladding and/or surface quality, fixing) of the board at the time of selection of the test pieces;

b) moisture content of board at the time of testing (see EN 322);

c) gas analysis value of the board together with the individual G_m values in milligrams formaldehyde per square metre and per hour.

National annex NA (informative)
Committees responsible

The United Kingdom participation in the preparation of this European Standard was entrusted by the Technical Sector Board for Building and Civil Engineering (B/-) to Technical Committee B/541, upon which the following bodies were represented:

American Plywood Association

Association of British Plywood and Veneer Manufacturers

British Woodworking Federation

Chartered Institute of Building

Coordinator for Timber and Timber Products

Council of the Forest Industries of British Columbia

Department of the Environment (Building Research Establishment)

Finnish Plywood International

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