Specification for

Urea-formaldehyde (UF) foam systems suitable for thermal insulation of cavity walls with masonry or concrete inner and outer leaves

UDC 678.652′41′21:692.232.2:699.86

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Plastics Standards Committee (PLM/-) to Technical Committee PLM/46, upon which the following bodies were represented:

Association of Building Component Manufacturers Ltd.
Brick Development Association
British Board of Agrément
British Plastics Federation
British Rigid Urethane Foam Manufacturers' Association
British Urethane Foam Contractors' Association (BUFCA)
Calcium Silicate Brick Association Limited
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Phenolic Foam Manufacturers' Association
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Shipowners' Refrigerated Cargo Research Association
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The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Building Employers' Confederation
Eurisol (UK) Association of Manufacturers of Mineral Insulation Fibres
Welwyn Hall Research Association

Amendments issued since publication

Amd. No.	Date of issue	Comments

This British Standard, having been prepared under the direction of the Plastics Standards Committee, was published under the authority of the Board of BSI and comes into effect on
31 July 1985

First published August 1978
First revision July 1985

The following BSI references relate to the work on this standard:
Committee reference PLM/46
Draft for comment 85/35764 DC

ISBN 0 580 14652 9

Contents

Foreword

This revision of BS 5617, which has been prepared under the direction of the Plastics Standards Committee, supersedes BS 5617:1978 which is withdrawn.

The successful insulation of external cavity walls still relies on two standards, i.e. this standard, which specifies requirements for the foam systems which would be suitable for the application and the second standard, BS 5618 which is the code of practice used by the installation contractor to satisfactorily install suitable foam systems.

Accordingly, BS 5617 addresses the interface between the foam system supplier and the installation contractor, and BS 5618 that between the installation contractor and his client.

In this revision the foam systems have been restricted to use in cavities with masonry or concrete inner and outer leaves, requirements relating to the activities of the installation contractor have been removed (and placed as recommendations in the revision of BS 5618), and the property requirements made more stringent.

Attention is drawn to the fact that the urea-formaldehyde resins used for foam system production have a limited shelf-life: during storage they will ultimately undergo changes and become unsuitable for use. It is therefore important that the manufacturer's recommendations with regard to storage should be observed if the maximum storage life is to be obtained.

Also foam systems differ according to the source of supply of the UF resin and the foaming hardener, and certain properties listed in Table 2 to Table 4 have therefore been given tolerances rather than specific values.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 10, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

A urea-formaldehyde foam system is generated at the point of injection from a mixture of aqueous resin solution, aqueous foaming hardener solution and air. The resin and hardener solutions are supplied at controlled rates to suitable foam system generating equipment from pressurized pots or by a pumping system.

The foam system, which is fluid at the time of injection into the cavity, sets shortly afterwards by chemical reaction. This chemical reaction continues and simultaneously loss of residual water occurs by absorption by and subsequent evaporation from the wall to produce the final foam.

Urea-formaldehyde foam systems complying with this standard have a fine, uniform, cellular structure which is vapour permeable. The foam is durable and has sufficient strength to be self-supporting in the cavity.

Because chemical reactions are taking place during the foam system injection process, some variation in foam properties can occur due to differences in in situ operating conditions. Foam system tests are carried out on site prior to injection to ensure that the quality of the system to be injected complies with this standard. These aspects are detailed in BS 5618.

The thermal insulation is achieved by the foam restricting air circulation in the cavity and by limiting radiation losses without adding substantially to the conducted heat loss. Its performance is therefore primarily determined by the extent to which the cavity is filled rather than by variations in the foam density.

1 Scope

This British Standard specifies the property requirements, the properties of the components and the production parameters, of urea-formaldehyde foam systems suitable for injection into external masonry or concrete cavity walls to provide improved thermal insulation.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply:

2.1
urea-formaldehyde (UF) foam

an infusible cellular matrix of cured urea-formaldehyde resin insoluble in water and other common solvents

2.2
urea-formaldehyde (UF) foam system

a mixture of urea-formaldehyde resin, hardener, surfactant, water, air and water additives

2.3
foaming hardener

a mixture of surface active agents and acids that enables a foam system to be produced by the introduction of air into an aqueous solution and will cause UF resin, when mixed into the foam system, to set to an insoluble, infusible matrix

2.4
cavity

an air space between two leaves of an external wall

2.5
effective density (*ED*)

the mass of a specified sample divided by its initial volume using the method described in Appendix A

2.6
declaration

the document supplied by the foam system supplier to the purchaser or to any authorized testing or approvals organization, containing relevant details for the proper use of the foam system

3 Property requirements

NOTE The quality of the foam system depends on the choice of components (see **4.1**) and their method of application as declared by the foam system supplier (see **4.2**).

3.1 Type tests

The UF foam system shall be such that the foam produced, when tested in accordance with the methods given in Table 1, with samples prepared in accordance with the declaration of the foam system supplier as specified in **4.2**, shall comply with the property requirements also given in Table 1. The samples required for the type tests given in Table 1 shall be conditioned to constant mass, at 23 ± 2 °C and 63 ± 5 % r.h., after being allowed to dry naturally for a period of three weeks.

3.2 Quality control tests

NOTE Details of when these tests are to be carried out are given in **6.5** of BS 5618:1985.

When tested in accordance with the methods given in Table 2, with samples prepared in accordance with the declaration of the foam system supplier as specified in **4.2**, the UF foam system shall comply with or, as appropriate, be such that the foam produced complies with the quality control requirements also given in Table 2.

4 Processing requirements

4.1 Foam system components

The application of the two foam system components, an aqueous solution of a urea-formaldehyde resin and an aqueous solution of a foaming hardener shall be as declared by the foam system supplier as specified in **4.2**.

The values of the properties given in Table 3 for the system components shall be declared for each foam system by the system supplier. The components shall then comply with the permissible deviations and limiting values given in Table 3.

Table 1 — Property requirements: type tests

Property	Requirement	Test method
Linear shrinkage, % max.	8	Appendix B
Water absorption, kg/m^2 max.	2	Appendix C
Thermal conductivity, W/(m·K) max.	0.035	Method 7 of BS 4370-2:1973
Resistance to microbial attack	No attack	Method 3 of BS 1982:1968
Ignitability	Class P	BS 476-5
Burning characteristics[a]	Extent of burning not to exceed 125 mm	BS 4735

NOTE 1 Because UF foam chars on contact with flame and emits little smoke, the presence of foam tends to reduce the risk of fire and smoke spread via the cavity. However, the use of UF cavity insulation does not affect requirements for the provision of cavity barriers.

NOTE 2 For design purposes an effective thermal conductivity value for UF foam installed in masonry cavity walls should be taken to be 0.04 W/(m·K). This aspect is more fully discussed in Appendix J of BS 5618:1985.

[a] **CAUTION. The small scale laboratory test described in BS 4735:1974 is solely for assistance in monitoring consistency of production and is not for use as a means of assessing the potential fire hazard of a material in use.**

Table 2 — Property requirements: quality control tests

Property	Requirements or limiting values	Permissible deviations	Test method
Effective density, kg/m^3	Target value specified by the system supplier	± 25 %	Appendix A
Linear shrinkage, % max.	10	—	Appendix B
Wet density, kg/m^3	Target value specified by the system supplier	± 20 %	Appendix D
Gel time, s	To be within the limits specified by the system supplier	—	Appendix E
Foam stability	Does not collapse	—	Appendix F
Appearance	Uniform, fine cellular structure	—	Appendix G

Table 3 — Limiting values and permissible deviations for foam system components

Property	Limiting values and permissible deviations on declared values	Test method
UF resin:		
Solid resin yield, % *m*/*m*	± 2	Appendix H
Density, g/mL	± 1.5 %	Use a hydrometer complying with BS 718
Viscosity, mPa·s	± 30 %	Method 1 of BS 5350-B8:1977
Free formaldehyde content, % *m*/*m*	Between 0 and 1	Appendix J
Water tolerance, % *V*/*V*	± 100	Appendix K
Foaming hardener:		
Total acidity, % *m*/*m*	± 2	Appendix L
Surfactant concentration, % KOH *m*/*m*	± 10	To be specified by system supplier

4.2 Declaration

The foam system supplier shall make a declaration for each foam system with respect to the following parameters.

a) The dilution at which the UF resin is to be used and the dilution procedure.

b) The dilution at which the foaming hardener is to be used and the dilution procedure.

c) The ratio to be used of the diluted UF resin to the diluted foaming hardener.

d) Any water hardness limitations and the method of correction.

e) The method of coping with variations in operating temperatures.

f) The data required in Table 2, the values of the properties given in Table 3 and the usable limits as required in Table 4.

5 Shelf-life limitations of foam system components

5.1 UF resin

NOTE The urea-formaldehyde resins of the type used for foam system production have a limited shelf-life. During storage they undergo changes and will ultimately become unsuitable for use.

The foam system supplier shall ensure that UF resins for use in UF foam systems specified by this standard shall remain usable for a period of 3 months when stored at temperatures up to 20 °C. The period shall be counted from the quality control release date and shall be stated for each container.

To ensure that UF foam system quality is not affected by the ageing of the UF resin the foam system supplier shall define usable limits for the resins in respect of the properties given in Table 4.

5.2 Foaming hardener

If there are shelf-life limitations on foaming hardener they shall be stated by the foam system supplier.

Table 4 — UF resin: shelf-life limitations

Property	Usable limits	Test method
Maximum viscosity, s Minimum water tolerance, % *V*/*V*	To be specified by the system supplier	Appendix M Appendix K

Appendix A Method for determination of effective density

A.1 Principle

The effective density is obtained from the sample by relating its dried mass to its original volume.

A.2 Test sample

A cylindrical shaped sample shall be produced in a polyethylene bag which is slightly greater in circumference than the internal circumference of the tube into which it is placed.

A.3 Apparatus

A.3.1 *Rigid tube,* approximately 450 mm long and approximately 200 mm internal diameter.

A.3.2 *Polyethylene bag,* of length approximately 1 000 mm and circumference approximately 10 mm greater than the internal circumference of the rigid tube.

A.3.3 *Sharp knife or saw blade,* approximately 400 mm long.

A.3.4 *Flexible measuring tape,* of glass fibre or equivalent material.

A.3.5 *Balance,* accurate to 1.0 g.

A.4 Procedure

Place the polyethylene bag inside the tube. Produce the foam sample by injecting through a hole in the bottom of the bag in order to minimize entrapment of air when filling the bag.

Allow the foam sample to remain within the tube for at least 24 h. After removal from the tube retain the foam in the polyethylene bag and cut a test specimen as a slice of uniform measured thickness, with its plane normal to the major axis of the tube and from near the tube centre as shown in Figure 1. The initial thickness of the test specimen shall be within the range 100 ± 10 mm. Allow the test specimen to dry naturally for a minimum of three weeks with the polyethylene cover removed.

Determine the mass of the sample using the balance to the nearest 1.0 g.

A.5 Calculation and expression of results

Calculate the effective density ED (in kg/m^3) from the equation:

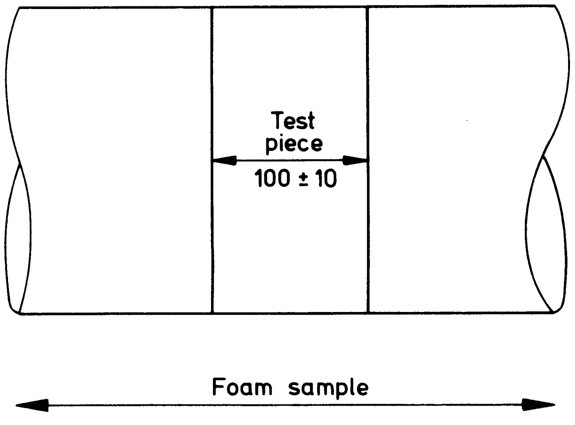
$$ED = \frac{F}{\pi r^2 L} \times 10^6$$

where

r is the internal radius of the tube (in mm);

L is the initial thickness of test specimen (in mm);

F is the final mass of the naturally dried test specimen (in g).



The dimension is in millimetres.

Figure 1 — Test sample for effective density and shrinkage tests

Appendix B Method for determination of linear shrinkage

B.1 Principle

The linear shrinkage is determined by measuring the reduction in circumference of a foam sample after drying for a specified period.

NOTE It is possible to carry out this test and the test for effective density described in Appendix A on the same test specimen.

B.2 Test sample

A cylindrical shaped sample shall be produced in a polyethylene bag which is slightly greater in circumference than the internal circumference of the tube into which it is placed.

B.3 Apparatus

B.3.1 *Rigid tube,* approximately 450 mm long and approximately 200 mm internal diameter.

B.3.2 *Polyethylene bag,* of length approximately 1 000 mm and circumference approximately 10 mm greater than the internal circumference of the rigid tube.

B.3.3 *Sharp knife or saw blade,* approximately 400 mm long.

B.3.4 *Flexible measuring tape,* of glass fibre or equivalent material.

B.4 Procedure

Place the polyethylene bag inside the tube. Produce the foam sample by injecting through a hole in the bottom of the bag in order to minimize entrapment of air when filling the bag.

Allow the foam sample to remain within the tube for at least 24 h. After removal from the tube retain the foam in the polyethylene bag and cut a test specimen as a slice of uniform measured thickness, with its plane normal to the major axis of the tube and from near the tube centre as shown in Figure 1. The thickness of the test specimen shall be within the range 100 ± 10 mm. Allow the test specimen to dry naturally for a minimum of three weeks with the polyethylene cover removed.

Measure the final circumference of the test specimen to the nearest millimetre.

B.5 Calculation and expression of results

Calculate the percentage linear shrinkage *LS* from the equation:

$$LS = \frac{(CT - CF)}{CT} \times 100$$

where

CT is the internal circumference of tube (in mm);

CF is the final circumference of the test specimen (in mm).

Appendix C Method for determination of water absorption

C.1 Principle

The water absorption is determined by floating a test piece of foam on water for 24 h and measuring the mass of water absorbed.

C.2 Test pieces

Two test pieces shall be tested. Each shall have cut surfaces with a base measurement of 100 ± 5 mm by 100 ± 5 mm and a height of 40 ± 5 mm.

A smooth clean surface is required with minimal damage to the structure of the foam surface.

C.3 Apparatus

C.3.1 *Balance,* accurate to 0.05 g.

C.3.2 *Water,* of known hardness, i.e. between 150 and 250 parts per million by mass calcium carbonate equivalent content and free of surfactant contamination.

C.4 Procedure

Cut the test pieces to the dimensions specified in **C.2**. Make accurate measurements of the dimensions to ± 0.5 mm and record the mass to the nearest 0.05 g.

Float each test piece on the water, the water temperature being maintained at 15 ± 1 °C, the whole test being conducted in air at a temperature of 23 ± 2 °C. After 24 h, remove the test piece and drain excess water for 30 s by holding the test piece with one corner of the base pointing downwards. Determine the mass of the test piece plus absorbed water to an accuracy of 0.05 g.

C.5 Calculation and expression of results

Calculate the water absorption *WA* (in kg/m^2) from the equation:

$$WA = \frac{M_a - M}{1000A}$$

where

M_a is the mass of the test piece plus absorbed water (in g);

M is the mass of the test piece (in g);

A is the area of the base (in m^2).

C.6 Report

This shall state the water absorption as the average of the values obtained for the two test pieces and the date of the test.

Appendix D Method for determination of wet density

D.1 Principle

The wet density is determined by weighing a container of known volume filled with foam system. The method is suitable for use on site with a bucket.

D.2 Test sample

The test sample shall be foam system as injected into the cavity.

D.3 Apparatus

D.3.1 *Wide open-topped container of known volume,* preferably wider at the top than at the bottom.

D.3.2 *Balance* (spring or pan) of sufficient capacity divided into 0.01 kg divisions.

D.4 Procedure

Determine the mass of the empty container (M_1). Fill the container (see note) with foam system, keeping the foam system injection nozzle below the foam system surface to minimize the production of entrained air pockets, and level off the foam system top using a straight-edged stick or knife. Determine the mass of the filled container to the nearest 0.01 kg (M_2).

NOTE The use of a thin plastics liner makes it much easier to keep the measuring container clean. Care should be taken to avoid trapping air between the liner and the container.

D.5 Calculation and expression of results

Calculate the wet density WD (in kg/m^3) from the equation:

$$WD = \frac{M_2 - M_1}{V}$$

where

M_1 is the mass of the container empty (in kg);

M_2 is the mass of the container and foam system (in kg);

V is the volume of the container (in m^3).

Appendix E Method for determination of foam system gel time

E.1 Principle

The gel time is the time elapsing from making the sample until the foam system is no longer fluid, i.e. it readily parts when a palette knife is drawn across it.

E.2 Apparatus

E.2.1 *Stop watch,* or other suitable timing device.

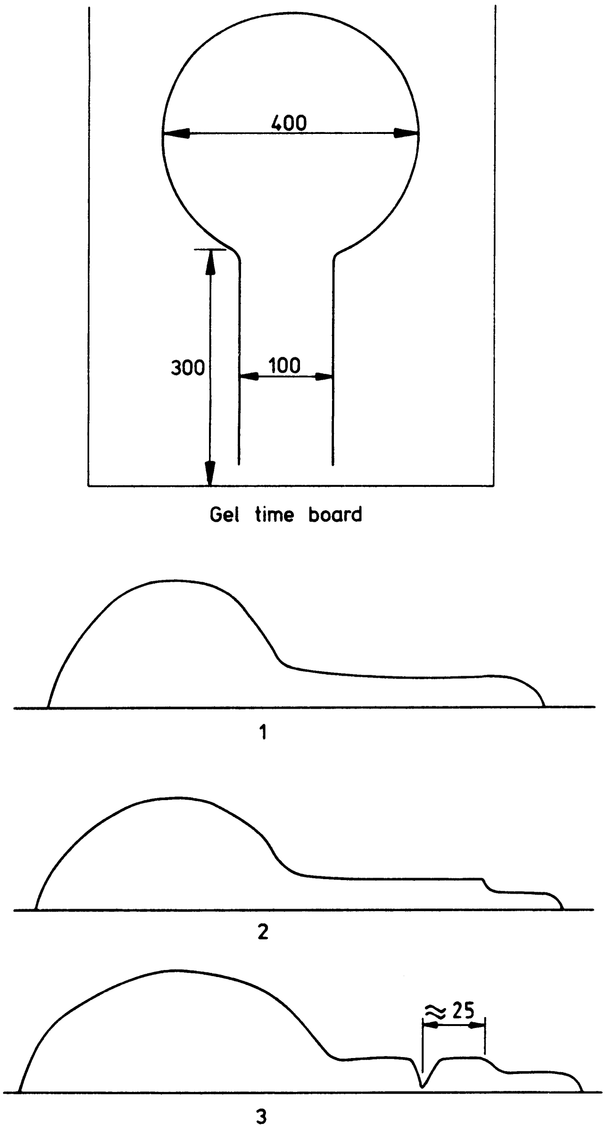
E.2.2 *Flat palette knife,* with blade 150 mm to 200 mm long and 24 mm to 40 mm wide.

E.2.3 *Clean board* at least 750 mm square, or, alternatively, a *polyethylene sheet.*

E.3 Procedure

Set up the foam system generating equipment to produce a foam system, in accordance with the method of application declared by the foam system supplier as specified in **4.2**. Take a sample for determination of gel time by forming a pile of foam system approximately 400 mm in diameter, then drawing the nozzle away from the pile to produce a ridge approximately 300 mm in length, 100 mm wide and 75 mm high (see Figure 2).

Start the stop watch as soon as the formation of the ridge has been prepared [see Figure 2(1)]. Start testing the gel time at the point on the ridge most remote from the conical pile by inserting a palette knife to two-thirds of the depth of the foam system and drawing it across the ridge in a direction normal to the principal axis of the ridge. Before the gel time has been reached the cut will not cause splitting of the foam system and it will retain its creamy consistency [see Figure 2(2)].



All dimensions are in millimetres.

Figure 2 — Determination of foam system gel time

Continue testing in this manner, inserting the palette knife into the foam system to make tests approximately 25 mm apart whilst progressing towards the conical pile. Record the time as the gel time when the foam system readily parts as the palette knife is drawn across it [see Figure 2(3)].

E.4 Expression of results

Report as the gel time of the foam system, the time elapsing between the start of the preparation of the ridge and the time when parting occurs.

Appendix F Method for determination of foam system stability

F.1 Principle

The absence of oil carry-over from the compressor is checked by the administration of a sharp shock to the foam system which will precipitate its collapse if significant quantities of oil are present.

F.2 Test sample

The test sample shall be a sample of foam system, of at least 5 L, in a suitable rigid container.

F.3 Procedure

Approximately 1 min after the foam system has gelled, determined by the method described in Appendix E, drop the container on to some hard ground from a height of approximately 100 mm.

F.4 Report

Report whether the level of foam system has significantly decreased.

Appendix G Method for determination of foam system appearance

G.1 Principle

The appearance of the cell structure obtained in the foam system is determined by visual examination.

G.2 Test sample

The sample of foam system shall be prepared as described in Appendix E.

G.3 Procedure

After the foam system has gelled, split the initial 400 mm diameter pile of foam system down the middle on the test board. Examine the section.

G.4 Report

Report whether the foam system has a fine, uniform, cellular structure with no pockets of collapsed foam system and with no evidence of formation of layers in the foam system structure.

Appendix H Method for determination of solid resin yield

NOTE The procedure described may be used with either powdered or liquid resins. This test is very sensitive to the oven characteristics.

H.1 Principle

The percentage loss in mass of the resin is determined after the resin has been heated under specified conditions.

H.2 Test sample

The test sample shall be approximately 3 g of resin.

H.3 Apparatus

H.3.1 *Ventilated oven,* capable of being maintained at a temperature of 120 ± 2 °C throughout the working space.

H.3.2 *Flat bottomed dish,* 70 mm to 90 mm in diameter and maximum depth of 100 mm.

H.3.3 *Desiccator,* containing silica gel.

H.3.4 *Balance,* capable of determining the mass to the nearest 0.001 g.

H.4 Procedure

Dry the dish for at least 30 min in the oven at a temperature of 120 °C. Cool in the desiccator and weigh to the nearest milligram.

Put into the dish 2 ± 0.2 g of resin, spreading the contents as evenly as possible over the bottom of the dish. Record the mass of the dish and contents to the nearest 0.001 g.

Place the dish and contents in the oven on a level perforated sheet metal shelf and maintain at a temperature of 120 ± 2 °C for a period of 3 h. Remove the dish and contents from the oven and allow to cool in the desiccator. Remove the dish and contents from the desiccator and redetermine the mass immediately.

H.5 Calculation and expression of results

Calculate the percentage solid resin yield *SRY* (in % solids *m*/*m*) from the equation:

$$SRY = \frac{(M_3 - M_1)}{(M_2 - M_1)} \times 100$$

where

M_1 is the mass of the dish;

M_2 is the mass of the dish and contents before heating:

M_3 is the mass of the dish and contents after heating.

Appendix J Method for determination of free formaldehyde content of UF resin

J.1 Principle

The determination of free formaldehyde in the UF resin is based on the reaction between sodium sulphite and formaldehyde and is carried out at a reduced temperature to prevent decomposition of the resin by the sulphite.

J.2 Reagents

J.2.1 *Hydrated sodium sulphite* 20 % (*m*/*m*) solution.

J.2.2 *Thymolphthalein indicator* 1 % (*m*/*m*) in 50 : 50 *V*/*V* 64 O.P. industrial methylated spirits: distilled water solution.

J.2.3 *Sulphuric acid.* c (H_2SO_4) = 0.5 mol/L.

J.2.4 *Sulphuric acid.* c (H_2SO_4) = 0.05 mol/L.

J.2.5 *Sodium hydroxide.* c (NaOH) = 0.1 mol/L.

J.3 Apparatus

J.3.1 *Conical flask,* 100 mL capacity, stoppered.

J.3.2 *Weighing bottle*

J.3.3 *Ice bath*

J.3.4 *Burette*

J.3.5 *Balance,* capable of determining the mass to the nearest 0.01 g.

J.4 Procedure

From the weighing bottle weigh accurately 6 ± 0.1 g of the resin into the stoppered conical flask.

Add 15 mL of deionized water and three to four drops of the thymolphthalein solution. Shake the mixture vigorously until the complete solution of the resin is obtained. Neutralize the solution with 0.1 mol/L sodium hydroxide or 0.05 mol/L sulphuric acid as required. Cool the solution to + 0.5 °C.

Add 25 mL of the sodium sulphite solution, previously cooled to a temperature of 0.5 °C. If free formaldehyde is present, a brilliant blue colour appears. Run in rapidly from the burette the 0.5 mol/L sulphuric acid until the colour disappears. Check the end point by adding one or two extra drops of the indicator solution and note if this addition causes any colouration. When no further colouration is observed the end point has been reached.

J.5 Calculation and expression of results

Calculate the percentage of free formaldehyde content *F* (in %*m*/*m*), from the equation:

$$F = \frac{3S}{M}$$

where

S is the volume of 0.5 mol/L sulphuric acid used (in mL);

M is the mass of the test portion (in g).

Appendix K Method for determination of water tolerance of UF resin

K.1 Principle

Water tolerance is determined by progressively diluting the resin solution to determine the dilution at which precipitation of the resin occurs.

NOTE The water tolerance is a measure of the degree to which the resin can be diluted. The correct water tolerance is an important factor in ensuring good foam formation.

K.2 Test portion

The test portion shall be undiluted resin, approximately 100 mL.

K.3 Apparatus

K.3.1 *Water bath,* capable of being maintained at a temperature of 25 ± 0.5 °C.

K.3.2 *Test tubes,* 152 mm × 25 mm *and test tube holders*.

K.3.3 *Glass sample jars,* two, with well fitting lids.

K.3.4 *Burette,* of capacity 100 mL.

K.3.5 *Beaker,* of capacity 100 mL.

K.3.6 *Measuring cylinder,* of capacity 50 mL with stopper.

K.3.7 *Pipette,* of capacity 10 mL.

K.3.8 *Glass stirring rod*

K.3.9 *Thermometer,* 0 °C to 100 °C.

K.3.10 *Timer,* 1 h.

K.3.11 *Balance,* capable of determining masses up to 50 g with an accuracy of 0.1 g.

K.4 Procedure

K.4.1 *Weighing method*

Add 6.5 ± 0.1 g, equivalent to approximately 5 mL, of resin to each of the test tubes and place in a rack in the water bath. First, add 5 mL of water from the burette, drop by drop, to each of the tubes, shaking well. In the same manner add to individual tubes appropriate quantities of water (see note) as shown in Table 5, selected on the basis of experience or a preliminary test. Shake continuously to ensure good mixing. Retain the tubes in the bath for 1 h before inspecting them.

NOTE It is very important not to over-dilute inadvertently at any time. Not more than 1 mL of water should be added at a time, and it should be added very slowly at the start when the resin is most viscous.

Over-dilution will result in premature precipitation and a false result.

K.4.2 *Volumetric method*

Bring the temperature of the water bath containing resin sample and tap water for dilution to 25 ± 0.5 °C. Measure 50 mL of the resin into the beaker and add 50 mL of tap water from the burette (see note to **K.4.1**) with constant stirring. Return some of the diluted resin back to the 50 mL cylinder, insert the stopper and shake for a few seconds. Pour the fluid back into the beaker.

Repeat the operation twice to ensure that all the resin in the cylinder is transferred to the beaker. Pipette 10 mL of the solution into each of the test tubes and add to individual tubes from the burette appropriate quantities of water as shown in Table 5, selected on the basis of experience or a preliminary test, and shaking continuously to ensure good mixing. Retain the tubes in the water bath for 1 h before inspecting them.

K.5 Calculation and expression of results

Some tubes will contain a uniformly white liquid, others will have a clear demarcation line between a clear solution and the white liquid. Note the maximum quantity of water which does not result in a clear demarcation and calculate the percentage water tolerance *WT* from the equation:

$$WT = \frac{(\text{Volume of water added} + 5)}{5} \times 100$$

For convenience, use Table 5.

Table 5 — Water tolerance conversion

Water added	Tolerance
mL	% V/V
0	100
2	140
4	180
6	220
8	260
10	300
12	340
14	380
16	420
18	460
20	500
22	540
24	580

K.6 Report

Report the percentage water tolerance *WT*.

Appendix L Method for determination of total acidity of foaming hardeners

L.1 Principle

The acid content (expressed as the % phosphoric acid) is determined by titration with standard alkali.

L.2 Reagents

L.2.1 *Sodium hydroxide solution.* c (NaOH) = 1.0 mol/L.

L.2.2 *Phosphate indicator solution.* Mix 2 parts of solution (A) with 1 part of solution (B).

solution (A): 0.1 % *m*/*m* phenolphthalein in 50 : 50 *V*/*V* 64 O.P. industrial methylated spirits: distilled water;

solution (B): 0.1 % *m*/*m* naphthol-phthalein in 50 : 50 *V*/*V* 64 O.P. industrial methylated spirits: distilled water.

L.2.3 *Distilled water or deionized water*

L.3 Apparatus

L.3.1 *Analytical balance,* accurate to 0.1 mg.

L.3.2 *Conical flask,* of capacity 250 mL.

L.3.3 *Burette,* of capacity 50 mL.

L.4 Procedure

Weigh approximately 3 g to 4 g accurately of hardener into the 250 mL conical flask. Dilute with approximately 50 mL of distilled or deionized water. Add 3 to 4 drops of indicator solution and titrate with 1.0 mol/L sodium hydroxide solution to a violet end point.

L.5 Calculation and expression of results

Calculate the total acidity, *A* (expressed as % phosphoric acid) from the equation:

$$A = \frac{4.9T}{M}$$

where

T is the titre (in mL);

M is the mass of the sample (in g).

L.6 Report

Report the total acidity *A* (expressed as % phosphoric acid).

Appendix M Method for determination of resin viscosity by the break time method

M.1 Principle

The break time of the resin is determined by measuring the time taken for it to flow through the orifice of a standard flow cup, before the stream breaks into droplets.

M.2 Test sample

The test sample shall be approximately 50 mL of UF resin.

M.3 Apparatus

M.3.1 *No. 6 flow cup,* complying with BS 3900-A6.

M.3.2 *Cup stand*

M.3.3 *Orifice plug* for each cup.

M.3.4 *Stop watch*

M.3.5 *Beaker,* of capacity 100 mL.

M.3.6 *Water bath,* capable of being maintained at 25 ± 0.5 °C.

M.3.7 *Thermometer*

M.4 Procedure

Immerse the resin sample, enclosed in a screw-topped bottle, and the test cup in the water bath for 2 h or until the resin sample has reached a temperature of 25 ± 0.5 °C. Dry the cup, plug it, clamp it into the stand, and place the beaker beneath the cup. Pour the resin sample into the cup until it runs into the overflow. Unplug the orifice so that the resin sample flows into the beaker, and simultaneously start the stop watch. Stop the watch when the first drip of resin appears, i.e. when the flow becomes discontinuous.

M.5 Report

Report the time recorded to the nearest second as the average of three results.

NOTE As the flow of these resins may be non-Newtonian, it is unsound to convert the break time to absolute units of viscosity.

Publications referred to

BS 476, *Fire tests on building materials and structures.*

BS 476-5, *Method of test for ignitability.*

BS 718, *Specification for density hydrometers.*

BS 1982, *Methods of test for fungal resistance of manufactured building materials made of or containing materials of organic origin.*

BS 3900, *Methods of test for paints.*

BS 3900-A6, *Determination of flow time by use of flow cups.*

BS 4370, *Methods of test for rigid cellular materials.*

BS 4370-2, *Methods 6–10.*

BS 4735, *Laboratory methods of test for assessment of the horizontal burning characteristics of specimens no larger than 150 mm × 50 mm × 13 mm (nominal) or cellular plastics and cellular rubber materials when subjected to a small flame.*

BS 5350, *Methods of test for adhesives.*

BS 5350-B8, *Determination of viscosity.*

BS 5618, *Code of practice for thermal insulation of cavity walls (with masonry or concrete inner and outer leaves) by filling with urea-formaldehyde (UF) foam systems.*

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