BRITISH STANDARD

BS 5241-2: 1991

Rigid polyurethane (PUR) and polyisocyanurate (PIR) foam when dispensed or sprayed on a construction site —

Part 2: Specification for dispensed foam for thermal insulation or buoyancy applications

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Plastics and Rubber Standards Policy Committee (PRM/-) to Technical Committee PRM/72, upon which the following bodies were represented:

Association of Building Component Manufacturers
Brick Development Association
British Board of Agrement
British Plastics Federation
British Rigid Urethane Foam Manufacturers' Association
Calcium Silicate Brick Association Limited
Cavity Foam Bureau
Chief and Assistant Chief Fire Officers' Association
Department of the Environment (Building Research Establishment)
Department of the Environment (Construction Industries Directorate)
Engineering Equipment and Materials Users' Association
Flat Roofing Contractors' Advisory Board
Loss Prevention Council
Ministry of Defence
National Cavity Insulation Association
National Federation of Roofing Contractors
National House-building Council
Phenolic Foam Manufacturers' Association
Polyethylene Foam Insulation Association
Royal Institute of British Architects

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Ceramic Research Ltd.
British Urethane Foam Contractors' Association (BUFCA)
Department of the Environment
Department of the Environment (Property Services Agency)
RAPRA Technology Ltd.

This British Standard, having been prepared under the direction of the Plastics and Rubber Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on
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Contents

Foreword

This Part of BS 5241 has been prepared under the direction of the Plastics and Rubber Standards Policy Committee, and is the final Part of the revision of BS 5241:1975, which is withdrawn.

The standard has now been divided into two Parts to bring the standard in line with the current technology.

In Part 1 the specific requirements of sprayed polyurethane and polyisocyanurate foams applied externally have been detailed, whereas Part 2 now covers the requirements for applications where foam is dispensed and introduces requirements for the thermal conductivity to be designated by the manufacturer.

The attention of contractors and purchasers is drawn to the fact that this specification covers the foam only. It may be necessary to apply primers or vapour retarders to the substrate to enhance the adhesion, prevent corrosion or reduce vapour transmission.

WARNING. Adequate fire precautions should be taken when repairing any structure containing polyurethane or polyisocyanurate foams. Do not use welding or flame cutting equipment.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, 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.

1 Scope

This Part of BS 5241 specifies the physical property and compositional requirements for dispensed polyurethane (PUR) and polyisocyanurate (PIR) foams used for thermal insulation of external surfaces and for positive buoyancy, e.g. small boats, buoys or pontoons, for surface applications.

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

2 Designation

The materials shall be designated according to their compression strength and ignitability characterisitcs into five types (see Table 1). Each type shall be further divided into subtypes by the addition of a code to indicate the thermal conductivity (see **5.2**).

NOTE The higher strength materials are clearly of benefit in robust applications, e.g. in very cold applications. Type 3 is preferred for buoyancy applications because of its greater resistance to water penetration (see Appendix A).

The designation shall consist of a three component code comprising the following items, in the order presented.

a) The number and date of this British Standard, i.e. BS 5241-2:1991.

b) A number indicating the foam type, as given in Table 1.

c) A double digit number to indicate the thermal conductivity selected in accordance with Table 2.

An example of the designation required for a type 4 foam with a thermal conductivity of 0.020 W/(m·K) (see **5.2**) is as follows:

BS 5241-2:1991/4/20.

3 Composition

The material shall be of rigid polyurethane (PUR) or polyisocyanurate (PIR) foam. A material indicated by (PUR) shall be substantially composed or urethane linkages and one indicated by (PIR) shall be substantially composed of isocyanurate linkages.

NOTE No requirements for odour is included as its assessment is largely subjective. However, it is recommended that the material should be free from objectionable odour.

4 Sampling

Samples shall be prepared in a suitably designed jig of similar thickness to the application, and constructed from the same material as the facing materials being treated.

5 Physical properties

5.1 General

The materials shall comply with Table 1 when tested in accordance with the methods listed therein.

5.2 Thermal conductivity

Thermal conductivity shall be determined by either method 7A or 7B of BS 4370-2:1991 at a mean temperature of 10 °C, 30 ± 2 days after manufacture. Materials shall be conditioned throughout this period at 23 ± 2 °C and 50 ± 5 % r.h.

NOTE See additional guidance in Appendix B on information concerning the thermal conductivity design values and on the values to be obtained 3 days after manufacture.

6 Marking

The material, packaging, or invoice shall be clearly marked with at least the following information:

a) the manufacturer's name or trademark;

b) the designation[1)] as given in clause **2**.

[1)] Marking BS 5241-2:1991 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsiblility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Table 1 — Physical properties

Physical property	Test requirement					Test method
	Foam type 1	Foam type 2	Foam type 3	Foam type 4	Foam type 5	
Density core minimum (in kg/m^3)	30	40	50	35	35	Method 2 of BS 4370-1
Minimum compressive strength (in kPa) (see Appendix A)	100	150	200	150	150	Method 3 of BS 4370-1 applying the force in a direction normal to the major plane of the foam
Dimensional stability: maximum change (in %)						Method 5A or 5B of BS 4370-1
24 h at – 15 ± 2 °C	1	1	1	1	1	
24 h at 100 ± 2 °C	2	2	2	2	2	
24 h at 125 ± 2 °C	—	—	—	2	2	
24 h at 70 ± 2 °C and 95 ± 5 % r.h.	3	3	3	3	3	
Closed cell content: minimum apparent volume (in %)	85	85	90	90	90	Method 10 of BS 4370-2
Burning characteristics: extent of burning (in mm)	< 125	< 125	< 125	< 125	< 25	Method 8 of BS 4735 (see cautionary note)
Maximum water vapour permeability [in ng/(Pa s m)]	5.5	5.5	3.5	5.5	8.5	Method 8 of BS 4370-2 at 38 °C and 88 % r.h.
Maximum apparent water absorption by volume (in %)	6.5	6.5	2.0	6.5	6.5	As described in Appendix B of BS 5241-1:1989

CAUTION. The small scale laboratory test described in BS 4735 is solely for assistance in monitoring consistency of production and is not for use as a means of assessing potential fire hazard of a material in use (see Appendix C).

Table 2 — Designation codes for thermal conductivity

Thermal conductivity[a] (see **5.2**)	**Code**
W/(m·K)	
0.015	15
0.016	16
0.017	17
0.018	18
0.019	19
0.020	20
0.021	21
0.022	22
0.023	23
0.024	24
0.025	25
0.026	26
0.027	27
0.028	28
0.029	29
0.030	30
0.031	31
0.032	32

[a] CAUTION. These values are 30 day values for quality control purposes. For corresponding long term design values the manufacturer's advice should be sought.

Appendix A Notes for designers

Attention is drawn to the following points of specific relevance to rigid PUR and PIR foams.

a) Type 1 are normally found to be suitable for most general purpose insulation between 0 °C and 85 °C, and for positive buoyancy in surface applications less than 1 m in depth. Higher compression strength materials, type 2, are used in thermal insulation applications where temperatures fall into the range – 30 °C to 85 °C and for buoyancy in water depths up to 3 m. Type 3 are used for temperatures – 100 °C to 85 °C and in water depths from 3 m to 10 m. Thermal insulation for temperatures lower than – 100 °C and buoyancy in depths of water greater than 10 m need special formulations not covered by this specification. Types 4 or 5 are to be used for thermal temperatures exceeding 85 °C but less than 150 °C.

Type 3 foams are also more stable for applications where a greater degree of robustness is required, such as applications in floats or tank roofs which may be subject to foot traffic.

b) When specifying materials for the insulation of district heating pipes designers should also consult BS 4508.

Appendix B Guidance on thermal conductivity design and 3 day values

In addition to the 30 day maximum thermal conductivity value which forms the specification value for the purposes of this standard, two related maximum thermal conductivity values have practical importance, and will be necessarily provided for the product by the manufacturer as follows.

a) Design value of thermal conductivity.

This figure takes into account the limited diffusion of gases which can take place in the foam with time. The design value should be used as a basis for user calculations. Generally this will be higher than or equal to the 30 day value.

b) The 3 day value of thermal conductivity.

This value is often used in manufacturing control operations, to ensure the quality of product is regularly maintained. Generally it will be lower than or equal to the 30 day value.

Appendix C Burning characteristics of polyurethane and polyisocyanurate rigid foams and recommendations regarding their use

Consideration of the fire performance of the finished structure incorporating rigid polyurethane (PUR) foam is relevant to the possible hazard associated with PUR foam. This should be assessed using BS 6336 which gives recommendations on how fire hazard should be considered, taking into account the design of the end product and any possible risk to which it might be exposed in use.

PUR foam is an organic, and hence combustible material. Care should be taken to avoid ignition, particularly since the burning rate of the foams, if exposed, can be significantly greater than that of wood. The contribution to fire growth of PUR is controlled by the type of finish or facing used in conjunction with the foam.

It is generally accepted that insulation contained behind facings of high heat capacity does not have a significant effect on the initial rate of fire growth which is primarily affected by the fire performance of the exposed surface lining. Recent research[2)] has indicated that generally, provided the insulation is contained within a cavity wall with limited ventilation so that circulation of air and hot gas is prevented in the cavity, an effective restriction to fire spread can be achieved.

Care should be taken during installation or repair of any structure or article which contains PUR to avoid any possible ignition sources.

[2)] Fire performance of combustible insulation in masonry cavity walls. B.F.W. Rogowski, *Fire Safety Journal*, 1984/85, **8**, 119–134.

Publication(s) referred to

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

BS 4370-1, *Methods 1 to 5.*

BS 4370-2, *Methods 6 to 10.*

BS 4508, *Thermally insulated underground pipelines.*

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

BS 5241, *Rigid polyurethane (PUR) and polyisocyanurate (PIR) foam when dispensed or sprayed on a construction site.*

BS 5241-1, *Specification for sprayed foam thermal insulation applied externally.*

BS 6336, *Guide to development and presentation of fire tests and their use in hazard assessment.*

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