

CONFIRMED
DECEMBER 2007

Glossary of

Thermal insulation terms

UDC 536.2:001.4

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSi
Documents

AVA

Document Sharing Hub

Cooperating organizations

The Refrigeration, Heating and Air Conditioning Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following:

Association of Consulting Engineers.	Electricity Supply Industry in England and Wales*
Association of Manufacturers of Domestic Electrical Appliances	Heating and Ventilating Contractors' Association
Boiler and Radiator Manufacturers' Association Limited	Hevac Association
British Combustion Equipment Manufacturers' Association	Institute of Fuel
British Gas Corporation*	Institute of Refrigeration
British Refrigeration and Air Conditioning Association	Institution of Gas Engineers*
Building Services Research and Information Association	Lloyd's Register of Shipping
Chartered Institution of Building Services	Manufacturers Association of Radiators & Convector Ltd.
Department of Energy — Energy Technology	Ministry of Defence
Department of Health and Social Security	National Coal Board
Department of the Environment (PSA)	Society of British Gas Industries
	Water-tube Boilermakers' Association

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the Technical Committee entrusted with the preparation of this British Standard:

Albury Laboratories Limited	Era Technology Ltd.
Asbestos Cement Manufacturers' Association Limited	Eurisol (U.K.) Association of Manufacturers of Mineral Fibre Insulation
British Ceramic Research Association	Fibre Building Board Development Organization Ltd.
British Rubber Manufacturers' Association	Gypsum Products Development Association
Cbmpe	Institution of Mechanical Engineers
Chemical Industries Association	Process Plant Association
Combustion Engineering Association	Royal Institute of British Architects
Cranfield Institute of Technology	Structural Insulation Association
Department of Industry — National Physical Laboratory	Thermal Insulation Manufacturers' and Suppliers' Association (TIMSA)
Department of the Environment — Building Research Establishment	Thermal Insulations Contractors' Association
Engineering Equipment Users' Association	Yarsley Testing Laboratories Ltd.
Eps Association	Coopted experts

This British Standard, having been prepared under the direction of the Refrigeration, Heating and Air Conditioning Standards Committee, was published under the authority of the Executive Board and comes into effect on 27 February 1981

© BSI 11-1999

First published August 1962
First revision February 1981

The following BSI references relate to the work on this standard:
Committee reference RHE/9
Draft for comment 79/74975 DC

ISBN 0 580 11833 9

Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

	Page
Cooperating organizations	Inside front cover
Foreword	ii
References	1
Section 1. Physical properties	1
Section 2. Insulating materials	4
Section 3. Descriptive terms	8
Section 4. Fittings and accessory materials	11
Index	14
Publications referred to	Inside back cover

Foreword

BS 3533 was first issued in 1962. The standard originated as a result of work on the preparation of British Standards for the properties, methods of test and applications of thermal insulating materials in general; it was recognized that the nomenclature employed required definition in order to avoid misrepresentation.

In the present revision the text has been brought up to date with technical developments and takes into account the need for harmony with other standard glossaries in related fields published since 1962. It also takes account of current work being undertaken by the International Organization for Standardization (ISO).

This glossary is intended to explain terms used in the insulation industry rather than to provide a full list of relevant scientific definitions. For this reason the term “description” is considered more appropriate than “definition” as normally used in British Standard glossaries. The descriptions are however compatible with the scientific definitions given in BS 874 and other British Standards publications. Where it has been considered to be helpful, the descriptions have been elaborated by explanatory notes, references and symbols.

Where units are indicated (in parentheses at the end of appropriate definitions), these are given in terms of the *Système International d’Unités* (abbreviated to “SI units”). For details see PD 5686.

The glossary has been divided somewhat arbitrarily into four sections dealing respectively with physical properties, insulating materials, descriptive terms, and fittings and accessory materials. In view of the relative infrequency of associated terms, items in the four sections have been tabulated in alphabetical order and an index has been provided for ease of reference.

Preferred terms are printed in bold type, and non-preferred terms in non-bold type. Terms considered undesirable because their use could lead to confusion are followed by the word “deprecated” in italics.

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.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 16, 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.

References

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

Section 1. Physical properties

NOTE For more detailed definitions of a number of the terms relating to thermal properties, see BS 874.

No.	Term	Description
101	absorptivity	The ratio of the amount of radiation absorbed by a surface to the amount falling on the surface. It can refer to radiation of any wavelength but commonly refers to solar radiation.
102	air permeability	The fluid permeability of a material where air is the given fluid. See 113.
103	bulk density	The mass per unit volume of the insulating material (kg/m ³).
104	compressibility	The relation between deformation and applied mechanical pressure on a material.
105	compressive strength crushing strength	The capacity of a material to withstand mechanical pressure up to the point of fracture. NOTE For materials that do not fail by shattering, the compressive strength may be deduced arbitrarily from a load/deformation curve.
106	convection coefficient (f_c)	The quantity of heat transferred by convection in unit time to or from unit area of surface, divided by the temperature difference between the surface and the surrounding air or other fluid [W/(m ² K)].
107	covering capacity (dry)	The area covered to unit thickness by unit mass of material as supplied, when it has been applied and dried to constant mass in accordance with BS 2972 (m ² per tonne at unit thickness).
108	creep	Progressive permanent deformation of a material under load.
109	dimensional change (expansion or shrinkage)	The increase or decrease in a characteristic dimension, which may be measured in linear, superficial or volumetric units.
110	emissivity (E)	The ratio of the thermal radiation from unit area of a surface to the radiation from unit area of a full emitter ("black body") at the same temperature.
111	equivalent thermal conductivity	The thermal conductivity assigned to a hypothetical uniform material of the same dimensions as a particular composite insulation that would give the same rate of heat flow under identical conditions.
112	flexural strength modulus of rupture cross-breaking strength	The capacity of a material to withstand bending up to the point of fracture.
113	fluid permeability	The property of a material that determines the rate at which a given fluid passes through it under the influence of unit pressure gradient. See 102.
114	mean free path	The average distance travelled by a gas molecule between successive collisions with other molecules.
115	nominal thickness designated thickness	Manufactured thickness within agreed tolerances.

No.	Term	Description
116	packing density	The bulk density of loose-fill insulating material after application.
117	permanent set	The deformation of a material that remains after removal of the deforming stress.
118	porosity (apparent)	The volume of open pores in a material expressed as a percentage of the total volume of the material.
119	porosity (true)	The combined volume of open and closed pores in a material, expressed as a percentage of the total volume of the material.
120	radiation coefficient (f_r)	The net quantity of heat radiated per unit time from unit area of a surface divided by the temperature difference between the radiating surface and the surroundings with which it is exchanging radiation [$W/(m^2 K)$].
121	radiation constant (σ) Stefan's constant	The constant of proportionality of the Stefan-Boltzman equation relating the radiation loss per unit area of the surface to the fourth power of the absolute temperature of a body. $\sigma = 5.67 \times 10^{-8} [W/(m^2 K^4)]$.
122	reflectivity (r)	The ratio of the amount of thermal radiation reflected from a surface to the amount that falls on the surface.
123	resilience	The ability of a material to recover or partly recover its original dimensions after deformation.
124	shape factor	A quantity derived from surface area divided by thickness, used in calculating heat transfer by thermal conduction and varying with the geometry of the insulation (m).
125	surface coefficient (f)	Thermal transmission per unit area to or from a surface in contact with air or other fluid, due to convection, conduction and radiation, divided by the difference between the temperature of the surface and the effective ambient temperature in "steady state" conditions [$W/(m^2 K)$]. NOTE 1 The value of the surface coefficient depends on many factors, such as the movement of air or other fluid, the roughness and emissivity of the surface and the temperature and nature of the surroundings. NOTE 2 The term "effective ambient temperature" is used to indicate that the actual measured temperature may need to be corrected for factors such as atmospheric humidity, solar radiation and wind velocity before comparable results can be obtained.
126	surface resistance ($1/f$)	The reciprocal of surface coefficient (see 125).
127	tensile strength	The capacity of a material to withstand tension up to the point of fracture.
128	thermal capacity	The quantity of heat required to raise the temperature of a given structure or quantity of material by 1 K.
129	thermal capacity per unit mass (c) specific heat capacity	The quantity of heat required to raise the temperature of unit mass by 1 K [$J/(kg K)$].
130	thermal capacity per unit volume	Thermal capacity per unit mass multiplied by bulk density [$J/(m^3 K)$].

No.	Term	Description
131	thermal conductance (C)	The thermal transmission through unit area of a slab of material, or of a structure, divided by the temperature difference between the hot and cold faces in “steady state” conditions [$\text{W}/(\text{m}^2 \text{ K})$]. NOTE 1 When the hot face and the cold face are not equal in area, e.g. the internal and external surfaces of insulation on a box or pipe, it is necessary to state the position at which the area is measured. NOTE 2 Thermal conductance depends upon the actual thickness of the material or structure, whereas thermal conductivity refers to unit thickness of the material.
132	thermal conductivity (λ)	The thermal transmission through unit area of a slab of a uniform material of unit thickness when unit difference of temperature is established between its faces [$\text{W}/(\text{m K})$]. NOTE 1 Thermal conductivity was formerly given the symbol k. NOTE 2 $\text{W}/(\text{m K})$ is a simplification of $\text{W m}/[\text{m}^2 \text{ K}]$.
133	thermal diffusivity (α)	Thermal conductivity divided by thermal capacity per unit volume (m^2/s).
134	thermal resistance (R)	The reciprocal of thermal conductance.
135	thermal resistivity ($1/\lambda$)	The reciprocal of thermal conductivity.
136	thermal transmission (q) heat flux	The quantity of heat flowing in unit time (W).
137	thermal transmittance (U) overall heat transfer coefficient	The thermal transmission through unit area of a given structure divided by the difference between the effective ambient temperatures on either side of the structure in “steady state” conditions [$\text{W}/(\text{m}^2 \text{ K})$]. NOTE 1 If the structure is not a simple slab, it is necessary to state where the area is measured. NOTE 2 “Transmittance” differs from “conductance” because the temperature difference is measured between different positions. For conductance the temperature difference is that between the faces; for transmittance it is that between the effective ambient temperatures on either side of the structure. Thus the thermal transmittance (U) of a structure involves both the thermal conductance and the surface coefficient of the structure. NOTE 3 The term “effective ambient temperature” is used to indicate that the actual measured temperature may need to be corrected for factors such as atmospheric humidity, solar radiation and wind velocity before comparable results can be obtained. The U-value is normally referred to a particular combination of these factors.
138	total thermal resistance ($1/U$)	The sum of the surface resistances and the thermal resistance of the structure itself.
139	U-value	A conventionally used value of thermal transmittance of a structure related to design conditions. NOTE For calculation of standardized U-values, reference should be made to Building Research Establishment Digest no. 108.
140	vapour permeance	The property of a material that determines the rate at which vapour passes through it under the influence of unit partial water vapour pressure difference across the specimen [$\text{g}/(\text{s MN})$]. NOTE For water vapour permeance conversion factors see BS 2972.
141	vapour permeability	The vapour permeance of a material per unit thickness [$\text{g m}/(\text{s MN})$]. See also BS 3177.
142	vapour resistance	The reciprocal of vapour permeance (see 140).
143	vapour resistivity	The reciprocal of vapour permeability (see 141).