
British Standard

Coatings for fire protection of building elements

Part 1. Code of practice for the selection and installation of
sprayed mineral coatings

Revêtements de protection contre l'incendie des éléments de construction

Partie 1. Choix et installation des isolants minéraux pulvérisés — Code de bonne pratique

Brandschutzüberzüge von Bauteilen

Teil 1. Leitfaden für die Auswahl und die Anwendung gespritzter anorganischer Überzüge

Foreword

This British Standard has been prepared under the direction of the Elements and Components (of Diverse Materials) for Buildings Standards Committee. This Part of BS 8202 covers all types of sprayed mineral coatings, with the exception of sprayed asbestos, which is now prohibited by law. It supersedes DD 71 : Part 1 which is withdrawn. The eventual aim is to recommend the standard for adoption by ISO as an international standard.

This standard gives recommendations for the selection and installation of sprayed mineral coatings for fire protection of building elements. However, the same coatings are used for thermal insulation of buildings, pipework and equipment, for noise level reduction and condensation control in buildings and for lining refractories. A new British Standard covering thermal and acoustic uses of sprays is in preparation.

There are various methods of assessment of fire resistance which may be based on systematic testing or theoretical considerations. For further guidance, see ASFPCM/Constrado 'Fire Protection for Structural Steel in Buildings*'. Research covering the following topics is in progress:

- (a) assessment of fire resistance of structural steel rolled, hollow and castellated sections;
- (b) prediction of fire resistance. (See 'European recommendations for the fire safety of steel structures'†.)

A method for measuring bond strength between coatings and substrates is described in DD 156.

Specialist advice can be provided by appropriate organizations represented on the committee as listed on the back cover.

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

* Obtainable from Association of Structural Fire Protection Contractors and Manufacturers, 45 Sheen Lane, London SW14 8AG.

† Published by Elsevier Scientific Publishing Co. Amsterdam 1983.

Contents

	Page
Foreword	Inside front cover
Committees responsible	Back cover
Code of practice	
1 Scope	2
2 Definitions	2
3 Independent validation	2
4 General	2
5 Substrate preparation	3
6 Methods of mechanical retention	4
7 Structural fire protection	8
8 Fungal growth	9
9 Workmanship	9
Appendices	
A Structural fire protection on ships	16
B Density test	16
Table	
1 Types of mechanical retention	5
Figures	
1 Mechanical retention	6
2 Encapsulation and re-entrant profiles	10
3 Cases where there is no re-entrant profile or encapsulation	11
4 Typical equipment for application of sprays	13
5 Typical needle gauge for direct measurement of coating thickness	15
6 Measurement of coating thickness to the face of laths	15

Code of practice

1 Scope

This Part of BS 8202 gives recommendations for the selection and installation of sprayed mineral coatings to enhance fire resistance of building elements. It describes methods of application to various types of surface in varying densities and finishes.

This standard is intended for the guidance of specifiers, applicators and site inspectors.

NOTE 1. Recommendations for structural fire protection in ships are given in appendix A.

NOTE 2. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 8202 the following definitions apply.

2.1 spray. Sprayed mineral coating.

2.2 adhesive retention. Use of an additional material to improve the bond of the spray to a substrate.

2.3 mechanical retention. Use of mechanical system(s) to retain the spray in-situ.

NOTE. See clause 6.

3 Independent validation

3.1 The appropriate independent validation should be provided as evidence that the recommendations of this standard have been followed. For many applications particularly those relating to building control, it will be necessary for the specifier, manufacturer and/or applicator to produce test reports from an approved testing laboratory to show that the required performance criteria can be achieved.

Any changes in the spray system, i.e. primer, spray and surface finish, or its method of application may affect its performance. Ideally, performance tests previously carried out should be repeated to ensure that the level of performance is not affected. However, in practice this is not always possible because of the cost of some types of test, particularly fire resistance tests complying with BS 476 : Part 21, and because of the range of variables which may occur, e.g. raw materials may be obtained from several sources or a spray may be required to be used with a large number of different primers. Thus changes in the chemical or physical nature of the components of the spray or their relative proportions should be the subject of a full re-test in accordance with the appropriate performance standard whilst detail changes in the spray system may be validated without repeating the appropriate performance test, using analytical laboratory tests and/or reduced scale performance tests. It is important that any reduced scale tests can be shown to correlate with the appropriate performance standard. In many cases the spray manufacturer/supplier would be the only source of this information. The justification for any assessment of changes in the spray system should be available for inspection as appropriate.

Assessments of the performance of spray systems are often required where it is not practical to test the full range of the substrate shapes and/or sizes with which the system may be used, e.g. structural steelwork. In such cases assessments by an appropriate authority, based on relevant test information relating to the specific spray under consideration, may be accepted in addition to fire performance tests.

3.2 Where materials and methods are used that are not referred to by this standard, their use is not discouraged, provided that:

- (a) they are proven by test; and
- (b) they are such as to ensure a level of performance at least equal to that recommended in this standard.

4 General

4.1 Composition

4.1.1 General. Spray comprises the principal ingredients given in 4.1.2, 4.1.3 and 4.1.4.

4.1.2 Base, as given in either (a), (b) or (c).

(a) *Various man-made mineral fibres*, having a length to breadth ratio of at least 3 to 1.

NOTE. Man-made mineral fibres are fibres of inorganic composition, generally manufactured by a smelting process.

(b) *Exfoliated vermiculite*, complying with BS 3797 : Part 2.

NOTE. Vermiculite is the name given to a group of hydrated laminar minerals resembling mica in appearance and composed of hydrated aluminium iron magnesium silicates. When vermiculite is subjected to intense heat, it expands to many times its original volume. This phenomenon is known as exfoliation.

(c) *Expanded perlite*, complying with BS 3797 : Part 2.

NOTE. Perlite is a naturally occurring volcanic rock, principally composed of silica and alumina, and contains 2 % to 5 % occluded water, which, upon rapid heating to high temperature, causes expansion of the material to many times its original volume.

4.1.3 Binding agent. Typical examples of binding agents are hydraulic binders, such as Portland cement complying with BS 12, high alumina cement complying with BS 915 : Part 2 or gypsum plaster complying with BS 1191 : Part 1.

4.1.4 Fillers. Typical fillers are hydrated lime, limestone or other aggregate.

4.2 Choice of product

Sprays are versatile materials which will cover areas of irregular size and shape including complex angles and profiles. However, each product should be chosen carefully so as to meet the particular requirements for a given end use. For example, in an external environment or in damp conditions some products may be unsuitable or may require additional weather protection. The variety of products and application methods available enable a wide range of surface finishes to be obtained, ranging from flat surfaces to highly textured surfaces.

4.3 Decorative and protective surface finishes

Where decorative or protective surface finishes are required either initially or subsequently (owing to change of occupancy or use of buildings), it is essential to ensure that the applied finish is compatible with the spray and does not impair its performance. Attention is drawn to the risk of detachment of the spray brought about by excessive weight of the applied finish. This will depend on a number of factors, e.g. orientation of the substrate, type of coating and type of finish, and is particularly important where dense finishes are being applied to low density coatings.

Any surfacing material should satisfy the appropriate requirements of any approving authority, which may include the following:

- (a) non-combustibility, when tested as described in BS 476 : Part 4;
- (b) fire propagation, when tested as described in BS 476 : Part 6;
- (c) surface spread of flame, when tested as described in BS 476 : Part 7;
- (d) heat emission, when tested as described in BS 476 : Part 11.

In all applications the elasticity of the surfacing material has to accommodate any dimensional movement of the spray.

4.4 Health and safety considerations

This Part of BS 8202 covers a wide range of different types of material. The need for site controls will vary according to the type of material being used. The application of some types of spray may generate levels of dust and particulate matter sufficient to cause irritation of the skin, eyes and respiratory tracts. For guidance on personal exposure and exposure limits reference should be made to the guidance notes published by the Health and Safety Executive.

5 Substrate preparation

5.1 General

The purpose of substrate preparation is to ensure that:

- (a) an adequate bond or retention of the spray is obtained to enable it to perform its required function; and
- (b) the spray is compatible with the materials to which it is applied.

The initial surface condition of any substrate is important when considering bonding of any coating to it, i.e. the surface should be free from oil, grease, dirt, dust, scale, mould release agents or other materials likely to impair adhesion.

When deciding on substrate preparation, which in cases of inadequate bond may involve mechanical retention (see clause 6), it is essential to consider the following:

- (1) nature of surface, including any finishes applied prior to application of the spray;
- (2) geometric shape of the substrate;
- (3) vibration;

- (4) thermal movement;
- (5) properties of the spray;
- (6) evidence of adequate bond between the spray and the substrate;
- (7) any possible effects of high temperatures on the bonding or retention of the mix to the substrate.

It is not possible to give recommendations for all types of spray and all surface conditions in this standard. Recommendations for common substrates are given in 5.2.

5.2 Common substrates

5.2.1 Painted surfaces. All paint finishes other than compatible primers should be removed prior to application of the spray, unless mechanical retention is being used (see clause 6) or there is fire resistance data showing that the presence of the paint will not adversely affect the performance of the coating. Where mechanical retention is used, it is still necessary to use an alkali-resistant sealer coat (see 5.3) where the paint is not chemically compatible with the spray.

NOTE. Portland cement has an initial pH value of 12 to 12.5 and cement-bound mixes may, therefore, attack alkali-sensitive paints, e.g. paints containing alkyd binders. Paints containing water sensitive binders are also attacked by sprays.

5.2.2 Concrete and masonry. It may be necessary to reduce the suction of masonry by applying a light water spray or a suitable sealer (see 5.3). Normal sound clean concrete surfaces require no particular treatment but very smooth surfaces, as for example concrete cast against a hard impervious form face, are liable to require the use of mechanical or other treatment, e.g. abrasive blasting, to provide a suitable key (see also 7.5).

5.2.3 Gypsum plaster and plasterboard. Portland cement-bound sprays should not be applied directly to unsealed gypsum plaster surfaces or plasterboard, as the setting characteristics of the cement can be affected and bond loss may result.

5.2.4 Metals. Primers are not usually needed for Portland cement-bound sprays if the building environment is such that it will remain dry after construction. Careful consideration should be given to the need for priming of ferrous metal surfaces, bearing in mind possible changes in use or occupancy of the building following application of the spray. Any primer used has to be compatible with the spray to be applied. For guidance on protective measures, see BS 5493.

Plastics coated metals should be chemically compatible with the spray. Most plastics materials have a smooth surface, which can cause adhesion problems. Mechanical retention will normally be necessary and specialist advice should be sought.

'White rusting' of zinc coated steel, which can result in corrosion of the base steel, may occur in continually damp conditions and where ventilation is poor. Under these conditions it is advisable to prime steel surfaces which have been zinc coated, e.g. galvanized, using a primer system compatible with both the coated steel and the cement based spray. Specialist advice should be sought.

On large flat steel surfaces mechanical retention (see clause 6) should be used.

Aluminium should be sealed (see 5.3) before applying alkaline materials, e.g. cement-bound sprays.

5.2.5 *Plastics materials (including glass reinforced and foam materials).* Specialist advice should be sought. Many plastics materials are flexible and temperature sensitive.

5.2.6 *Timber and wood-based materials.* Timber and wood-based materials are subject to high drying shrinkage and moisture movement. A water resistant sealer should be used before applying the spray (see 5.3).

5.2.7 *Gaps and joints.* Sprays are suitable for bridging static gaps up to 15 mm wide. Wider gaps should be bridged using an appropriate supporting material before applying the spray.

Minor movement of the substructure may be accepted without making special provisions, as the spray has sufficient inherent elasticity to meet this condition. Where excessive structural movement is anticipated, a movement joint should be provided in the spray, with mechanical retention on either side of the joint.

5.3 Sealers and bonding agents

Alkali-resistant and water-resistant sealers may be needed to prime particular surfaces. It is essential to check that the sealer to be used is compatible with the surface to which it is being applied.

Adhesives or key coats may be used to improve bonding of sprays to various substrates. The adhesives used are normally based on polyvinyl acetate, styrene butadiene or acrylic emulsions. These are often mixed with a cementitious base.

Special care should be taken to ensure that any primers or adhesives will not adversely affect the performance of the spray (see 7.4).

6 Methods of mechanical retention

6.1 General

6.1.1 The need for mechanical retention, and the type and extent to be used, will depend on a number of factors, e.g. proposed use, substrate details, environmental factors and properties of sprayed material. Some particular circumstances in which it is necessary to include mechanical retention are given in clause 7. Details of the different techniques available for providing mechanical retention are given in 6.2.

6.1.2 Consideration should be given to the need for mechanical retention to ensure adequate retention to the substrate and/or cohesion within the spray. (Certain types of mechanical retention may not always perform both functions.) If necessary, specialist advice should be sought, e.g. ASFCM/Constrado 'Fire Protection for Structural Steel in Buildings'.

Lack of adhesion to the substrate can be caused by:

- (a) the nature of the substrate, e.g. chemical composition, surface texture, orientation and shape; or
- (b) contamination of the substrate, e.g. by oil; or
- (c) the existing surface finishes; or
- (d) environmental factors, e.g. vibration.

Lack of cohesion within a spray can arise in certain circumstances, e.g. where the coating thickness exceeds a certain value depending on the type of spray.

6.2 Types of mechanical retention

6.2.1 *Introduction.* A wide range of mechanical retention systems and components are available (see table 1). The most common of these are described in this clause but other systems or components may be acceptable (see clause 3). In certain circumstances a combination of systems may be necessary.

The properties of the materials from which the various components are made should be taken into account when deciding on the most appropriate system, e.g. strength, rigidity, resilience, temperature resistance, weather resistance, chemical compatibility, resistance to corrosion. Steel components are most commonly used, particularly for fire protection purposes, where good temperature resistance is necessary. Aluminium components are sometimes used. Galvanic (bi-metallic) corrosion arising from the use of dissimilar metals is not significant in most cases. However, as aluminium is subject to attack by alkaline materials, it is not suitable for use with Portland cement-bound sprays unless suitably protected. For further guidance see appendix A and table 3 of BS 5493 : Part 20 : 1977.

Plastics components and organic adhesives have been used for applications at ambient temperature but are generally unsuitable due to their low resistance to high temperatures.

6.2.2 *Mesh*

6.2.2.1 *Mesh categories.* Wire mesh is commonly used for mechanical retention and can be conveniently classified into the following categories.

(a) *Keying mesh*, typically of relatively small aperture size, i.e. 10 mm to 25 mm, that allows some penetration by spray in order to produce a good key. It is installed in close proximity to the substrate (see figures 1(a) and 1(b)) or to provide a background for the spray to bridge gaps between structures, e.g. to provide a fire barrier or to encase a column.

(b) *Reinforcing mesh*, typically of relatively large aperture size, e.g. 50 mm, that allows full penetration by the spray and thereby provides reinforcement. It is located within the spray so as to reinforce the spray (see figure 1(c)). It is important that the aperture size is not too small and that the mesh material is not too thick, for otherwise a plane of weakness may be formed within the spray.