British Standard

BRITISH STANDARD

BS 2569-2: 1965

Specification for

Sprayed metal coatings —

Part 2: Protection of iron and steel against corrosion and oxidation at elevated temperatures

UDC 669.056.99:621.793.7:620.197.6

Co-operating organizations

The Surface Coatings (other than Paints) Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Aluminium Federation*
Assay Offices Committee of Great Britain
Association of British Chemical Manufacturers
Association of Metal Sprayers*
British Bolt, Nut, Screw and Rivet Federation
British Cycle and Motor Cycle Industries Association Limited
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Individual firms

This British Standard, having been approved by the Surface Coatings (other than Paints) Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 12 August 1965

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Committee references SRE/6, SRE/6/2
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Amendments issued since publication

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Contents

Foreword

This standard makes reference to the following British Standards:

BS 245, *White spirit*.

BS 427, *Method for Vickers hardness test*.

BS 479, *Coal-tar naphthas*.

BS 1475, *Wrought aluminium and aluminium alloys for general engineering purposes. Wire*.

BS 2451, *Chilled iron shot and grit*.

BS 2569, *Sprayed metal coatings — Part 1: Protection of iron and steel by aluminium and zinc against atmospheric corrosion.*

Sprayed metal coatings are produced industrially by melting the coating metal in a stream of hot gas and projecting it in the form of a dispersed spray on to the surface to be coated. The coating metal may be introduced into the hot gas stream either as powder or as wire.

The principal changes made in this edition of BS 2569-2 are:

1) the introduction of coating metals that have become established since 1955;

2) a new classification of types of coating according to service temperature, to avoid confusion with the previous edition;

3) in the specified thicknesses of coatings;

4) in the description of the method of preparing a reference surface;

5) the introduction of an adhesion test for certain classes of coatings, but it is hoped that a better test will be developed in the future;

6) the introduction of an appendix giving some broad guidance on design features.

It is essential that the purchaser should state the Class of coating; merely asking for metal spraying to be carried out to BS 2569-2 without the classification is insufficient.

Other coating metals, e.g. nickel aluminide, are becoming established but it is felt that their use cannot be standardized at this stage. Coating materials other than metals, although they may be applied by spraying, are outside the scope of this standard.

For the protection of iron and steel by sprayed aluminium and zinc coatings against atmospheric corrosion reference should be made to BS 2569-1*.

NOTE 1 Metric equivalents are given in Appendix F. The figures in British units are to be regarded as the standard. The metric conversions are approximate. More accurate conversions should be based on the tables in BS 350, "*Conversion factors and tables*"

NOTE 2 In place of the customary, but incorrect, use of the pound and kilogramme as units of force, the units pound-force (abbreviation lbf) and kilogramme-force (abbreviation kgf) have been used in this standard. These are the forces which, when acting on a body of mass one pound or one kilogramme respectively, give it an acceleration equal to that of standard gravity.

BS 2569, "*Sprayed metal coatings*" — Part 1: "*Protection of iron and steel by aluminium and zinc against atmospheric corrosion*".

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 5 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.

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1 Scope

This British Standard applies to sprayed metal coatings used for the protection of iron and steel against corrosion and oxidation at elevated temperatures. Five Classes of coating are specified for use in service temperature ranges up to 550 °C, 900 °C and 1 000 °C.

2 Coating metal

a) *Composition.*

i) *Aluminium.* The chemical composition of the aluminium to be sprayed shall be in accordance with the requirements of BS 1475[1)] for material G1B (99·5 per cent aluminium) or G1C (99·0 per cent aluminium), as agreed between the manufacturer and purchaser.

ii) *Aluminium alloy.* The chemical composition of the aluminium alloy to be sprayed shall be as follows:

Cadmium	0.5 to 0.75 per cent.
Impurities	Total not more than 1.00 per cent, of which zinc shall not exceed 0.20 per cent.
Aluminium	Remainder.

iii) *Nickel-chromium.* The chemical composition of the nickel-chromium alloy to be sprayed shall be as follows:

Nickel	60 to 80 per cent.
Chromium	15 to 20 per cent.
Iron	25 per cent maximum.

b) *Form.* The diameter of the wire or the sieve analysis of the powder to be sprayed shall be appropriate to the particular spraying apparatus employed.

3 Surface preparation

The surface shall be thoroughly cleaned and roughened by compressed air or centrifugal blasting with a suitable abrasive grit[2)], or by other suitable means. Immediately before spraying it shall be free from grease, scale, rust, moisture or other foreign matter. It shall be comparable in roughness with a reference surface produced in accordance with Appendix A and shall provide an adequate key for the subsequent sprayed metal coating. Where the preparation results in a surface texture which cannot be compared with a reference standard produced in accordance with Appendix A, the criterion of acceptability shall be agreed between the manufacturer and the purchaser on the basis of the adhesion test specified in Appendix C.

For sheet steel of a thickness up to and including 0.064 in, some relaxation on the degree of roughness may be agreed between the manufacturer and purchaser, in order to minimize distortion during surface preparation.

NOTE 1 In order to achieve the correct surface preparation or to prevent contamination of the grit, it may first be necessary to remove existing coatings, e.g. grease or paint.

NOTE 2 Parts that have been blasted should be handled with clean gloves.

4 Application of coating

The coating shall be applied to the clean and dry surface, prepared in accordance with Clause **3**, by means of metal spraying pistols fed with metal powder or wire.

The sprayed coating shall be applied as soon as possible after surface preparation and before visible deterioration[3)] of the surface has occurred. If on comparison with a freshly prepared surface of material of similar quality visible deterioration has occurred, the surface preparation shall be repeated. In no case shall delay between surface preparation and coating application exceed 4 hours unless special precautions, agreed between manufacturer and purchaser, are taken to ensure a suitably controlled storage atmosphere.

NOTE In the case of coatings to Class D (see Table 1), an initial thin coating of the sprayed metal may be applied to preserve the prepared surface; the requirements of Clause **8** would then apply.

The surface of the sprayed coating shall be of uniform texture free from lumps, coarse areas and loosely adherent particles.

[1)] BS 1475 "*Wrought aluminium and aluminium alloys. Wire*".

[2)] For metals having a hardness exceeding 360 HV it may be necessary to replace the usual chilled iron grit with alumina or silicon carbide. The danger of contamination from certain abrasives produced from metallic slags should be taken into consideration.

[3)] The rate of deterioration of the prepared surface will vary with the atmospheric conditions to which the surface is exposed. In particular high humidity conditions are deleterious.

Contamination or corrosion of the sprayed coating shall be avoided at all stages during the application of the coating and the coating shall be maintained in a dry and clean condition until any subsequent treatment according to the requirements of Clause **5** has been applied.

5 Subsequent treatment

The sprayed metal coating shall, with as little delay as possible after application, be subjected to the appropriate subsequent treatment given in Table 1.

Heating for the final treatment shall be carried out by bringing the sprayed article as quickly as possible to the specified temperature and soaking at that temperature for 15 minutes. Any requisite cooling shall be carried out in a still atmosphere.

6 Thickness

The nominal thickness of the coating shall be as given in Table 1 for the appropriate Class of coating. When determined by the method described in Appendix B, the minimum local thickness shall be not less than 75 per cent of the specified nominal thickness, and the maximum local thickness shall not exceed the specified nominal thickness by more than 0.005 in.

Thickness measurements shall be taken after the application of each coating metal and before any subsequent treatment is applied.

7 Adhesion

For coatings of Classes D, E and F an adhesion test, using the method described in Appendix C, shall be carried out before any subsequent treatment is applied. If any part of the coating between the lines breaks away from the basis metal, it shall be deemed to have failed the test. The items or areas selected for this test shall be agreed between the manufacturer and purchaser.

As it is impracticable to apply this test to coatings of Classes G and H, special attention shall be paid to the requirements of Clauses **3** and **4**.

Table 1 — Coating requirements and treatments for classes of service conditions

Class	Service temperature[a]	Sprayed coating		Subsequent treatment	
		Coating metal (see Clause 2)	Nominal thickness	Intermediate treatment	Final treatment
			in		
D	550 °C	Aluminium	0.007	None	None
E	900 °C	Aluminium	0.007	Coat uniformly and completely with solution of coal-tar pitch (see Appendix E)	Heat to 800–900 °C
F	900 °C	Aluminium alloy	0.007	None	[b]Heat to 800–900 °C
G	1 000 °C (in absence of sulphurous gases)	Nickel-chromium alloy	0.015	[c]Coat uniformly and completely with solution of coal-tar pitch plus aluminium pigment (see Appendix E)	Heat to 1 050–1 150 °C
H	1 000 °C (in presence of sulphurous gases)	Nickel-chromium alloy followed by aluminium	0.015 0.004	[c]Coat uniformly and completely with solution of coal-tar pitch plus aluminium pigment (see Appendix E)	Heat to 1 050–1 150 °C

[a] Provided it is realized that the service life will be affected, higher temperatures than those quoted may be tolerated. The reduction in service life will depend on the duration of the higher temperatures.
[b] A mildly oxidizing atmosphere is necessary.
[c] This intermediate treatment may be omitted, but only by agreement between manufacturer and purchaser.

8 Re-treatment of defective areas

Any area found to be defective immediately prior to subsequent treatment shall be blasted clean of all sprayed metal prior to respraying, except that where the rejection has been solely due to too thin a coating, sprayed metal of the same quality may be added, provided that the surface has been kept dry and is free from visible contamination.

Appendix A Method of preparation of a reference surface for comparison

Basis metal. A flat piece of medium- or low-carbon steel not less than ¼ in thick, having a Vickers hardness[4] of 180–220 HV 10.

Abrasive. Chilled iron grit in accordance with the requirements of BS 2451[5] for Grade G24.

Grit-blasting equipment. Any suitable direct-pressure equipment, such that the air pressure is 40 lbf/in^2 to 45 lbf/in^2 at the pressure grit container, the blast hose being not more than 15 ft long and of diameter not less than three times the nozzle diameter.

Procedure. Grit-blast with the blasting nozzle approximately at right angles to and approximately 9 in from the surface, until a uniformly rough, clean surface not less than 4 in^2 in area, has been obtained, and maintained without visible change for at least 25 per cent of the total blasting time, and preserve in that condition.

NOTE The blasting conditions given in this Appendix are not necessarily those for blasting the actual work.

Appendix B Method for the determination of local thickness

Equipment. Any instrument, of a type agreed between manufacturer and purchaser, that will measure local thickness of a known standard with an accuracy of ± 10 per cent.

Calibration of instrument. Calibrate and check the meter on one of the following standards:

1) (applicable to magnetic and electromagnetic meters other than the pull-off type). A soft brass shim, free from burrs, in contact with the grit-blasted surface of the basis metal prior to its being sprayed. If access to this surface is not possible, the shim may be mounted on a base of similar composition and thickness to the article being sprayed, prepared in accordance with Clause **3**. Readings shall not be taken within ½ in of the edge of the base. The thickness of the shim shall be measured by micrometer and shall be approximately the same as the thickness of the coating.

2) A sprayed metal coating of uniform known thickness approximately the same as the thickness of the sprayed coating to be tested, applied to a base of similar composition and thickness to the article being sprayed, grit-blasted in accordance with Clause **3**.

Procedure. For each measurement of local thickness, make an appropriate number of determinations according to the type of instrument used.

With instruments measuring the average thickness over an area of not less than 0.1 in^2, the local thickness shall be the result of one reading.

With instruments having one or more pointed or rounded probes, the local thickness shall be the mean of three readings within a circle of ⅜ in diameter (i.e. 0.1 in^2 in area).

With meters having two such probes, each reading shall be the average of two determinations with the probes reversed in position.

NOTE It is important to take into account the limitations of individual instruments, for instance, magnetic instruments, particularly those of the single probe type, the readings of which may be affected by residual magnetism in the work or the magnetic field associated with the shape and thickness of the article.

Appendix C Method of test for adhesion

Using a straight edge and a hardened steel scriber which has been ground to a sharp 30° point, scribe two parallel lines at a distance apart equal to approximately ten times the average coating thickness. In scribing the two lines, apply enough pressure on each occasion to cut through the coating to the basis metal in the minimum number of strokes.

The criterion of failure is given in Clause **7**.

Appendix D Design recommendations for structures to be metal sprayed[6]

Components and structures to be metal sprayed should be designed from the outset with metal spraying and possibly heat treatment clearly in mind. Failure to do so is almost certain to increase the difficulties and cost of application and also to reduce the overall service life.

Three major guiding principles should be observed.

[4] BS 427, "*Vickers hardness test*".
[5] BS 2451, "*Chilled iron shot and grit*".
[6] Work is in progress on a British Standard giving design recommendations for articles that are to be coated by various processes including metal spraying.

1) Design should ensure that all surfaces are fully accessible for surface preparation and permit complete and uniform application of the sprayed coatings.

2) Structure should be designed so that corrosion and oxidation have the greatest difficulty in establishing any focal point from which they can spread. This requirement demands cleanness of design and the elimination of all features that might facilitate lodgement or retention of foreign matter.

3) The overall design should be planned to facilitate full inspection, ease of cleaning and maintenance.

Appendix E Solution of coal-tar pitch

The coating shall consist of a homogeneous solution of coal-tar pitch in a suitable solvent, e.g. solvent naphtha[7] with or without the addition of white spirit[8], having a viscosity at ambient temperature suitable for brush application.

The volatile matter in the solution measured as the loss in weight on heating to 105 °C to constant weight shall not exceed 50 per cent.

For Class E, up to 20 per cent of aluminium pigment *may* be added to the homogeneous solution before application, but for Classes G and H, 10–20 per cent of aluminium pigment *shall* be added.

Appendix F Metric Equivalents

British units	Metric units
in	mm
0.004	0.10
0.005	0.13
0.007	0.18
0.015	0.38
0.064	1.63
¼	6.3
⅜	9.5
½	12.7
9	230
15 ft	4.6 m
0.1 in^2	65 mm^2
4 in^2	26 cm^2
40 lbf/in^2	2.8 kgf/cm^2
45 lbf/in^2	3.2 kgf/cm^2

[7] BS 479, "Coal-tar naphthas".
[8] BS 245, "White spirit".

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