British Standard

BRITISH STANDARD

BS 4921:1988

Specification for

Sherardized coatings on iron or steel

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Surface Coatings (other than Paints) Standards Committee (SRC/-) to Technical Committee SRC/1, upon which the following bodies were represented:

British Constructional Steelwork Association Ltd.
British Industrial Fasteners Federation
British Lock Manufacturers' Association
British Malleable Tube Fittings Association
British Metal Finishing Suppliers' Association
British Steel Industry (Wire Section)
British Telecommunications plc
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Ministry of Defence
Society of Motor Manufacturers and Traders Ltd.
Spring Research and Manufacturers' Association
Telecommunication Engineering and Manufacturing Association (TEMA)
Zinc Alloy Rust-proofing Co. Ltd.
Zinc Development Association

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Foreword

This revision of this British Standard has been prepared under the direction of the Surface Coatings (other than Paints) Standards Committee. it supersedes BS 4921:1973, which is withdrawn.

In this revision, the requirements of this specification are restricted to those which define minimum coating thickness and the material to be applied in the coating process. Information to be agreed between the interested parties is no longer included in this specification but instead comprises Appendix A, which is intended for guidance for ordering purposes.

Two classes of sherardized coating thickness are included and these are considered adequate for most requirements. The microscopical method of thickness measurement is given as the reference method in cases of dispute. Other test methods, including the use of electronic and magnetic measuring devices and the stripping test, may be used when desired particularly for production control purposes.

Product certification. Users of this British Standard are advised to consider the desirability of third party certification of product conformity with this British Standard based on testing and continuing surveillance, which may be coupled with assessment of a supplier's quality systems against the appropriate Part of BS 5750.

Enquiries as to the availability of third party certification schemes will be forwarded by BSI to the Association of Certification Bodies. If a third party certification scheme does not already exist, users should consider approaching an appropriate body from the list of Association members.

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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 British Standard specifies minimum thickness requirements for two classes of coatings consisting substantially of zinc applied by the sherardizing process to steel articles and to grey and malleable iron castings. It also specifies requirements for the zinc used during the sherardizing process (but see the foreword and the note to clause **4**).

NOTE 1 Guidance is given on requirements which require agreement between the interested parties in Appendix A and general guidance on sherardizing is given in Appendix B.
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 British Standard, the following definitions apply.

NOTE Definitions **2.1** to **2.2** are taken from BS 5411-1.

2.1
significant surface

that part of the article covered or to be covered by the coatings and for which the coating is essential for serviceability and/or appearance

2.2
measuring area

the area of the significant surface over which a single measurement is made

"measuring area" for the following methods is defined as:

a) for analytical methods: the area from which the coating is removed;

b) for the anodic dissolution method: the area enclosed by the sealing ring of the cell;

c) for the microscopical method: the place at which a single measurement is made;

d) for non-destructive methods: the probe area or the area influencing the reading.

2.3
reference area

the area within which a specified number of single measurements is required to be made

2.4
local thickness

the mean of the thickness measurements, of which a specified number is made within a reference area

2.5
minimum local thickness

the lowest value of the local thicknesses found on the significant surface of a single article

2.6
maximum local thickness

the highest value of the local thicknesses found on the significant surface of a single article

2.7
average thickness

either the value obtained by analytical methods or the mean value of a specified number of local thickness measurements that are evenly distributed over the significant surface

2.8
sherardized coating

a coating of zinc-iron alloy layers obtained by heating iron or steel components in a container together with zinc dust (see clause **4**)

3 Thickness

3.1 Thickness of coating

The minimum local thickness of the coating shall comply with the appropriate requirements of Table 1.

Table 1 — Thickness of coating

Class of coating	Minimum local thickness
	μm
Class 1	30
Class 2	15

NOTE The two classes of coating thickness given in this table should be suitable for the majority of applications. Guidance on selection of coating thickness is given in **B.5**.

3.2 Measurement of thickness

The thickness of the coating shall be measured in accordance with Appendix C.

For reference purposes, the coating thickness shall be determined by the microscopical method given in **C.2**.

NOTE 1 For production control purposes, the local thickness of the coating may be measured by the means of electronic or magnetic measuring devices as specified in BS 5411-2 and BS 5411-11.
NOTE 2 The average coating thickness may be determined by the stripping method described in **C.2**.

4 Coating material

The zinc dust used shall have contained not less than 94 % by mass of metallic zinc, not more than 0.2 % by mass of lead and not more than 0.0005 % by mass of copper. The particle size shall have been such that 95 % of all particles passed through a 75 μm sieve complying with BS 410.

NOTE Attention is drawn to the note on product certification given in the foreword.

Appendix A Guidance on information to be supplied

A.1 General

The requirements of this specification relate only to thickness and to the material to be applied in the coating process. However, the purchaser, when ordering, may wish to specify further requirements and this appendix gives guidance on the information to be supplied in such cases. **A.2** and **A.3** give details of this information.

A.2 Information which should be supplied

The purchaser should supply the following information to the sherardizer:

a) the number of this standard, i.e. BS 4921;

b) the class of coating required or, alternatively, the coating thickness (see clause **3** and **B.5**);

c) the nature of the basis material including its mechanical properties (see **B.2**);

d) the significant surface of the article to be sherardized indicated, for example, by drawings or by the provision of suitably marked samples;

e) the sampling procedure to be adopted;

NOTE 1 Sampling should be carried out in accordance with the appropriate procedures described in BS 6001 in conjunction with BS 6000 or in accordance with BS 6041.

NOTE 2 The sampling procedure to be used is dependent on the acceptable quality level (AQL) required for the articles being sherardized.

NOTE 3 The sampling plans given in BS 6041 are based on AQLs of 1.5 % and 4.0 %. If other AQLs are to be used, reference should be made to the more comprehensive BS 6001, in conjunction with BS 6000.

f) where appropriate, clearances depending on the class of sherardizing required, which should be specified on the product drawing or in a document associated with the order (see **B.6**);

g) whether the articles have been subjected to any form of heat treatment;

h) any material or fabrication likely to be affected by heating to 475 °C (see **B.2**).

A.3 Additional information which may be supplied

The purchaser should supply the following additional information, as appropriate, to the sherardizer:

a) any post treatment, e.g. phosphating, chromating, oiling, staining or painting;

b) any special adhesion requirements, including the test method;

c) any special requirements for appearance, indicated if necessary by a sample showing the required finish (see **B.4**);

d) any other special "requirements" (see Appendix B).

Appendix B Information for guidance

B.1 The process

Sherardizing is a diffusion process in which articles are heated in close contact with zinc dust and inert operating media. The process is normally carried out in a slowly rotating closed container at a temperature in the region of 385 °C, although temperatures up to 475 °C can be used, and a sherardized coating as defined in **2.8** is produced. For special applications the processing temperature can be reduced to 330 °C. The coating closely follows the contours of the basis material, and uniform coatings are produced on all articles including those of irregular shape.

The corrosion resistance is proportional to the coating thickness which can be controlled.

B.2 Basis material

Most mild and alloy steels and cast irons are suitable for sherardizing. Spring steels can generally be treated without affecting their temper by selecting a processing temperature which is lower than that normally used. The process does not give rise to hydrogen embrittlement, but when cleaning the surface of springs of high tensile strength (>1 450 N/mm^2) prior to the sherardizing treatment, it is essential that cathodic acid cleaning is not employed. Pre-treatment by anodic cleaning methods or mechanical cleaning is preferred.

The surfaces should be free from any contamination which cannot be removed by normal pre-treatment methods.

If they are part of an iron or steel assembly which has to be coated, copper based alloys and brazed components can be sherardized but aluminium alloys are unsuitable. It is essential that soft-soldered and resin-bonded joints be avoided as their melting points are below the temperature at which the sherardizing process is carried out.

B.3 Suitable articles

Sherardizing is most suitable for relatively small pressings, forgings, machined parts, nuts, bolts, washers, chains and sintered parts and also for long lengths of tube, rod and rolled section.

As articles to be coated have to be packed in a container, their size is limited to its dimensions. The process is more economical for articles which pack densely together than for bulky articles and with some assemblies it may be preferable to sherardize the parts individually before they are fitted together.

B.4 Coating appearance

Sherardized coatings have a matt, grey appearance and may show superficial scratches. As the coatings are relatively hard, such scratches resulting from normal contact with other articles or containers are not detrimental to their corrosion resistant qualities. When examined by the unaided eye or normally corrected vision, the significant surfaces of the sherardized article should be free from visible defects, such as blisters, pits, cracks or unsherardized areas.

The coating should be smooth and continuous, but any burnishes or superficial scratches may be ignored, as can any residual surface dust.

NOTE Orange staining of sherardized coatings may occur early in their life outdoors but this is not detrimental to their performance.

B.5 Coating thickness

The life of a sherardized coating in any given environment is proportional to its thickness. Both industrial and marine environments are more corrosive to zinc coatings, including sherardized coatings, than rural environments. Class 1 coatings should normally be specified for use out of doors, but class 2 coatings may also be used in rural outdoor atmospheres where a life of only a few years to first maintenance is required. Class 2 coatings are suitable for normal uses indoors.

Other coating thicknesses can be specified, but it should be noted that chipping of the coating can sometimes occur at sharp edges where coatings exceeding the requirements of class 1 are specified.

Where doubt exists concerning the class of coating or coating thickness required, the purchaser should seek the advice of the sherardizer.

B.6 Additional clearances for screwed fasteners

When external and internal threads of fasteners have to be assembled together after both have been sherardized, an additional clearance between them before sherardizing is necessary to allow for the coating. In such cases, this additional clearance may be given for either the external or internal thread, whichever is preferred to suit requirements.

Table 2 gives the additional clearance that should be allowed for class 1 and class 2 coatings.

Table 2 — Additional clearance allowances on screw threads

Class of coating	ISO metric, UNF and UNC threads	BSW, BSPF and BSF threads
	µm	µm
Class 1	360	390
Class 2	180	195

When only the external thread is to be sherardized and then used with an uncoated internal thread, an additional clearance equivalent to half that shown in Table 2 should be allowed on the thread to be sherardized in the case of class 1 and class 2 coatings.

NOTE It is recommended that wherever possible nuts and bolts, or similar parts of fasteners which have to be used together, are sent for sherardizing at the same time so that the sherardizer can check that the sherardized parts mate together, and thus avoid the risk of assembly difficulties at a later stage.

B.7 Distortion

Distortion may arise with some articles which are too fragile to withstand the rotary movement required during sherardizing but this can often be eliminated by consultation with the sherardizer, preferably at the design stage.

Appendix C Methods for determination of coating thickness

C.1 Choice of method

A method should be chosen that can be expected to yield the most reliable results considering the factors such as coating thickness, shape of components, size of components, coating material, basis material, etc. and can be demonstrated to have an accuracy of 10 % or better, or to be better than the methods given in **C.2** for the particular application.

Two methods are given in **C.2** that are considered to have an adequate accuracy when properly used with test specimens suitable for the particular method.

C.2 Microscopical and stripping methods

Measure the thickness of the coating over the reference area on any part of the significant surface by the microscopical method described in BS 5411-5 or by the stripping method for galvanized coatings described in Appendix A of BS 729:1971. In the case of an article having a significant surface of 100 mm^2 or greater, regard the minimum value of average thickness (as determined by the method described in Appendix A of BS 729:1971) as the minimum local thickness (see also BS 5411-1).

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Publications referred to

BS 410, *Specification for test sieves.*

BS 729, *Specification for hot dip galvanized coatings on iron and steel articles.*

BS 5411, *Methods of test for metallic and related coatings.*

BS 5411-1, *Definitions and conventions concerning the measurement of thickness.*

BS 5411-2, *Review of methods for the measurement of thickness.*

BS 5411-5, *Measurement of the local thickness of metal and oxide coatings by the microscopical examination of cross-sections.*

BS 5411-11, *Measurement of coating thickness of non-magnetic metallic and vitreous or porcelain enamel coatings on magnetic basis metals: magnetic method.*

BS 5750, *Quality systems*[1)].

BS 6000, *Guide to the use of BS 6001, sampling procedures and tables for inspection by attributes.*

BS 6001, *Sampling procedures for inspection by attributes.*

BS 6041, *Methods of sampling of electrodeposited metallic coatings and related finishes: procedures for inspection by attributes.*

[1)] Referred to in the foreword only.

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