BRITISH STANDARD

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Sherardizing — Zinc diffusion coatings on ferrous products — Specification

The European Standard EN 13811:2003 has the status of a British Standard

ICS 25.220.40

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee STI/41, Specification and methods of test for mechanical coatings, which has the responsibility to:

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Shérardisation - Revêtements par diffusion de zinc sur les produits ferreux - Spécifications

Sherardisieren - Zink-Diffusionsüberzüge auf Eisenwerkstoffen - Anforderungen

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Contents

Foreword

This document EN 13811:2003 has been prepared by Technical Committee CEN /TC 262, "Metallic and other inorganic coatings", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2003, and conflicting national standards shall be withdrawn at the latest by October 2003.

Annex A is normative. Annexes B and C are informative.

This document includes a Bibliography.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies minimum thickness requirements for three classes of zinc coating applied to ferrous products by the sherardizing process for the purpose of protection against corrosion and abrasion.

It also specifies minimum requirements for the zinc dust to be used during the sherardizing process.

This standard does not specify any requirements for the surface condition (finish or roughness) of the basis material before sherardizing.

After-treatments or overcoating of sherardized articles is not covered by this standard.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 10204, *Metallic products — Types of inspection documents*.

EN ISO 1460, *Metallic coatings — Hot dip galvanized coatings on ferrous materials — Gravimetric determination of the mass per unit area (ISO 1460:1992)*.

EN ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method (ISO 2178:1982)*.

EN ISO 3549, *Zinc dust pigments for paints — Specifications and test methods (ISO 3549:1995)*.

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1
sherardizing
solid diffusion process in which articles are heated in close contact with zinc dust and an inert material such as sand

3.2
sherardized coating
coating consisting of zinc/iron alloys obtained by the sherardizing process, and subsequently passivated

NOTE ‘Sherardized coating’ is referred to in this standard as ‘coating’.

3.3
coating mass
total mass of zinc/iron alloys per unit area of surface, expressed in grams per square metre, g/m^2

3.4
coating thickness
total coating thickness of zinc/iron alloys, expressed in micrometres, μm

3.5
significant surface
the part of the article covered or to be covered by the coating and for which the coating is essential for serviceability and/or appearance and where the coating must meet all of the specified requirements

[ISO 2064:1996, definition 3.1]

3.6
control sample
article, or group of articles, from a lot which is selected for testing

3.7
reference area
area within which a specified number of single measurements is required to be made

[ISO 2064:1996, definition 3.3]

3.8
local coating thickness
mean value of coating thickness obtained from a number of measurements within a reference area in a magnetic or electro-magnetic test

3.9
local coating mass
value of coating mass obtained from a single gravimetric test

3.10
inspection lot
one or more articles of the same type and size comprising either a single order or a single delivery load or the number of articles identified as a lot by the sherardizer

4 General requirements

4.1 Zinc dust

When determined in accordance with EN ISO 3549 the zinc dust used in the sherardizing process shall contain a mass fraction of not less than 94 % of metallic zinc and total impurities (other than zinc oxide) of not more than 2% mass fraction.

4.2 Information to be supplied by the purchaser

Information shall be supplied by the purchaser in accordance with annex A.

5 Sampling

A control sample (3.6) for thickness testing shall be taken randomly from each inspection lot (3.10) selected for testing. The minimum number of articles to form the control sample shall be taken in accordance with Table 1.

Alternatively, sampling procedures selected from ISO 2859-1 and ISO 2859-3 may be used.

Acceptance inspection shall be undertaken before the products leave the sherardizer’s custody, unless otherwise specified at the time of ordering by the purchaser.

Table 1 — Control sample size related to batch size

Number of articles in the batch	Minimum number of articles in the control sample
1 to 3	All
4 to 500	3
501 to 1 200	5
1 201 to 3 200	8
3 201 to 10 000	13
Above 10 000	20

6 Coating requirement

6.1 Thickness

When tested in accordance with 6.2.3, the local coating thickness shall be not less than the values given in Table 2.

NOTE 1 Coatings applied by sherardizing are designed to protect ferrous products against corrosion and abrasion. The service life of such coatings in a given environment is approximately proportional to the coating thickness.

NOTE 2 When thicker coatings than those specified in this European Standard are required for extremely aggressive conditions and/or when an exceptionally long service life is required, their specification should be the subject of agreement between the sherardizer and the purchaser.

Table 2 — Coating thickness

Class of coating	Local coating thickness (minimum value) /μm
Class 15	15
Class 30	30
Class 45	45
NOTE 1 The three classes of coating thickness given in Table 2 should be suitable for the majority of applications. Guidance on the selection of coating thickness is given in C.6. NOTE 2 There can be a requirement for specific pre-treatment when thicker coatings, e.g. Class 45, are specified. The purchaser should seek the advice of the sherardizer in such cases. NOTE 3 The local coating thickness should only be determined in relation to reference areas selected in accordance with 6.2.2.	

6.2 Test methods

6.2.1 General

The local coating thickness shall be determined in accordance with the magnetic method (EN ISO 2178) or the gravimetric method (EN ISO 1460). The magnetic method is generally more appropriate for routine quality control.

NOTE Annex B provides additional information on the determination of thickness.

6.2.2 Reference areas

The number and position of reference areas and their sizes for the gravimetric test shall be chosen with regard to the shape and size of the article(s) in order to obtain a result as representative as possible of average coating mass per unit area.

For articles with a significant surface area greater than or equal to 1 000 mm^2, there shall be at least one reference area on each article in the control sample. Control sample sizes are given in Table 1.

For articles with a significant surface area of less than 1 000 mm^2, there shall be enough articles grouped together to provide at least 1 000 mm^2 surface for an individual reference area. Hence, the total number of articles tested shall equal the number of articles required to provide one reference area multiplied by the total number of articles in a control sample, in accordance with Table 1 (or the total number of articles sherardized, if that is less). Alternatively, sampling procedures selected from ISO 2859-1 and ISO 2859-3 may be used.

6.2.3 Magnetic method

The reference areas shall be within, and representative of, those which would have been chosen for the gravimetric method.

A minimum of five magnetic test readings shall be taken within each reference area. Because the area over which each measurement is made in this method is very small, individual figures may be lower (typically up to 15 %) than the values for the local thickness. This is irrelevant as only the average value over the whole of each reference area is required to be equal to, or greater than, the local coating thickness minimum value.

If the local coating thickness on a control sample does not conform to 6.1, twice the original number of articles (or all the articles, if that is the lower number) shall be taken from the batch and tested. If this larger control sample conforms to 6.1, the batch shall be deemed to conform. Failure of the larger control sample to meet the requirements of 6.1 shall constitute grounds for rejection of the batch. If the batch is rejected, individual articles may be submitted for re-testing.

When more than five articles have to be taken to make up a reference area of at least 1 000 mm^2, a single magnetic measurement shall be taken on each article if a suitable area of significant surface exists. If such a suitable area does not exist, the gravimetric method given in EN ISO 1460 shall be used. If a sufficient number of measurements are made within the reference area, effectively the same coating thickness will be determined by the magnetic method as the gravimetric method.

6.2.4 Gravimetric method

The mass of sherardized coating per unit area shall be determined in accordance with EN ISO 1460 and the nominal density of the coating in grams per cubic centimetre (g/cm^3). In case of dispute, this shall be the referee method.

7 Certificate of conformity

When required, the sherardizer shall provide a certificate of conformity with the requirements of this European Standard (see EN 10204).

Annex A
(normative)

Information to be supplied by the purchaser to the sherardizer

A.1 Essential information

The purchaser shall provide the following information on all relevant documents:

a) the number of this European Standard, i.e. EN 13811:200X;

b) the class of coating or, alternatively, the minimum coating thickness required (see Table 2).

A.2 Additional information

The following information may be required for particular purposes and, if so, shall be specified by the purchaser:

a) identification of significant surfaces, for example, by drawings or by the provision of suitably marked samples;

b) thread clearances, depending on the class of coating thickness specified, to be stated on the product drawing or on the order document;

c) any likely effects on the metallurgical properties of the basis material caused by heating temperatures of up to 500 °C;

d) any special pre-treatment requirements;

e) any after-treatments or overcoating to be applied to the sherardized coating (see C.7);

f) any requirements for inspection;

g) whether a certificate of compliance is required in accordance with EN 10204.

Annex B
(informative)

Determination of thickness

B.1 General

The most general non-destructive method of determining coating thickness is the magnetic method. Among the destructive methods are the determination of mass per area by the gravimetric method, converted to thickness, and the microscopic cross-section method.

Careful consideration should be made of the relationship between local and average thickness where the magnetic method of EN ISO 2178 is used and the results are compared with those from the gravimetric method of EN ISO 1460.

B.2 Microscopic cross-section method

The microscopic cross-section method (EN ISO 1463) is not recommended as it is considered inappropriate for routine use because it is destructive and relates only to a single line.

B.3 Calculation of thickness from mass per unit area (reference method)

The gravimetric method given in EN ISO 1460 provides a result for the coating mass per unit area expressed in grams per square metre. This can be converted to local thickness in micrometres by dividing by the nominal density of the coating 7,2 g/cm^3. Equivalent values of coating thickness and coating mass are given in Table B.1.

Table B.1 — Equivalent coating thickness and coating mass

Class of coating	Minimum local coating thickness /µm	Minimum local coating mass /g/m^2
Class 15	15	108
Class 30	30	216
Class 45	45	324

Annex C
(informative)

General information

C.1 Sherardizing process

Sherardizing is a solid diffusion process in which articles are heated in the presence of zinc dust and an inert material such as sand. The process is normally carried out in a slowly rotating closed container at temperatures ranging from 320 °C to 500 °C. The zinc/iron alloyed coating is subsequently zinc phosphated or chromated, resulting in a clean passivated surface. The coating closely follows the contours of the basis material, and uniform coatings are produced on articles, including those of irregular shape.

C.2 Basis material

Unalloyed carbon steels, low alloy steels, sintered material, malleable grey and cast iron are suitable for sherardizing. The process does not give rise to hydrogen embrittlement. However, when pre-cleaning high tensile material (above 1 000 N/mm^2) cathodic cleaning should not be employed. Pre-treatment by anodic, mechanical or any other processes which do not affect the base material are recommended. The surface should be free from any contamination prior to processing.

It is essential that parts having soft-soldered or resin bonded joints are not sent for sherardizing as joints of this nature are affected by the process. Any such jointing should be carried out after processing has taken place.

C.3 Appearance

The sherardized coating has a matt grey appearance and may show scratches resulting from normal contact with other articles. Due to the hardness of the coating, such scratches are superficial and not detrimental to its corrosion resistance.

C.4 Adhesion

No suitable European or International Standards currently exist for testing the adhesion of sherardized coatings on fabricated products. Adhesion between zinc and basis metal generally does not need to be tested as good bonding is characteristic of the sherardizing process. The coated articles should be able to withstand, without peeling or flaking, handling consistent with the nature and thickness of the coating and the normal use of the article.

C.5 After-treatments

Oils, stains, paints, special lubricants, sealants or organic coatings can subsequently be applied to the sheradized and passivated coating to enhance the corrosion resistance and/or decorative appearance, or to regulate the coefficient of friction of the coating.

C.6 Coating thickness

Coatings applied by the sherardizing process are designed to protect the basis material against corrosion and abrasion.

The service life of such coatings in a given environment is approximately proportional to their coating thickness.

Class 15 coatings can be specified for normal indoor and outdoor environments. Class 30 coatings should be specified for outdoor applications in more severe environments, or where there is a requirement for extended service life. Class 45 coatings should be specified for use in highly corrosive environments, e.g. industrial or marine.

Guidance for the coating thickness of zinc coated products for use in environments with different corrosion categories is given in Table 1 of EN ISO 14713:1999.

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

For special applications, thicker coatings than those specified in this standard can be required. There can be a requirement for specific pre-treatment when thicker coatings are specified. See note 2 to 6.1.

C.7 Additional clearances for threaded fasteners

Additional clearance is necessary to accommodate the specified coating thickness on sherardized threaded fasteners. This additional clearance can be allowed on either the internal or the external thread.

The purchaser should discuss the additional thread clearance requirement with the sherardizer.

Bibliography

[1] ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*.

[2] ISO 2859-3, *Sampling procedures for inspection by attributes — Part 3: Skip-lot sampling procedures*.

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