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**Zinc diffusion coatings on ferrous  
products — Sherardizing —  
Specification**

*Revêtements par diffusion de zinc sur les produits ferreux —  
Shérardisation — Spécification*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#).

The committee responsible for this document is ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 4, *Hot dip coatings (galvanized, etc.)*.

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## Introduction

Sherardizing is a thermal diffusion coating process in which ferrous articles are heated in the presence of a sherardizing mixture consisting of zinc dust with or without an inert material.

The process is commonly performed in closed, slowly rotating or fixed containers at temperatures ranging from around 300 °C to 500 °C. The normal processing temperature is below the melting point of zinc (419 °C).

During the process, zinc reacts with the surface to form inter-metallic layers on ferrous articles.

A coating thickness of 10 µm to 75 µm (and higher if required) can be achieved. The coating thickness is accurately controlled by the amount of zinc dust, processing time and temperature. The coating closely follows the contours of the base material and uniform coating thicknesses are produced on articles, including those of irregular shape.

After sherardizing, the container load is cooled down. A screening process separates the sherardized articles from the unused sherardizing mixture. The articles, with the zinc-iron inter-metallic layers, are eventually post-treated (by phosphating, chromating or another suitable passivation process) resulting in a clean and passivated surface.

It is common to use articles coated with zinc-iron inter-metallic layers as a primer or base-coat for duplex-systems.

For additional information about the sherardizing process and the application possibilities of sherardized articles, see Reference [12] and Reference [13].

Sherardizing (thermal diffusion coating) is also known as the following:

- diffusion zinc plating (Germany); [ISO 17668:2016](https://standards.iteh.ai/catalog/standards/sist/7a7c86e7-2db3-400f-b55f-c146a2b80ad6/iso-17668-2016)
- thermal diffusion coating (Russia); <https://standards.iteh.ai/catalog/standards/sist/7a7c86e7-2db3-400f-b55f-c146a2b80ad6/iso-17668-2016>
- thermal diffusion galvanizing (Ukraine);
- vapour galvanizing (UK);
- zinc diffusion coating (USA);
- zinc inter-metallic coating (Russia);
- zinc thermo diffusion galvanizing (Israel).

In China, Europe and the USA, the common name for the thermal diffusion coating process is sherardizing.

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# Zinc diffusion coatings on ferrous products — Sherardizing — Specification

## 1 Scope

This International Standard specifies minimum thickness requirements for six classes of zinc diffusion layers applied to ferrous products by the sherardizing process for the purpose of protection against corrosion and wear.

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

Post-treatments (conversion coatings), after-treatments or organic over-coatings (Duplex) of sherardized articles are not in the scope of this International Standard.

NOTE 1 For general information about post-treatments, see [Annex C](#) and [Annex D](#).

This International Standard does not apply to sherardized products (e.g. fasteners, tubes) for which specific standards exist and which might include additional requirements or requirements which are different from those of this International Standard.

NOTE 2 Individual product standards can incorporate this International Standard for the coating by quoting its number, or can incorporate it with modification specific to the product.

## 2 Normative references

ISO 17668:2016

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1460, *Metallic coatings — Hot dip galvanized coatings on ferrous materials — Gravimetric determination of the mass per unit area*

ISO 2064, *Metallic and other inorganic coatings — Definitions and conventions concerning the measurement of thickness*

ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 10474, *Steel and steel products — Inspection documents*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2064 and the following apply.

### 3.1

#### sherardizing process

zinc diffusion coating process in which articles are heated in close contact with a *sherardizing mixture* (3.3), commonly performed in a closed slowly rotating container or a fixed (non-rotating) container, to form *sherardized layers* (3.2)

**3.2**  
**sherardized layer**  
**zinc diffusion layer**

zinc diffusion coating consisting of zinc-iron alloy layers obtained by sherardizing

Note 1 to entry: The “sherardized layer” is referred to in this International Standard as “coating”.

Note 2 to entry: The sherardized layer may subsequently be post-treated by phosphating, chromating or another suitable passivation process (guidance for these post-treatments are given in [Annex C](#) and [Annex D](#)).

**3.3**  
**sherardizing mixture**

mixture consisting of mainly zinc dust, with or without other process-supporting ingredients

Note 1 to entry: Zinc dust is also known as zinc powder.

**3.4**  
**mass of the zinc diffusion layer**

total mass of zinc/iron alloys per unit area of surface

Note 1 to entry: The mass of the zinc diffusion layer is expressed in grams per square metre (g/m<sup>2</sup>).

**3.5**  
**thickness of the zinc diffusion layer**

total zinc diffusion layer thickness consisting of zinc/iron alloys

Note 1 to entry: The thickness of the zinc diffusion layer is expressed in micrometre (µm).

**3.6**  
**significant surface**

part of the article covered or to be covered by the *zinc diffusion layer* (3.2) and for which these coating is essential for serviceability and/or appearance and where the layer will meet all the specified requirements

**3.7**  
**control sample**

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

**3.8**  
**reference area**

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

**3.9**  
**local thickness of the zinc diffusion layer**

mean value of zinc diffusion layer thickness obtained from the specific number of measurements within a *reference area* (3.8) for a magnetic or electro-magnetic test or the single value of a gravimetric test

Note 1 to entry: Guidance for the methods of measurement of the zinc diffusion layer thickness is given in [6.2.2](#) and [Annex B](#).

**3.10**  
**mean thickness of the zinc diffusion layer**

average value of the local zinc diffusion layer thicknesses of different *reference areas* (3.8)

Note 1 to entry: In case there is only one *reference area* (3.8), the mean zinc diffusion layer thickness is the same as the local zinc diffusion layer thickness.

**3.11**  
**inspection lot**

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



### 3.12

#### acceptance inspection

inspection of an *inspection lot* (3.11) at the sherardizer's works (unless otherwise specified)

## 4 General requirements

### 4.1 Surface condition base material

The surface of the base material should be clean before sherardizing.

Surface contamination that cannot be removed by grit blasting should be removed prior to the mechanical pre-treatment process. The responsibility of removing the contamination should be agreed upon between the sherardizer and purchaser.

The surface condition of the base material, the mass of the parts and the sherardizing conditions can affect the appearance, the thickness, surface roughness and the physical and mechanical properties of the coating. This International Standard does not define any requirements regarding these properties.

NOTE Guidance on these parameters can be found in ISO 14713-3:2009, Clause 4.

### 4.2 Information to be supplied by the purchaser

Information shall be supplied by the purchaser in accordance with A.1 and A.2.

## 5 Acceptance inspection and sampling

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

Acceptance inspection involves the assessment of appearance of the coated article and testing the thickness. The results of other tests of the coated article are normally not provided. Other tests will only be carried out by agreement between purchaser and sherardizer made at the time of ordering.

A control sample for thickness testing shall be taken randomly from each inspection lot 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, ISO 2859-2, and ISO 2859-3 can be used.

**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 properties

### 6.1 Appearance

The surface of the coating has a grey (matt or lustrous) appearance and might show scratches resulting from normal contact with other articles, during processing or storage. Such scratches are superficial and not detrimental to the corrosion resistance of the sherardized articles.

The coating shows a certain surface roughness which is characteristic for the zinc-iron alloy type of coating.

NOTE It is noted that “grey (matt or lustrous) appearance” and “surface roughness” are relative terms. These appearance properties can be influenced by the composition of and surface conditions of the base material. It is not possible to establish a definition of appearance and finish of the coating covering all requirements in practice.

Areas without a zinc diffusion layer shall not be allowed, unless otherwise specified at the time of ordering by the purchaser and agreed upon with the sherardizer.

Rejected articles, regarding these areas, shall be re-sherardized and resubmitted for inspection in agreement with the purchaser.

The development of (grey-) white corrosion products (white staining), the formation of mainly basic zinc oxide during storage in humid conditions after sherardizing, shall not be cause for rejection.

It is not permitted for the sherardized articles to have an orange-brown colouring at the time of delivery, unless otherwise specified at the time of ordering by the purchaser and agreed upon with the sherardizer.

Rejected articles, regarding this discolouring, shall be re-sherardized and resubmitted for inspection in agreement with the purchaser.

### 6.2 Thickness

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#### 6.2.1 General

Coatings applied by sherardizing are designed to protect ferrous products against corrosion and wear. The service life of such coatings in a given environment is approximately proportional to the coating thickness (see ISO 14713-1).

#### 6.2.2 Test methods

Thickness measurements shall only be made on clean, washed surfaces. In case cleaning and/or passivation is not part of the coating process, samples for thickness testing shall be cleaned separately.

The local coating thickness shall be determined in accordance with the magnetic method given in ISO 2178 or the electro-magnetic method given in ISO 2808, also described in ISO 3882.

These two methods are generally most appropriate for routine quality control within works.

The gravimetric method according to ISO 1460 can be used to determine the coating mass. The coating thickness can be calculated by dividing the coating mass per unit area by the nominal coating density of the coating  $7,2 \text{ g/cm}^3$  (see [B.2](#)).

If a sufficient number of measurements is made within the reference area (see [6.2.3](#)), effectively the same coating thickness will be determined by the magnetic method, the electro-magnetic method as the gravimetric method.

For articles with a complex shape, in which no suitable reference area can be determined for measuring the thickness by the magnetic method, the electro-magnetic method, the gravimetric method shall be used.

The microscopic cross-section method according to ISO 1463 is less appropriate for routine use because it is destructive and relates only to a single line. However, this method can be used for special quality control operations for articles with a complex shape, agreed upon by the purchaser and the sherardizer at the time of ordering.

NOTE [Annex B](#) provides additional information and guidance on the measurement of thickness.

### 6.2.3 Reference areas

The number and position of reference areas and their sizes for the magnetic, electro-magnetic, micrometre method or 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 mean coating thickness or mass per unit area as applicable.

The reference areas shall be within the significant surfaces, unless otherwise agreed upon between purchaser and sherardizer.

For articles with a significant surface area greater than or equal to 10 cm<sup>2</sup>, 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 10 cm<sup>2</sup>, there shall be enough articles grouped together to provide at least 10 cm<sup>2</sup> significant surface for one 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, ISO 2859-2, and ISO 2859-3 can be used.

### 6.2.4 Magnetic method or electro-magnetic method

A minimum of five magnetic or electro-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 can 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.

When more than five articles have to be taken to make up a reference area of at least 10 cm<sup>2</sup>, 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 according to ISO 1460 shall be used.

### 6.2.5 Gravimetric method

The mass of the coating per unit area, expressed in g/cm<sup>2</sup>, shall be determined according to ISO 1460. This mass value can be converted to a thickness value in µm by dividing the nominal density of the coating 7,2 g/cm<sup>3</sup>.

NOTE See [B.2](#)

### 6.2.6 Thickness requirements

The thickness requirements for six classes are given in [Table 2](#).