
**Mechanically deposited coatings of
zinc — Specification and test methods**

*Dépôts de zinc par voie mécanique (matoplastie) — Spécifications et
méthodes de contrôle*

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Foreword

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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.

ISO 12683 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 3, *Electrodeposited coatings and related finishes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

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Foreword

This document (EN ISO 12683:2004) has been prepared by Technical Committee CEN/TC 262 “Metallic and other inorganic coatings”, the Secretariat of which is held by BSI, in collaboration with Technical Committee ISO/TC 107 “Metallic and other inorganic coatings”.

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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

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

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1 Scope

This document specifies the requirements for coatings of zinc that have been mechanically deposited on to fabricated metal articles to protect them from corrosion. It also describes the related test methods.

NOTE Annex A describes the process of applying a metal coating that is called mechanical deposition. In this instance the metal applied is zinc.

2 Normative references

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

EN ISO 1463, *Metallic and oxide coatings - Measurement of coating thickness - Microscopical method (ISO 1463:2003)*

EN ISO 2064:2000, *Metallic and other inorganic coatings - Definitions and conventions concerning the measurement of thickness (ISO 2064:1996)*

EN ISO 2177, *Metallic coatings - Measurement of coating thickness - Coulometric method by anodic dissolution (ISO 2177:2003)*

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

EN ISO 3497, *Metallic coatings - Measurement of coating thickness - X-ray spectrometric methods (ISO 3497:2000)*

EN ISO 9220, *Metallic coatings - Measurement of coating thickness - Scanning electron microscope method (ISO 9220:1988)*

EN ISO 10111, *Metallic and other inorganic coatings - Measurement of mass per unit area - Review of gravimetric and chemical analysis methods (ISO 10111:2000)*

ISO 2079:1981, *Surface treatment and metallic coatings — General classification of terms*

ISO 2080:1981, *Electroplating and related processes — Vocabulary*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptable quality level (AQL) for lot-by-lot inspection*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 9587, *Metallic and other inorganic coatings — Pretreatments of iron or steel to reduce the risk of hydrogen embrittlement*

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

ISO 10587, *Metallic and other inorganic coatings — Test for residual embrittlement in metallic-coated and uncoated externally threaded articles and rods — Inclined wedge method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 2064:2000, ISO 2079:1981 and ISO 2080:1981 and the following apply

3.1 mechanically deposited coating
coating obtained by compacting metallic powder particles onto correctly prepared metallic substrates in a rotating barrel in the presence of impact media (normally glass beads) and in a suitable chemical environment without the use of an electric current or applied heat

3.2 apparent coating density
product of thickness, determined in accordance with EN ISO 1463, and mass per unit area, determined in accordance with EN ISO 10111

4 Information and requirements to be agreed and documented by the purchaser

4.1 General

The following items to be agreed between the contracting parties, which are specified in the clauses referred to, shall be fully documented. Both the definitive requirements specified in this document and the documented items listed in 4.2 and 4.3 shall be satisfied before a claim of compliance can be made and verified.

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4.2 Essential information

The following information shall be given:

- a) number of this document: [ISO 12683:2004](https://standards.iteh.ai/catalog/standards/sist/ceb216e3-4f2c-495d-8b6b-32f9575b7974/iso-12683-2004)
- b) nature of the basis material, its surface condition and roughness;
- c) tensile strength of the article and before any requirements for stress relief before coating (see 7.1 and 7.2);
- d) service condition number (see 6.1) or the classification code of the coating (see 6.2);
- e) any supplementary finish required (see 6.2 and A.3);
- f) acceptability and positions of defects on non-significant surfaces (see 8.2);
- g) location at which coating thickness shall be measured, any maximum thickness if appropriate, and the test method to be used' (see 8.3);
- h) sampling procedure to be adopted (see Clause 9);
- i) method for testing adhesion (see 8.4);
- j) requirement for an attestation of conformity (see Clause 11);
- k) any special requirements for appearance (see 8.1).

4.3 Additional information

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

- a) any special post-plating treatment (see A.3);

- b) any special packaging requirements for the coated articles;
- c) requirement for any test report other than that specified.

5 Substrate

This document specifies no requirement for the condition, finish or surface roughness of the basis metal prior to mechanical zinc plating. However, it should be recognized that the surface roughness of the coated surface will be dependent on the initial roughness of the basis metal, and therefore this shall not be a cause for rejection of the mechanical zinc plated coating.

6 Classification and designation of coatings

6.1 Service condition number

The service condition number shall be used to indicate the severity of the service conditions in accordance with Table 1 (see EN 12500:2000, Annex E).

6.2 Class of zinc coating thickness and type of supplementary treatment

The zinc coatings shall be classified on the basis of thickness and the supplementary treatment required in accordance with Tables 1 and 2.

Table 1 — Minimum coating thickness for mechanical zinc coating

Class	Minimum coating thickness (µm)
Zn 110 M(Fe)	107
Zn 80 M(Fe)	81
Zn 65 M(Fe)	66
Zn 50 M(Fe)	53
Zn 40 M(Fe)	40
Zn 25 M(Fe)	25
Zn 12 M(Fe)	12
Zn 8 M(Fe)	8
Zn 6 M(Fe)	6

Table 2 — Supplementary coating finishing

Type	Description
1	As coated, without supplementary treatment
2	With a yellow, opaque green or black coloured chromate conversion treatment
3	With complementary treatment, as specified by the purchaser

7 Requirements for pretreatments

7.1 Stress relief treatment before coating

When specified by the purchaser, steel parts that have an ultimate tensile strength equal to or greater than 1000 Mpa (31 HRc) and that contain tensile stresses caused by machining, grinding, straightening, or cold forming operations shall be given a stress relief treatment prior to cleaning and metal deposition. The procedures and classes for stress relief heat treatment shall be as specified by the purchaser or the purchaser may specify appropriate procedures and classes from ISO 9587. Stress relief heat treatment shall be carried out before any electrolytic treatments are applied.

7.2 Cleaning

High strength steels, which become embrittled when charged with hydrogen, shall be cleaned before application of the coating in non-electrolytic alkaline, anodic-alkaline processes.

High strength steels that have heavy oxide or scale on them shall be further cleaned using inhibited acid processes to avoid the risk of producing hydrogen embrittlement.

8 Inspection

8.1 Appearance

When examined by the unaided eye or corrected vision the significant surfaces of the coated articles shall be free from any visible defects such as blisters, pits, roughness, cracks or uncoated areas and shall not be stained or discoloured. The acceptability and positions of defects on non-significant surfaces shall be specified by the purchaser. The coatings deposited shall have a uniform silvery appearance, and a matte to medium bright lustre.

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NOTE Applied finishes generally perform better in service when the substrate over which they are applied is smooth and free of torn metal, inclusions, pores, and other defects.

A metal finisher can often remove defects through special treatments such as grinding, polishing, abrasive blasting, chemical treatments, and electropolishing. However, these are not in the normal treatment steps preceding application of the finish. When desired they shall be specified by the purchaser.

8.2 Surface defects

Defects and variations in appearance in the coating that arise from surface condition of the substrate (scratches, pores, roll marks, inclusions, etc.) and finishing practices shall not be cause for rejection.

The coating shall be uniform in appearance and substantially free of blisters, pits, nodules, flaking, and other defects that can adversely affect the function of the coating. The coating shall cover all surfaces including roots of threads, thread peaks, corners and edges. The coating shall not be discoloured throughout to an extent that would adversely affect appearance as a functional requirement. However, superficial staining that results from rinsing and variations in colour or lustre shall not be cause for rejection.

NOTE The nature of the mechanical plating process is such that the coatings are generally not as smooth or as bright as some electroplated coatings.

8.3 Thickness

The thickness over the entire significant surface shall be measured in accordance with the following standards within the conventions defined in EN ISO 2064.

The thickness of the coating shall be determined in accordance with EN ISO 2178 (magnetic method), EN ISO 2177 (coulometric method), EN ISO 3497 (X ray spectrometric method) or EN ISO 9220 (microscopical method), as applicable. Other methods may be used if it can be demonstrated that the measurement uncertainty of EN ISO 2178, EN ISO 2177, EN ISO 3497 and EN ISO 9220 is less than 10 % reliable.

The thickness of the coating shall be measured at the significant surface of the product or at such locations as specified.

The thickness of coatings with supplementary finishes (see Table 2) shall be measured before the application of supplementary coating or treatment. The Type 2 chromate conversion coatings shall be removed from the test area before the thickness is measured using a very mild abrasive (such as a paste of levitated alumina or magnesium oxide) rubbed on gently with the finger.

NOTE 1 The process by which Type 2 coatings are produced dissolves a small amount of zinc. For this reason it is essential that the thickness is checked after the application of Type 2 coatings to ensure that it is the required thickness.

The minimum thicknesses shall be in accordance with Table 1.

NOTE 2 With mechanical deposition the coatings generally tend to be thinner at exposed edges and sharp projections, and thicker on flat surfaces and shielded or recessed areas.

NOTE 3 The coating thickness required by this specification is a minimum requirement; that is, the coating thickness has to equal or exceed the specified thickness everywhere on the significant surfaces. Variation in the coating thickness from point to point on a coated article is an inherent characteristic of mechanical deposition processes. Therefore, the coating thickness will have to exceed the specified value at some points to ensure that the thickness equals or exceeds the value at all points. Hence, in most cases the average coating thickness on an article will be greater than the specified value; how much greater is largely determined by the shape of the article and the characteristic of the deposition process.

8.4 Adhesion

Adhesion of the zinc deposit to the basis metal shall be tested in a manner that is consistent with the service requirements of the coated article. The ability to separate the coating from the substrate by peeling, as distinct from flaking caused by rupture of the deposit or of the basis metal, shall be evidence of failure. Adhesion shall be determined in accordance with one of the following methods:

- **Bend test:** the part shall be plastically deformed to rupture, if possible, as specified.
- **Scrape test:** the surface of the coated article shall be scraped or sheared with a sharp edge, knife or razor blade through the coating down to the basis metal and shall be examined under 4X magnification.

NOTE There is no satisfactory test for evaluating the adhesion of mechanically deposited coatings. Those given above are widely used; however, other tests may prove more applicable in specific cases. Various qualitative methods are discussed in EN ISO 2819.

8.5 Corrosion resistance in accelerated salt spray test

When tested in accordance with the neutral salt spray test (NSS) in accordance with ISO 9227, each class of coating shall withstand the minimum period specified in Table 3 for duration of exposure (measured in hours) before first significant corrosion.

NOTE If samples with Type 2 supplementary coating chromate film (see Table 3) are to be examined both for white corrosion and for rust, separate samples may be used to determine the end point for white corrosion and for rust. This allows uninterrupted exposure for the longer of the two test periods required without having to wash specimens for examination, in accordance with ISO 9227.

Parts with Type 2 supplementary coating chromate film shall be aged at room temperature for 24 h before salt spray testing.