

BS EN ISO 19598:2016



BSI Standards Publication

**Metallic coatings —
Electroplated coatings of zinc
and zinc alloys on iron or steel
with supplementary Cr(VI)-free
treatment (ISO 19598:2016)**

National foreword

This British Standard is the UK implementation of EN ISO 19598:2016.

The UK participation in its preparation was entrusted to Technical Committee STI/33, Electrodeposited and related coatings.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2016.
Published by BSI Standards Limited 2016

ISBN 978 0 580 86512 1

ICS 25.220.40

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 December 2016.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

EUROPEAN STANDARD

EN ISO 19598

NORME EUROPÉENNE

EUROPÄISCHE NORM

November 2016

ICS 25.220.40

English Version

Metallic coatings - Electroplated coatings of zinc and zinc alloys on iron or steel with supplementary Cr(VI)-free treatment (ISO 19598:2016)

Revêtements métalliques - Revêtements électrolytiques de zinc et d'alliages de zinc sur du fer ou de l'acier avec traitement supplémentaire sans Cr(VI) (ISO 19598:2016)

Metallische Überzüge - Galvanische Zink- und Zinklegierungsüberzüge auf Eisenwerkstoffen mit zusätzlichen Cr(VI)-freien Behandlungen (ISO 19598:2016)

This European Standard was approved by CEN on 1 October 2016.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

This document (EN ISO 19598:2016) has been prepared by Technical Committee ISO/TC 107 “Metallic and other inorganic coatings” in collaboration with Technical Committee CEN/TC 262 “Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys” 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 May 2017, and conflicting national standards shall be withdrawn at the latest by May 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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

Endorsement notice

The text of ISO 19598:2016 has been approved by CEN as EN ISO 19598:2016 without any modification.

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Designation	2
4.1 Electrodeposited coatings.....	2
4.2 Passivation.....	2
4.3 Post treatment.....	2
4.4 Significant (functional) surfaces.....	3
4.5 Examples of designations.....	3
5 Information to be supplied by the purchaser to the electroplater	3
6 Basis materials	4
7 Coating and processing	4
7.1 Surface preparation and deposition of zinc or zinc-alloy coating.....	4
7.2 Supplementary treatments.....	4
7.2.1 Passivation layers.....	4
7.2.2 Post treatment.....	5
7.3 Barrel-/rack-plating (handling of parts).....	5
7.3.1 Barrel electroplating.....	5
7.3.2 Rack electroplating.....	5
7.4 Hydrogen embrittlement.....	5
7.4.1 Basic factors.....	5
7.4.2 Choice of procedure.....	6
8 Requirements to be met by coatings and test methods	7
8.1 Thickness.....	7
8.2 Adhesion.....	7
8.3 Absence of Cr(VI).....	8
8.4 Accelerated corrosion testing.....	8
8.4.1 General.....	8
8.4.2 Minimum corrosion resistance of passivated zinc and zinc-alloy coatings.....	8
9 Test report	10
9.1 General information.....	10
9.2 Coatings on materials having a tensile strength $\geq 1\ 000\ \text{N/mm}^2$	10
9.3 Test results.....	10
Bibliography	11

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).

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).

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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 3, *Electrodeposited coatings and related finishes*.

Introduction

The chromium(VI) free systems differ in 2 points from the chromium(VI)-containing systems:

- a) there is no self-healing of the system;
- b) higher temperature resistance ($> 150\text{ °C}$), the limit for chromium(VI) containing systems, is $\leq 70\text{ °C}$.

Metallic coatings — Electroplated coatings of zinc and zinc alloys on iron or steel with supplementary Cr(VI)-free treatment

1 Scope

This International Standard applies to electrodeposited zinc and zinc-alloy coatings on iron and steel with Cr(VI)-free passivation. The zinc-alloy coatings contain nickel or iron as alloying elements (referred to as zinc/nickel and zinc/iron coatings, respectively).

The main purpose of the coatings or coating systems is protecting iron and steel components against corrosion.

This International Standard specifies

- the designations to be used for the above coating systems,
- the minimum corrosion resistance to be achieved in specified test procedures, and
- the minimum coating thicknesses required.

2 Normative references

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 2080, *Metallic and other inorganic coatings — Surface treatment, metallic and other inorganic coatings — Vocabulary*

ISO 3497, *Metallic coatings — Measurement of coating thickness — X-ray spectrometric methods*

ISO 3613:2010, *Metallic and other inorganic coatings — Chromate conversion coatings on zinc, cadmium, aluminium-zinc alloys and zinc-aluminium alloys — Test methods*

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

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

ISO 9588, *Metallic and other inorganic coatings — Post-coating treatments of iron or steel to reduce the risk of hydrogen embrittlement*

ISO 27830:2008, *Metallic and other inorganic coatings — Guidelines for specifying metallic and inorganic coatings*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2080 apply.

4 Designation

4.1 Electrodeposited coatings

The electrodeposited coatings shall be composed of zinc or zinc-alloys as listed in [Table 1](#).

Table 1 — Designation of electrodeposited coatings

Symbol	Definition
Zn	Zinc coating without alloying element
ZnFe	Zinc-alloy containing a mass fraction of 0,3 % to 1,0 % iron
ZnNi	Zinc-alloy containing a mass fraction of 12 % to 16 % nickel

4.2 Passivation

Passivation is the production of conversion coatings by treating coatings with suitable Cr(VI)-free solutions in order to improve their corrosion resistance. The conversion coating may optionally be dyed.

Since the Cr(VI)-free passivations are new coating systems, the new nomenclature is listed in [Table 2](#).

Table 2 — Passivations

Type of passivation	Code	Colouration, surface appearance ^a	Notes
Transparent	An	Colourless to coloured and iridescent	Often referred to as “thin-layer passivation”
Iridescent	Cn	Coloured and iridescent	Often referred to as “thick-layer passivation”
Black	Fn	Black	

^a Tints are permissible.

4.3 Post treatment

Application of a sealant or top coats increases corrosion resistance.

Sealant layers normally show a thickness of up to 2 µm and are composed of Cr(VI)-free organic and/or inorganic compounds. Coatings that can be removed with cold cleaning agents, such as those with an oil, grease or wax base, are not considered as sealants in the context of this International Standard.

Top coats are normally thicker than 2 µm and are Cr(VI)-free organic thin coatings which may need elevated temperature curing. Particularly for coatings with black passivation, a postdip can be used for increasing corrosion resistance and improving colour depth.

The impact of the post treatments mentioned to component properties such as contact resistance, weldability, compatibility with fuels, performance in bonded joints, etc., when in service shall be assessed on a case by case basis.

Since the range of surface modifications is very large, the use of a post treatment mentioned and the type shall be agreed on in the case of surface coatings that are subject to particular requirements.

NOTE The post treatment mentioned normally remove the interference colours produced by passivation.

Table 3 — Post treatment

Symbol	Meaning
Tx	Sealant may or may not be present ^a
T0	No sealant
T2nL	Sealant without integrated lubricant ^b
T2yL	Sealant with integrated lubricant ^b
T4	Subsequently added lubricant
T7nL	Top coat without integral lubricant ^b
T7yL	Top coat with integral lubricant ^b

NOTE T4 is not considered.

^a Left to the choice of the coater.

^b Optional designation of nL or yL, when required.

4.4 Significant (functional) surfaces

Components with complex shapes, particularly those having cavities, may not be capable of meeting the corrosion resistance and minimum thickness criteria required in the accelerated corrosion tests at all the points on the electroplated surface. In such cases, the significant surfaces for the coating system shall be indicated on the drawing by a dot-and-dash line.

If the purchaser does not specify a significant surface, the definition given in ISO 27830:2008, Clause 6 shall apply.

4.5 Examples of designations

Designation of a zinc/nickel alloy coating on a steel (Fe) component having a minimum local coating thickness of 8 µm (8) and iridescent passivation (Cn):

Electroplated coating ISO 19598 – Fe//ZnNi8//Cn//T0

Designation of a zinc/iron alloy coating on a steel (Fe) component having a minimum local coating thickness of 8 µm (8) with black passivation (Fn) and sealant (T2):

Electroplated coating ISO 19598 – Fe//ZnFe8//Fn//T2

Designation of a zinc coating on a steel (Fe) component having a minimum local coating thickness of 12 µm (12) and black passivation (Fn); application of a subsequent sealant is left to the choice of the coater:

Electroplated coating ISO 19598 – Fe//Zn12//Fn//Tx

5 Information to be supplied by the purchaser to the electroplater

The minimum information to be provided by the purchaser to the electroplater shall comprise the following:

- a) the tensile strength of the component (to enable the requirements in 7.4 to be taken into account);
- b) component information (basis material, production method, heat treatment);
- c) information on significant surfaces as required by 4.4;
- d) designation of the coating to be applied (see 4.5).

If desired, further requirements, such as appearance, friction properties and media resistance, may be imposed on the properties of the coatings to be applied and the testing extended accordingly.

If necessary, additional information relating to requirements or restrictions to be imposed on the coating process shall be provided.

6 Basis materials

The application of coatings complying with this International Standard to low-alloyed steels is state of the art. In the case of other iron-based materials, such as cast iron or sintered materials, materials with a substantial content of passivable alloying elements or materials with special strength properties, it may be necessary to specially adapt the treatment processes (pre-treatment, coating, supplementary treatment) and possibly to take additional measures in order to fulfil the requirements of this International Standard. For this reason, the electroplater shall have detailed information about the composition, properties and production of the components to be coated.

If steel components having tensile strengths of 1 000 N/mm² and above are to be coated, steps will have to be taken even at the early stages of production (e.g. when choosing the material, the hardening process and the assembly procedure) to eliminate with a high degree of reliability the possibility of damage resulting from internal hydrogen embrittlement.

The components to be coated shall not exhibit any material, processing or surface defects that may affect the corrosion protection and/or appearance of the coatings adversely or in an unpredicted way.

It shall be possible to remove any impurities (e.g. corrosion products or scale, oil, grease, dirt, etc.) from the surface of the components without leaving any residue by the standard cleaning and pre-treatment procedures.

It may be necessary to draw up an agreement on surface quality.

7 Coating and processing

7.1 Surface preparation and deposition of zinc or zinc-alloy coating

To ensure that the process is reliable and reproducible, the entire pre-treatment and coating cycle, together with the associated physical data, e.g. treatment times and temperatures, and all the processing chemicals, shall be recorded, documented and, if necessary, optimized. The individual process control limits shall be defined along with the frequency of monitoring and the analytical procedures. The actions these require shall be described and recorded by the electroplater.

A typical process cycle would be as set out below:

- a) alkaline degreasing (adapted to suit the oil- or grease-based films encountered);
- b) pickling (usually in hydrochloric acid, inhibited);
- c) electrolytic alkaline degreasing (preferably anodic);
- d) electroplating;
- e) supplementary treatment comprising passivation and possibly sealing;
- f) drying.

7.2 Supplementary treatments

7.2.1 Passivation layers

Passivation layers are conversion coatings produced by dipping components in, or spraying them with, passivation solutions. The deposited coating reacts with the passivation solution to form a thin film that protects the metallic coating. Some of the deposited coating is normally dissolved as a result of the reaction.

7.2.2 Post treatment

The post treatment is carried out by applying additional organic and/or inorganic substances to, or incorporating them in, the passivation.

Depending on the geometry of the component and the process, this may result in an accumulation of several post treatments. The latter shall be kept to a minimum, e.g. by spraying in the case of rack-electroplated components or agitation in the case of barrel-electroplated components.

7.3 Barrel-/rack-plating (handling of parts)

7.3.1 Barrel electroplating

Among the parts typically treated in coating barrels are screws, nuts and other small components. After the parts have been loaded into the barrels in bulk, they are pre-treated and coated with the barrel rotating. The rotation ensures that the coating of all the components is more or less identical, but it may give rise to surface damage. This damage can be minimized, for example, by reducing the barrel rotation or the drop height when the barrels are emptied. The corrosion resistance is normally less than that achieved by rack electroplating.

7.3.2 Rack electroplating

Parts may have to be coated in rack technology because of their size or shape or possibly because they have to meet special requirements. In this process, the components are placed on racks for coating. The characteristics of the coatings (especially the thickness of the metallic coating) may vary with the position of the components on the rack, but optimization may be possible, for example, by designing racks for particular components.

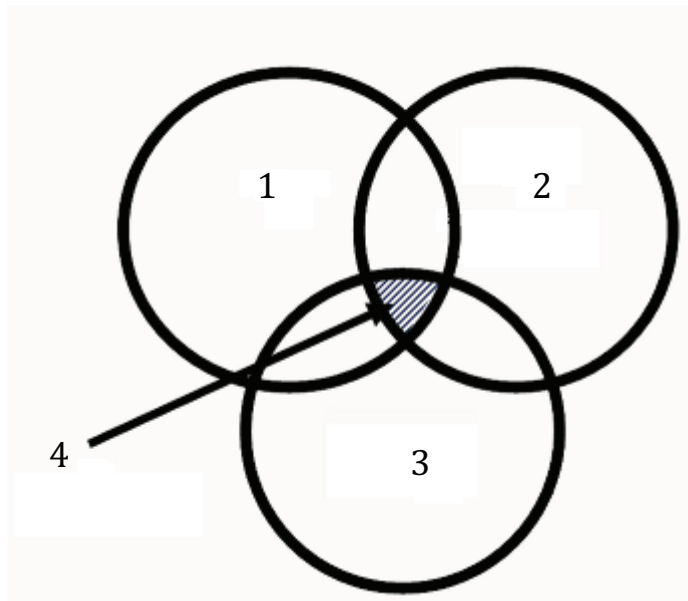
7.4 Hydrogen embrittlement

7.4.1 Basic factors

During processes such as pickling, electrolytic cleaning and electrodeposition of metal coatings, steel parts coated by the procedure described in this International Standard may absorb hydrogen as a result of hydrogen diffusing preferentially through the metal lattice to energetically favourable positions, such as structural defects in the lattice and points with high concentrations of stress.

This may result in delayed hydrogen-induced brittle fractures. Particular attention has to be paid to the critical interaction of

- the material and its characteristics (strength, hardness),
- hydrogen absorption during the pre-treatment and coating processes, and
- mechanical stresses in the components, including those that vary locally as a function of shape.



Key

- 1 material
- 2 mechanical stress (including internal and local stress)
- 3 hydrogen in the material
- 4 fracture in the event of critical interaction

Figure 1 — Interaction of material, mechanical stress and hydrogen absorption

The crucial material properties are strength and toughness, the risk of hydrogen embrittlement increasing with the strength of the material.

All steel parts having a tensile strength $R_m \geq 1\,000\text{ N/mm}^2$ (even if localized as in case-hardened or cold-worked structures or in the vicinity of welds) are considered high-strength and classified as critical.

NOTE R_m is the symbol of the tensile strength. The dimension of tensile strength is force per unit area; the commonly used units are N/mm^2 or MPa (megapascal).

7.4.2 Choice of procedure

7.4.2.1 Basis material strength $<1\,000\text{ N/mm}^2$

The choice of treatment procedures is unrestricted, provided the requirements of this International Standard are fulfilled and service performance is not adversely affected.

7.4.2.2 Basis material strength $\geq 1\,000\text{ N/mm}^2$

In coating high-strength components, the prevention of delayed brittle fractures (hydrogen embrittlement) is of paramount importance.

The surface treatment shall be performed in such a way as to prevent damage due to delayed hydrogen-induced brittle fractures with a high degree of certainty. How to deal with potentially defective coating (e.g. by stripping and re-coating) shall be investigated and the outcome documented.

The steps taken to minimize the risk of delayed hydrogen-induced brittle fractures shall be agreed between the electroplater and the purchaser. (The baking time and temperature shall be agreed between the supplier and purchaser, based on the coating material and properties.)

The necessary process investigation and process testing associated with the manufacture may be performed, for example, by strain testing an adequate number of suitable hydrogen-sensitive specimens.

The advice given in ISO 9587 and ISO 9588 shall be borne in mind.

To prevent brittle fractures, heat treatment processes shall be performed after electroplating to promote hydrogen effusion, and possibly even before electroplating, to relieve internal component stresses. In this connection, see ISO 9587 and ISO 9588.

Particular attention shall be paid to ensuring that the deposited metallic coating does not act as a diffusion barrier and prevent hydrogen effusion. The properties of the components shall not be adversely affected.

NOTE Guideline values for heat treatment to promote hydrogen effusion are given in [Table 4](#).

Table 4 — Guideline values for heat treatment to promote hydrogen effusion after electroplating

Tensile strength, R_m N/mm ²	Heat treatment conditions in hot-air circulation oven Minimum holding time at component temperature (215 ± 15) °C h
1 000 to 1 250	6
>1 250 to 1 450	12
>1 450 to 1 600	20
>1 600 to 2 000	24

In addition to the measures described above, components potentially subject to hydrogen damage shall be tested as specified in ISO 9588.

8 Requirements to be met by coatings and test methods

8.1 Thickness

[Table 5](#) shows the minimum zinc or zinc-alloy coating thicknesses (d_{min}) provided on significant surfaces by the specified processes.

The thicknesses of zinc and zinc-alloy coatings shall preferably be determined by X-ray fluorescence as in ISO 3497.

Examples of other methods that can be used are as follows:

- a) microscopic determination as in ISO 1463;
- b) coulometric determination as in ISO 2177;
- c) magnetic determination as in ISO 2178;
- d) eddy current permeability as in ISO 2360 and ISO 15549.

No account is taken of the thicknesses of passivation and sealant layers.

8.2 Adhesion

There shall be no peeling or blistering if the test pieces are kept at (220 ± 10) °C for 30 min and then immediately quenched in water at 15 °C to 25 °C (thermal shock test based on ISO 2819).

Bending or burnishing, if feasible, is recommended as a further adhesion test.

8.3 Absence of Cr(VI)

The coating deposited shall be free of Cr(VI) when analysed as specified in ISO 3613:2010, 5.5.2.

8.4 Accelerated corrosion testing

8.4.1 General

The process stability of the coatings can be controlled by salt spray test according to ISO 9227. For qualification of coated parts, the guidelines in, e.g. ISO/TR 16335, can be used.

NOTE Since the temperature, humidity, flow conditions, etc. may be very different from the limited test atmospheres specified in the accelerated corrosion tests, the results of accelerated corrosion tests cannot be used without qualification to predict the corrosion behaviour of components when in service.

8.4.2 Minimum corrosion resistance of passivated zinc and zinc-alloy coatings

No corrosion products, such as white corrosion in the coating or red rust in the basis material, shall appear within the minimum test times specified for a given coating system and test. The evaluation shall be based on the significant surfaces of the component.

The minimum corrosion resistances apply in the “coated state” and also after thermal ageing at 120 °C for 24 h prior to the corrosion test. Thermal ageing is unnecessary for the Zn//An//T0 coating system.

Treatments such as waxing and greasing, which have not been agreed but which could improve resistance in the corrosion test, are not permitted.

Operations such as sorting, transportation, assembly or exposure to aggressive media shall be avoided prior to corrosion testing since they may adversely affect the corrosion resistance properties of the coatings. Assessment or limitation of such damage is not covered by this International Standard.

The corrosion resistance that can be achieved by coatings may depend not only on the coating system and the quality of the coating, but also to a considerable extent on the component to be coated (e.g. on the material and the geometry). If optimum coating quality cannot readily be achieved in the case of a component (e.g. because of defects in the material or complicated component geometry), it may be necessary to agree a reduced corrosion resistance.

Table 5 — Minimum coating thicknesses and minimum test times for passivated transparent or iridescent zinc and zinc-alloy coatings subjected to the ISO 9227-NSS test

Type of surface protection coating	Coating designation	Type of electroplating	Minimum test time h			
			Without coating corrosion	Without basis material corrosion (as a function of Zn or Zn-alloy coating thickness)		
				5 µm	8 µm	12 µm
Transparent-passivated electroplated zinc coating	Zn//An//T0	Barrel	8	48	72	96
		Rack	16	72	96	120
Iridescent-passivated electroplated zinc coating	Zn//Cn//T0	Barrel	72	144	216	288
		Rack	120	192	264	336
Iridescent-passivated and sealed electroplated zinc coating	Zn//Cn//T2	Barrel	120	192	264	360
		Rack	168	264	360	480
Transparent-passivated electroplated zinc-iron alloy coating	ZnFe//An//T0	Barrel	96	168	240	312
		Rack	168	240	312	384
Transparent-passivated and sealed electroplated zinc-iron alloy coating	ZnFe//An//T2	Barrel	144	216	288	384
		Rack	216	312	408	528
Iridescent-passivated electroplated zinc-iron alloy coating	ZnFe//Cn//T0	Barrel	96	168	240	312
		Rack	168	240	312	384
Iridescent-passivated and sealed electroplated zinc-iron alloy coating	ZnFe//Cn//T2	Barrel	144	216	288	384
		Rack	216	312	408	528
Transparent-passivated electroplated zinc-nickel alloy coating	ZnNi//An//T0	Barrel	120	480	720	720^a
		Rack	192	600	720	720^a
Transparent-passivated and sealed electroplated zinc-nickel alloy coating	ZnNi//An//T2	Barrel	168	600	720	720^a
		Rack	360	720	720 ^a	720^a
Iridescent-passivated electroplated zinc-nickel alloy coating	ZnNi//Cn//T0	Barrel	120	480	720	720
		Rack	192	600	720	720^a
Iridescent-passivated and sealed electroplated zinc-nickel alloy coating	ZnNi//Cn//T2	Barrel	168	600	720	720^a
		Rack	360	720	720 ^a	720

^a To limit the testing costs, the requirement has been reduced to 720 h.

Table 6 — Minimum coating thickness and test times for passivated black zinc and zinc-alloy coatings subjected to the ISO 9227-NSS test

Type of surface protection coating	Coating designation	Type of electroplating	Minimum test time h			
			Without coating corrosion	Without basic material corrosion (as a function of Zn or Zn-alloy coating thickness)		
				5 µm	8 µm	12 µm
Black passivated electroplated zinc coating	Zn//Fn//T0	barrel	24	48	72	96
		rack	48	72	96	120
Black passivated and sealed electroplated zinc coating	Zn//Fn//T2	barrel	72	144	216	288
		rack	120	192	264	360
Black-passivated and sealed electroplated zinc-iron alloy coating	ZnFe//Fn//T2	barrel	120	192	264	360
		rack	168	264	360	480
Black-passivated and sealed electroplated zinc-nickel alloy coating	ZnNi//Fn//T2	barrel	168	480	720	720^a
		rack	240	600	720	720^a
Black-passivated electro-plated zinc-nickel alloy coating	ZnNi//Fn//T0	barrel	48	480	720	720^a
		rack	72	600	720	720^a

^a To limit the testing costs, the requirement has been reduced to 720 h.

Faint visual variations (a hazy grey veil) that are not voluminous in nature are permitted and do not adversely affect the corrosion protection layer.

9 Test report

9.1 General information

The electroplater shall provide a test report that:

- refers to this International Standard, i.e. ISO 19598;
- certifies conformance with the requirements of this International Standard;
- gives the name of the electroplater;
- records process details (rack or barrel plating and coating system deposited).

9.2 Coatings on materials having a tensile strength $\geq 1\ 000\ \text{N/mm}^2$

The test report shall certify that designated steps have been taken to minimize the risk of delayed hydrogen-induced brittle fracture.

9.3 Test results

The tests in 8.2, 8.3 and 8.4 shall be carried out concurrently with the process.

The test report shall include the following details:

- the results of the technological tests specified in [Clause 8](#);
- by whom the tests were performed (the supplier and/or subcontractor and/or an independent testing laboratory).

Bibliography

- [1] ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method*
- [2] ISO 2177, *Metallic coatings — Measurement of coating thickness — Coulometric method by anodic dissolution*
- [3] ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method*
- [4] ISO 2360, *Non-conductive coatings on non-magnetic electrically conductive basis materials — Measurement of coating thickness — Amplitude-sensitive eddy-current method*
- [5] ISO 2819, *Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion*
- [6] ISO 15549, *Non-destructive testing — Eddy current testing — General principles*
- [7] ISO/TR 16335, *Corrosion of metals and alloys — Corrosion tests in artificial atmospheres — Guidelines for selection of accelerated corrosion test for product qualification*

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit, or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than 1 device provided that it is accessible by the sole named user only and that only 1 copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.

Standards purchased in hard copy format:

- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than 1 copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright & Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email subscriptions@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services

Tel: +44 345 086 9001

Email (orders): orders@bsigroup.com

Email (enquiries): cservices@bsigroup.com

Subscriptions

Tel: +44 345 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

Copyright & Licensing

Tel: +44 20 8996 7070

Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK