INTERNATIONAL STANDARD

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Metallic and other inorganic coatings — Electroplated coatings of zinc with supplementary treatments on iron or steel

Revêtements métalliques et autres revêtements inorganiques — Dépôts électrolytiques de zinc avec traitements supplémentaires sur fer ou acier

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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 2081 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 3, *Electrodeposited coatings and related finishes*.

This third edition cancels and replaces the second edition (ISO 2081:1986), which has been technically revised.

Introduction

Zinc coatings are applied to iron or steel articles for protective and decorative purposes by electrodeposition from acid zinc chloride, alkaline non-cyanide zinc, and alkaline zinc cyanide solutions. Electroplated, bright zinc coatings are popular and the processes for preparing bright zinc coatings are widely used.

The ability of a zinc coating to prevent corrosion is a function of its thickness and the type of service conditions to which it is exposed. For example, the rate of corrosion of zinc will generally be greater in industrial exposures than in rural ones. The type of service condition should, therefore, be taken into consideration when specifying the minimum coating thickness. Chromate conversion coatings and other supplementary treatments enhance the corrosion resistance of electrodeposited zinc coatings and are commonly applied after electroplating.

Because the appearance and serviceability of zinc coatings depends on the surface condition of the basis metal, agreement should be reached between the interested parties that the surface finish of the basis metal is satisfactory for electroplating.

Chromate conversion coatings are omitted, or replaced by other conversion coatings, at the specific request of the purchaser. This International Standard provides the codes for all types of chromate conversion and other supplementary coatings.

Chemical conversion coatings that do not contain hexavalent chromium or are chromium-free, conforming to this International Standard, are commercially available. The appearance of these substitutes may be different from those produced with hexavalent chromium. All forms of chromate conversion coatings, alternative conversion coatings or substitutes, with the exception of phosphate coatings, can be used and are required to satisfy the corrosion requirements given in this International Standard.

Standard designations for metals and alloys can be found in References [6] to [10] in the Bibliography.

Metallic and other inorganic coatings — Electroplated coatings of zinc with supplementary treatments on iron or steel

WARNING — This International Standard may not be compliant with some countries' health, safety and environmental legislations and calls for the use of substances and/or procedures that may be injurious to health if adequate safety measures are not taken. This International Standard does not address any health hazards, safety or environmental matters and legislations associated with its use. It is the responsibility of the producers, purchasers and/or user of this International Standard to establish appropriate health, safety and environmentally acceptable practices and take appropriate actions to comply with any national, regional and/or international rules and regulations. Compliance with this International Standard does not, of itself, confer immunity from legal obligations.

1 Scope

This International Standard specifies requirements for electroplated coatings of zinc with supplementary treatments on iron or steel. It includes information to be supplied by the purchaser to the electroplater, and the requirements for heat treatment before and after electroplating.

It is not applicable to zinc coatings applied

— to sheet, strip or wire in the non-fabricated form,

— to close-coiled springs, or

— for purposes other than protective or decorative.

This International Standard does not specify requirements for the surface condition of the basis metal prior to electroplating with zinc. However, defects in the surface of the basis metal can adversely affect the appearance and performance of the coating.

The coating thickness that can be applied to threaded components can be limited by dimensional requirements, including class or fit.

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.

ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method*

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

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

ISO 2177, *Metallic coatings — Measurement of coating thickness — Coulometric method by anodic dissolution*

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

ISO 2819, *Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion*

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

ISO 3543, *Metallic and non-metallic coatings — Measurement of thickness — Beta backscatter method*

ISO 3613, *Chromate conversion coatings on zinc, cadmium, aluminium-zinc alloys and zinc-aluminium alloys — Test methods*

ISO 3892, *Conversion coatings on metallic materials — Determination of coating mass per unit area — Gravimetric methods*

ISO 4518, *Metallic coatings — Measurement of coating thickness — Profilometric method*

ISO 4519, *Electrodeposited metallic coatings and related finishes — Sampling procedures for inspection by attributes*

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 10289, *Methods for corrosion testing of metallic and other inorganic coatings on metallic substrates — Rating of test specimens and manufactured articles subjected to corrosion tests*

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

ISO 15724, *Metallic and other inorganic coatings — Electrochemical measurement of diffusible hydrogen in steels — Barnacle electrode method*

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2064 and ISO 2080 apply.

3.2 Abbreviated terms

C iridescent conversion coating

D opaque chromate conversion coating

ER hydrogen embrittlement relief heat treatment

NM non-metallic materials

PL plateable plastics materials

SR stress relief heat treatment

T2 organic sealant

3.3 Symbols

Al chemical symbol for aluminium

Cu chemical symbol for copper

Fe chemical symbol for iron

Zn chemical symbol for zinc

4 Information to be supplied by the purchaser to the electroplater

4.1 Essential information

The following information shall be supplied to the electroplater in writing, for example, in the contract or purchase order, or on engineering drawings:

a) the reference to this International Standard, ISO 2081, and the designation (see Clause 5);

b) the significant surface indicated, for example, by drawings or by the provision of suitably marked samples;

c) the nature, condition and finish of the basis metal if they are likely to affect the serviceability and/or appearance of the coating (see Clause 1);

d) the position on the surface for unavoidable defects, such as rack marks (see 6.1);

e) the finish required, for example, bright, dull or other finish, preferably accompanied by approved samples of the finish (see 6.1);

f) the type of chromate conversion coating or supplementary treatment (see 6.3 and Annex A); chromate conversion coatings shall only be omitted, and alternative conversion coatings and/or other supplementary treatments (see Table A.2) or conformal coatings, such as lacquers, applied over the chromate coating, at the specific request of the purchaser;

g) the requirements for thickness and adhesion test (see 6.2, 6.4 and Annex B);

h) the tensile strength of the parts and the requirements for heat treatment before and/or after electrodeposition (see 6.6 and 6.7);

i) sampling methods, acceptance levels or any other inspection requirements, if inspection is different from that given in ISO 4519 (see Clause 7);

j) any requirements for accelerated corrosion testing (see 6.5) and rating (see 6.5.2).

4.2 Additional information

The following additional information shall also be supplied to the electroplater:

a) any special requirements for, or restrictions on, preparation of the article to be coated (see Bibliography);

b) any other requirements, such as for articles of complex shape, an area for testing and rating.

5 Designation

5.1 General

The designation shall appear on engineering drawings, in the purchase order, in the contract or in the detailed product specification. The designation specifies, in the following order, the basis metal, stress relief requirements, the type and thickness of undercoats, if present, the thickness of the zinc coating, heat treatment requirements after electroplating, and the type of conversion coating and/or supplementary treatment (see Bibliography).

5.2 Designation specification

The designation shall comprise the following:

a) the term “Electrodeposited coating”;

b) the reference to this International Standard, ISO 2081;

c) a hyphen;

d) the chemical symbol of the basis material, Fe, (iron or steel) followed by its standard designation;

e) a solidus (/);

f) the SR designation, if necessary, followed by a solidus (/);

g) the chemical symbol for zinc, “Zn”;

h) a number indicating the minimum local thickness, in micrometres, of the zinc coating followed by a solidus (/);

i) the ER designation, if necessary, followed by a solidus;

j) if appropriate, codes designating the chromate conversion coating, followed by a solidus;

k) if appropriate, codes designating any supplementary treatments (see Annex A).

Solidi (/) shall be used to separate data fields in the designation corresponding to the different sequential processing steps. Double separators or solidi indicate that a step in the process is either not required or has been omitted (see ISO 27830).

If other supplementary treatments other than or in addition to chromate conversion coating are used, the designation for a coating thickness of 25 µm of zinc shall be

Fe/Zn25/*X*/*Y*

where

X represents one of the chromate conversion coating codes given in Table A.1;

Y represents one of the codes for other supplementary coatings given in Table A.2.

It is recommended that the specific alloy be identified by its standard designation following the chemical symbol of the basis metal; for example, its UNS number, or the national or regional equivalent, may be placed between the symbols, < >.

EXAMPLE Fe<G43400> is the UNS designation for one high-strength steel. (See Bibliography.)

5.3 Designation of the basis material

The basis material shall be designated by its chemical symbol or its principal constituent if an alloy. For example:

a) Fe for iron or steel;

b) Zn for zinc alloys;

c) Cu for copper and copper alloys;

d) Al for aluminium and aluminium alloys.

For plateable plastics materials, the letters PL shall be used and for non-metallic materials, the letters NM shall be used.

5.4 Designation of heat treatment requirements

The heat treatment requirements shall be in brackets and designated as follows:

a) by the letters SR for stress relief heat treatment prior to electroplating, and/or the letters ER for hydrogen embrittlement relief heat treatment after electroplating;

b) in parentheses, the minimum temperature, expressed in degrees Celsius (°C);

c) the duration, expressed in hours (h), of the heat treatment.

For example, SR(210)1 designates stress relief heat treatment at 210 °C for 1 h.

5.5 Examples

The following are examples of designations.

EXAMPLE 1 Designation of an electrodeposited coating of 12 µm zinc (Zn12) on iron or steel (Fe) which has had an iridescent conversion coating (C) applied:

Electrodeposited coating ISO 2081 – Fe/Zn12/C

EXAMPLE 2 Designation of an electrodeposited coating of 25 µm zinc (Zn25) on iron or steel (Fe) which is to be heat-treated after electroplating for hydrogen embrittlement relief for 8 h at 190 °C, designated as ER(190)8, and has been given a supplementary opaque chromate conversion coating (D) followed by a sealing treatment consisting of the application of an organic sealant (T2):

Electrodeposited coating ISO 2081 – Fe/Zn25/ER(190)8/D/T2

EXAMPLE 3 Same as Example 2, but in addition the articles are heat-treated prior to electroplating for stress relief purposes at 200 °C for a minimum of 3 h, designated as SR(200)3:

Electrodeposited coating ISO 2081 – Fe/SR(200)3/Zn25/ER(190)8/D/T2

6 Requirements

6.1 Appearance

Although this International Standard does not specify the condition, finish or surface roughness of the basis material prior to electroplating, the appearance of electroplated coatings depends on the condition of the basis material (see the Bibliography for surface preparation). The electroplated article on its significant surface shall be free from clearly visible plating defects such as blisters, pits, roughness, cracks or non-plated areas other than those arising from defects in the basis metal. On articles where a contact mark is unavoidable, its position shall be the subject of agreement between the interested parties (see 4.1). The articles shall be clean and free from damage.

Unless the purchaser specifies otherwise, the zinc coating shall be bright. If necessary, a sample showing the required finish shall be supplied or approved by the purchaser [see 4.1 e)].

6.2 Thickness

The thickness of the coating specified in the designation shall be the minimum local thickness. The minimum local thickness of the coating shall be measured at any point on the significant surface that can be touched by a ball 20 mm in diameter, unless otherwise specified by the purchaser (see 4.1 and 4.2).

Methods for the measurement of the thickness of zinc coatings on steel are specified in ISO 1463, ISO 2177, ISO 2178, ISO 3497, ISO 3543 and ISO 4518.

In case of dispute, the method specified in ISO 2177 shall be used for articles having a significant surface area greater than 100 mm^2. In the case of articles having a significant surface area less than 100 mm^2, the minimum local thickness shall be deemed to be the minimum value of the average thickness determined by the method specified in Annex B.

Prior to the use of the method specified in ISO 2177, it is essential that the chromate or other conversion coating is removed using a very mild abrasive, for example, a paste of levigated alumina. In the case of heavy conversion coatings, the results will, therefore, be slightly lower.

If the coatings are rough or matte, the microscopical (ISO 1463) and profilometric (ISO 4518) methods may give unreliable results, and magnetic methods may give measurements which are greater than those obtained on smooth coatings of the same mass per unit area.

Table 1 provides thickness requirements for corrosion protection under various conditions of service.

6.3 Conversion coatings and other supplementary treatments

Chromate conversion coatings shall only be omitted, or replaced by other conversion coatings, such as trivalent chromium or phosphate coatings, at the specific request of the purchaser [see 4.1 f)]. Annex A provides the codes for chromate conversion and all other supplementary coatings.

Chemical conversion coatings that do not contain hexavalent chromium, such as trivalent chromium, or are chromium free, conforming to the requirements of this International Standard, are commercially available. All forms of chromate conversion coatings, alternative conversion coatings or substitutes, with the exception of phosphate coatings, that may be used shall satisfy the corrosion requirements of this International Standard. However, the appearance of these substitutes may be different from those produced with hexavalent chromium conversion coatings. Table 1, Table 2, Table A.1, Table A.2 and Table C.1 reflect the requirements and products that have been used and accepted in practice over several decades by producers, purchasers and users in metal finishing industry worldwide.

6.4 Adhesion of zinc and chromate coatings

The zinc coating shall continue to adhere to the basis metal when subjected to the burnishing test specified in ISO 2819. The chromate coatings (hexavalent or others) shall be tested for adhesion in accordance with ISO 3613.

All tests, including accelerated corrosion testing, shall be carried out at least 24 h after chromate conversion treatment.

6.5 Accelerated corrosion testing

6.5.1 Neutral salt spray test

When tested in accordance with the neutral salt spray (NSS) test specified in ASTM B117 for the times given in Table 1 and Table 2, the test surface shall remain free from red corrosion products (see Table 1) and from white corrosion products (see Table 2) when examined by the unaided eye or corrected vision. Slight staining shall not be a cause for rejection.

The partial coating designation in Table 1 and Table C.1 gives the minimum local thickness of zinc after chromate treatment, if carried out, for various service conditions. The required thickness of the zinc coating to ensure resistance to corrosion depends on the severity of the service conditions. Coating designation, Fe/Zn5 for example, is recommended only for dry, indoor conditions. As the service conditions become more severe, it is necessary to increase the thickness of the zinc to ensure resistance to corrosion, and to specify zinc coating required with respect to the service conditions (see Table C.1).

When very long service life is required, as, for example, on structural steel components, the thicker zinc coatings required can be applied by hot-dip zinc coating in accordance with ISO 1461 (see Reference [1]).

The duration and results of artificial atmosphere corrosion tests may bear little relationship to the service life of the coated article and, therefore, the results obtained are not to be regarded as a direct guide to the corrosion resistance of the tested coatings in all environments where these coatings may be used.

Table 1 — Neutral salt spray corrosion resistance of zinc plus chromate conversion coatings before basis metal corrosion (red rust) begins

Coating designation (partial)	Neutral salt spray test duration h
Fe/Zn5/A Fe/Zn5/B Fe/Zn5/F	48
Fe/Zn5/C Fe/Zn5/D Fe/Zn8/A Fe/Zn8/B Fe/Zn8/F	72
Fe/Zn8/C Fe/Zn8/D Fe/Zn12/A Fe/Zn12/F	120
Fe/Zn12/C Fe/Zn12/D Fe/Zn25/A Fe/Zn25/F	192
Fe/Zn25/C Fe/Zn25/D	360

Table 2 — Corrosion resistance of the chromate conversion coating before corrosion of the underlying zinc coating

Chromate conversion coating code [a]	Neutral salt spray test time h	
	Barrel electroplated	Vat electroplated
A	8	16
B	8	16
C	72	96
D	72	96
F	24	48
[a] See Annex A.		

6.5.2 Corrosion rating

After testing, samples shall be rated in accordance with ISO 10289. The acceptable rating shall be specified by the purchaser.

6.6 Stress relief heat treatments before cleaning and metal deposition

When specified by the purchaser, steel parts that have an ultimate tensile strength equal to or greater than 1 000 MPa and that contain tensile stresses caused by machining, grinding, straightening or cold forming operations shall be given a stress relief heat 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 shall specify appropriate procedures and classes from ISO 9587.

When heat treatment for stress relief prior to electroplating or for hydrogen embrittlement relief after electroplating (see 6.7) are specified, the time and temperature of the heat treatment process shall be included in the coating designation as illustrated in 5.3, 5.4 and 5.5.

Steels with oxide or scale have to be cleaned before application of the coatings. For high strength steels (equal to or greater than 1 000 MPa), non-electrolytic alkaline and anodic alkaline cleaners as well as mechanical cleaning procedures are preferred to avoid the risk of producing hydrogen embrittlement during cleaning procedures (see Bibliography).

6.7 Hydrogen-embrittlement-relief heat treatments after electroplating

Steel parts having an ultimate tensile strength equal to or greater than 1 000 MPa as well as surface-hardened parts shall receive hydrogen-embrittlement-relief heat treatment according to the procedures and classes of ISO 9588 or as specified by the purchaser.

When heat treatment for stress relief prior to electroplating (see 6.6) or for hydrogen embrittlement relief after electroplating are specified, the time and temperature of the heat treatment process shall be included in the coating designation as illustrated in 5.3, 5.4 and 5.5. The effectiveness of the hydrogen-embrittlement-relief heat treatment shall be determined in accordance with ISO 10587 for testing threaded articles for residual hydrogen relief heat treatment, and with ISO 15724 for measuring relative, diffusible hydrogen concentration in steels unless otherwise specified by the purchaser.

Any heat treatment for the relief of hydrogen embrittlement shall be carried out before a chromate conversion coating is applied.

7 Sampling

A random sample of the size as specified by ISO 4519 shall be selected from the inspection lot. The articles in the sample shall be inspected for conformance to the requirements of this specification and the lot shall be classified as conforming or not conforming to each requirement in accordance with the criteria of the sampling plans given in ISO 4519. If other form of sampling plan is selected [see 4.1 i)], a random sample shall be selected and the articles in the sample shall be inspected for conformance to the requirements of this International Standard.

Annex A
(normative)

Designation of chromate conversion coatings and other supplementary treatments

A.1 General

Chromating solutions are usually acidic and might contain hexavalent or trivalent chromium salts, together with other salts which can be varied to affect the appearance and hardness of the film. Clear, bleached, iridescent, olive-green and black films on zinc coating can be obtained by processing in appropriate solutions. Transparent films can also be obtained by bleaching iridescent films in alkaline solutions or in phosphoric acid. See Table C.1 for guidance on the appropriate coating. Table A.1 gives the approximate surface density (mass per unit area) for each type of chromate conversion coating when measured in accordance with ISO 3892.

Table A.1 — Chromate conversion coating type, appearance and surface density

Type		Typical appearance	Coating surface density ρ_A g/m^2
Code	Name		
A	Clear	Transparent, clear to bluish	$\rho_A \leqslant 0{,}5$
B [a]	Bleached	Transparent with slight iridescence	$\rho_A \leqslant 1{,}0$
C	Iridescent	Yellow iridescent	$0{,}5 < \rho_A < 1{,}5$
D	Opaque	Olive-green	$\rho_A > 1{,}5$
F	Black	Black	$0{,}5 \leqslant \rho_A \leqslant 1{,}0$
NOTE Chromate coatings described in this table might not necessarily be specified for the improvement of the adhesion of paints and varnishes. All chromate coatings might or might not contain hexavalent chromium ions.			
[a] This is a two-stage process.			

A.2 Sealing

In order to give better protection against corrosion, chromate conversion coatings can be post-treated with sealing agents, by introducing organic or inorganic products into the chromate film. This operation also enhances the resistance of the chromate conversion coating to higher temperatures.

Sealing can be carried out by dipping or spraying the conversion coating with polymers in aqueous solutions. A similar process is based on the addition of suitable organic products to the chromating solution.

A.3 Supplementary treatments other than conversion coatings

If a supplementary treatment other than conversion coatings is required, the type of treatment shall be indicated in accordance with the codes in Table A.2.

Table A.2 — Supplementary treatments other than conversion coatings

Code	Type of treatment
T1	Application of paints, varnishes, powder coatings or similar coatings materials
T2	Application of organic or inorganic sealants
T3	Application of organic dye
T4	Application of grease or oil, or other lubricants
T5	Application of wax

Annex B
(normative)

Measurement of average thickness of coating on small articles

B.1 Materials

WARNING — Carry out the stripping process in a fume cupboard or hood. Formaldehyde solution is toxic, is an irritant and causes burns. Avoid breathing the vapour. Avoid contact with the skin and eyes.

IMPORTANT — Parts stripped in accordance with this annex shall not be re-used.

Solutions A and B are suitable stripping solutions.

B.1.1 Solution A, comprising 10 ml formaldehyde (mass fraction of 30 %) dissolved in 500 ml hydrochloric acid (1,16 g/ml $< \rho_{HCl} <$ 1,19 g/ml) and diluted with 500 ml distilled or de-ionized water.

B.1.2 Solution B, comprising 300 g/l ammonium nitrate (NH_4NO_3).

B.2 Procedure

For articles having a significant surface area of less than 1 cm^2, take a sufficient number of articles to give a mass of coating not less than 100 mg. Weigh the articles, to the nearest milligram, and strip off the zinc coating at room temperature using a suitable stripping solution.

If the articles are of complex shape, an area for testing and rating shall be specified by the purchaser [(see 4.2 b)].

Rinse the articles in running water, if necessary brushing to remove any loose deposits from the surface, dry carefully and reweigh, noting the loss in mass. Calculate the thickness of the zinc coating, d, in micrometres, from the following equation:

$$d = (\Delta m \times 10^3) / (A \times \rho)$$

where

Δm is the loss in mass, in milligrams;

A is the area of the surface, in square millimetres, under examination;

ρ is the density, in grams per cubic centimetre, of the zinc coating, normally 7,1 g/cm^3.

Annex C
(informative)

Additional information on corrosion resistance, rinsing and drying, processing parts in bulk and dyeing of chromate conversion coatings

C.1 Corrosion resistance of zinc plus chromate conversion coatings in neutral salt spray

Table C.1 provides additional information on the neutral salt spray (ASTM B117) corrosion resistance of zinc plus chromate conversion coatings under different conditions of service.

Table C.1 — Neutral salt spray corrosion resistance of zinc plus chromate conversion coatings

Coating designation (partial)	**Service condition number**	**Service conditions**	**Neutral salt spray test duration** h
Fe/Zn5/A Fe/Zn5/B Fe/Zn5/F	0	Purely cosmetic applications	48
Fe/Zn5/C Fe/Zn5/D Fe/Zn8/A Fe/Zn8/B Fe/Zn8/F	1	Service indoors in warm, dry atmospheres	72
Fe/Zn8/C Fe/Zn8/D Fe/Zn12/A Fe/Zn12/F	2	Service indoors in places where condensation may occur	120
Fe/Zn12/C Fe/Zn12/D Fe/Zn25/A Fe/Zn25/F	3	Service outdoors in temperate conditions	192
Fe/Zn25/C Fe/Zn25/D	4	Service outdoors in severe corrosive conditions, e.g. marine or industrial	360

For some critical applications, the minimum local thickness of the zinc coating for service condition 3 is recommended as 14 µm in lieu of 12 µm. For threaded items whose diameter is less than 20 mm, the minimum thickness requirement is recommended to be 10 µm, and for items such as rivets, taper pins, split cotters and washers, the minimum local thickness is recommended as 8 µm.

C.2 Rinsing and drying

If hot water is used as the final rinse after the chromating process, the time of rinsing should be kept as short as possible, for hexavalent type of coating if used, in order to prevent the dissolution of the hexavalent chromium, if present. The drying of the article should be carried out at a temperature compatible with the type of chromating used in order to prevent cracking due to dehydration of the chromate coating (in general, the maximum drying temperature is 60 °C).

C.3 Processing of parts in bulk

If parts are processed in bulk by electroplating and chromating in barrels, the corrosion resistance of the chromate coating is reduced by a degree which is reflected in the salt spray test requirements given in Table 2.

C.4 Dyeing

If required, chromate conversion coatings of types A or B can be dyed with organic dyes to produce coloured finishes suitable for identification purposes. The process is carried out by dipping in or spraying with aqueous solutions of the appropriate organic dye.

Bibliography

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[4] ISO 27831-1, *Metallic and other inorganic coatings — Cleaning and preparation of metal surfaces — Part 1: Ferrous metals and alloys*

[5] ISO 27831-2, *Metallic and other inorganic coatings — Cleaning and preparation of metal surfaces — Part 2: Non-ferrous metals and alloys*

[6] ASTM E527, *Standard Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)*

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