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ISO/FDIS 9717

Metallic and other inorganic coatings — Phosphate conversion coating of metals

Revêtements métalliques et autres revêtements inorganiques — Couches de conversion au phosphate sur métaux

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Foreword

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings, Subcommittee SC 8, Chemical conversion coatings*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 262, *Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 9717:2017), which has been technically revised.

The main changes are as follows:

— the Introduction has been clarified (1 bracket shifted);

— 5.1 Table 1 formatted and for Znph second line added to describe types of Znph; new Table 1 copied on Table C.1

— 5.2 and ff.: all terms are uniformed from “phosphate coating” or “conversion coating” to “phosphate conversion coating” (when applicable);

— 5.2 and ff.: “after-treatment” was changed to “post treatment”; other definitions and spelling changed according to ISO 2080;

— 6.3 Table 2: definition of T1 recharged, second sentence deleted (this is content of T2);

— 6.3: last sentence updated to describe impact of neutral salt spray test;

— 6.4: revision of 6.4, thickness measurement replaced by area related mass;

— Annex B: last sentence of B.1 deleted: Table B.1 updated;

— Annex B: Table B.1 and B.3 headlines updated;

— Annex B: Table B.4 headline updated;

— Annex C: the element nickel has been added to C.1, C.2.3, C.2.5 and C.4; ICP was added as method to C.2.3; XRF was added as method to C.3.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Phosphate conversion coatings are produced by treating substrates with appropriate solutions. The main constituents of these solutions are the appropriate dihydrogen orthophosphates.

They are intended to

— impart corrosion resistance,

— improve adhesion to paints and other organic finishes,

— facilitate cold-forming operations, such as wire drawing, tube drawing and extrusion, and

— modify surface frictional properties to facilitate sliding.

Phosphate conversion coatings are produced by treatment with solutions, the main constituents of which are the appropriate dihydrogen orthophosphates. These phosphate conversion coatings are applied principally to ferrous materials and zinc, and differ in coating mass per unit area and apparent density, depending on

— the construction material and surface condition of the components,

— previous mechanical and chemical treatment of the components, and

— processing conditions for phosphating.

All phosphate conversion coatings are crystalline and porous but can be sealed substantially by subsequent sealant processes.

Metallic and other inorganic coatings — Phosphate conversion coating of metals

WARNING — This document calls for the use of substances and/or procedures that could be injurious to health if adequate safety measures are not taken. This document does not address any health hazards, safety or environmental matters associated with its use. It is the responsibility of the producers, purchasers and/or users of this document to establish appropriate health, safety and environmentally acceptable practices and take appropriate actions.

1 Scope

This document specifies the requirements for phosphate conversion coatings which are usually destined for application on ferrous materials, aluminium, zinc, and their alloys (see Annex B).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 2080, *Metallic and other inorganic coatings — Surface treatment, metallic and other inorganic coatings — Vocabulary*

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

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

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

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

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Information to be supplied by the purchaser to the processor

The following information shall be provided by the purchaser:

a) a description of the phosphate conversion coating according to this document, i.e., ISO 9717 (see 5.2);

b) in cases of phosphating steel parts with tensile strength ≥ 1 000 MPa, also in locally restricted areas, e.g., for case-hardened or cold-formed structures or in weld seam areas, the safety against brittle fracture (hydrogen embrittlement) is of primary importance. The phosphating process shall be carried

out in such a manner that a risk of hydrogen embrittlement is kept to a minimum. Appropriate measures to minimize the risk of hydrogen embrittlement shall be specified by the purchaser and applied by the supplier. Any heat treatment in accordance with specifications or recommendations cannot ensure complete prevention of hydrogen embrittlement. The effectiveness of a heat treatment, if any, shall be verified by the supplier;

c) the sampling procedure, the acceptable quality limit or any other requirements and tests that deviate from ISO 4519;

d) the surface treatment or phosphating;

e) the desired appearance of the treated surface;

f) the desired corrosion resistance;

g) the quality appearance and surface condition of the basis metal, if any, if these properties affect the performance and/or appearance of phosphate conversion coatings;

h) where applicable, technical measures to minimize the risk of hydrogen embrittlement as specified by the purchaser.

5 Coating types and their importance

5.1 Coating types

The phosphate conversion coating shall be designated in accordance with Table 1.

Table 1 — Designation of phosphate conversion coatings

Elements present in phosphate conversion coating	Coating type
Iron (II)	Feph
Manganese	Mnph
Zinc (no Calcium) Zinc and Mn, Ni, Fe(II) (no Calcium)	Znph
Zinc and Calcium	ZnCaph
Zinc, Mn and Ni	Triph

There are various phosphate conversion coating types of zinc phosphate that are altered because of the build-in of iron and/or nickel and/or manganese. This altered metal is usually present as a double salt, such as $Zn_2ME(PO_4)_2 \times 4\ H_2O$, whereby ME can be Fe(II), Ni and/or Mn. Zn will continue to be the main metal element of those phosphate conversion coatings, which do not have separate markings in order to avoid confusion. It should also be noted that metal taken from the basis material is included in the phosphate conversion coating.

Information for phosphate conversion coating characteristics can be found in Annex B and the identification methods can be found in Annex C.

5.2 Designation of phosphate conversion coating

The designation of the phosphate conversion coating shall consist of the following information.

a) number of this document, i.e., ISO 9717, and the designation “phosphate conversion coating”;

b) followed by a hyphen (/);

c) designation of the metal layer the phosphate layer will be applied upon: by means of the material chemical symbol (or the symbol of the primary alloy components);

d) followed by a solidus (/);

e) a symbol describing the type of phosphate conversion coating (see Table 1);

f) followed by a solidus (/);

g) a symbol, which indicates the function of the phosphate conversion coating as follows:

   1) r = adhesion promoter and/or corrosion protection;

   2) z = simplification of cold forming;

   3) g = reduction of friction;

   4) e = electrical insulation;

h) followed by a solidus (/);

i) a number, which indicates the surface-related mass per square metre with a measurement uncertainty of ±30 %.

If the phosphate conversion coating receives a supplementary treatment, the following information shall be added to the designation:

j) solidus (/);

k) a symbol, which defines the supplementary treatment (see Table 2).

Repeat this process if necessary.

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).

5.3 Example for designation of phosphate conversion coating

A phosphate conversion coating of zinc phosphate type Znph, which has been applied on a ferrous material to prevent corrosion (r), with an area related mass of for example (3 ± 0,9) g/m^2 (3) and a post treatment with a sealant (T2) and a painting (T1), has the following designation:

Phosphate conversion coating ISO 9717 — Fe/Znph/r/3/T2/T1

6 Requirements

6.1 Appearance

Zinc phosphate, zinc calcium phosphate and manganese phosphate conversion coatings shall evenly cover the metal surface and shall not show any white stains, corrosion products or fingerprints.

NOTE Slight fluctuations in the appearance of phosphate conversion coatings because of contact with frames, local changes in surface roughness, properties of the basis material, or through minor contact inside the drum do not constitute any reason for claim.

6.2 Coating mass per unit area

The coating mass is measured in accordance with the procedures specified in ISO 3892.

6.3 Post treatment

Untreated phosphate conversion coatings do not provide a corrosion protection. A suitable post treatment can affect a temporary protection. Table 2 shows the symbols when post treatments are required.

Table 2 — Symbols for post treatment

Symbol	Type of treatment
T1	Application of varnishes, electrocoat or organic coatings (as monolayer or multilayer)
T2	Application of inorganic or organic sealants[a]
T3	Dyeing
T4	Application of grease or oil or other lubricants
T5	Application of wax
T6	Application of soap
[a] For the purpose of phosphated surfaces usually water-based solutions containing Zr, Ti, Cr and/or polymers are applied.	

The corrosion resistance of the post treated components shall be verified in accordance with the corrosion test specified by the purchaser. If there is no test method prescribed, the components shall be tested according to the neutral salt spray (NSS) test described in ISO 9227 and Annex A. The test duration shall be agreed on between the contractual parties. The minimum testing periods specified by the customer shall be reached before the first appearance of corrosion effect.

NOTE 1 Zinc or zinc alloy coated steel substrates and aluminium with a post treatment according to T1 (see Table 2) can be tested according to the acetic acid salt spray (AASS) test described in ISO 9227.

NOTE 2 Aluminium with a post treatment according to T1 (see Table 2) can be tested according to the acetic acid salt spray (AASS) test described in ISO 9227.

NOTE 3 For parts with organic coating according to T1 (see Table 2) the use of the C classes of ISO 9223 can be useful.

NOTE 4 To find an appropriate corrosion test to test the phosphate coating with or without the above-named post treatments, parties involved can use the guideline ISO/TR 16335.

6.4 Correlation of coating thickness and area related mass

Phosphate conversion coatings form crystallized, porous layers which cannot be detected by standard thickness measurement, such as magnetic inductive method according to ISO 2178, dissolving method according to ISO 2177 or X-ray spectrometric methods according to ISO 3497. Therefore, the area related mass is the applicable method to describe phosphate conversion coatings.

NOTE 1 For In-process control the layer thickness according to ISO 2178 can be used to characterize the phosphate layer. A direct relationship between layer thickness and area related mass is only possible based on the defined process, the production line and the component.

NOTE 2 The listed methods are only applied if a respective agreement is made between (internal) suppliers and customers.

7 Heat treatment

Heat treatment after the phosphating process should not be applied because the phosphate layer can be affected. Otherwise the customer shall provide the parameters for the heat treatment according to ISO 9588.

NOTE Heat treatment is only performed if a respective agreement is made between (internal) suppliers and customers.