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Autocatalytic nickel-phosphorus coatings — Specification and test methods

Dépôts autocatalytiques de nickel-phosphore — Spécifications et méthodes d'essai

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4527 was prepared by Technical Committee ISO/TC 107, *Metallic and other non-organic coatings*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Autocatalytic nickel-phosphorus coatings — Specification and test methods

0 Introduction

Autocatalytic¹⁾ nickel-phosphorus coatings can be obtained from baths formulated to produce bright, semi-bright or dull deposits. Their appearance depends upon the brightness and smoothness of the substrate. The deposits are normally used without machining or polishing.

These coatings are produced by the catalytic reduction of nickel metal ions in hot, usually mildly acidic aqueous solutions at atmospheric pressure using sodium hypophosphite as the reducing agent. Suitable solutions, proprietary or otherwise, are those that produce a deposit which will meet the requirements of this specification.

The coatings produced are uniform in thickness on irregularly shaped parts, provided that the processing solution circulates freely over all surfaces.

The coating is a metastable alloy of nickel and phosphorus containing up to 15 % (*m/m*) of phosphorus. The physical and chemical properties and the structure of autocatalytic nickel are dependent upon the coating composition, the chemical make-up of the plating bath, the pretreatment of the substrate, and heat treatment after plating.

It should be noted that heat treatments above 220 °C may reduce the corrosion resistance of the coatings. Heat treatments up to 200 °C used to improve adhesion or to give relief from hydrogen embrittlement do not impair the corrosion resistance, or substantially modify the hardness, or the wear properties of the coatings.

It should be recognized that autocatalytic nickel-phosphorus coatings tend to be less ductile than those of electrodeposited nickel. Certain coatings of less than 10 µm thickness will generally permit limited deformation without cracking or spalling.

1 Scope and field of application

This International Standard specifies requirements and test methods for autocatalytic nickel-phosphorus coatings.

This International Standard is not applicable to nickel-boron alloys.

2 References

ISO 468, *Surface roughness — Parameters, their values and general rules for specifying requirements.*

ISO 1462, *Metallic coatings — Coatings other than those anodic to the basis metal — Accelerated corrosion tests — Method for the evaluation of the results.*

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

ISO 2064, *Metallic and other non-organic coatings — Definitions and conventions concerning the measurement of thickness.*

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 2859, *Sampling procedures and tables for inspection by attributes.²⁾*

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 3768, *Metallic coatings — Neutral salt spray test (NSS test).*

ISO 3769, *Metallic coatings — Acetic acid salt spray test (ASS test).*

1) Autocatalytic nickel-phosphorus coatings are also known as "electroless" or "chemical" nickel.

2) At present at the stage of draft. (Revision of ISO 2859-1974.)

ISO 3770, *Metallic coatings — Copper-accelerated acetic acid salt spray test (CASS test)*.

ISO 4516, *Metallic and related coatings — Vickers and Knoop microhardness tests*.

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

ISO 4538, *Metallic coatings — Thioacetamide corrosion test (TAA test)*.

ISO 4540, *Metallic coatings — Coatings cathodic to the substrate — Rating of electroplated test specimens subjected to corrosion tests*.

ISO 4541, *Metallic and other non-organic coatings — Corrosion test (CORR test)*.

ISO 4793, *Laboratory sintered (fritted) filters — Porosity grading, classification and designation*.

IEC Publication 68-2-20, *Basic environmental testing procedures — Part 2 — Test T: Soldering*.

3 Definition

significant surface: The part of the article covered or to be covered by the coating and for which the coating is essential for serviceability and/or appearance.

(Definition taken from ISO 2064.)

4 Information to be supplied by the purchaser to the plater

NOTE — Close liaison between designers, manufacturers and platers is desirable in order to obtain satisfactory autocatalytic nickel-phosphorus coatings and to avoid adverse effects on the mechanical properties of the article.

4.1 Essential information

The following information shall be supplied by the purchaser to the plater:

- a) the number of this International Standard;
- b) the thickness, in micrometres, of the coating and of any undercoats;
- c) details of significant surfaces, to be indicated on drawings or by the provision of suitably marked samples — similarly, any areas on which autocatalytic nickel coatings may not be present shall be indicated;
- d) the sampling procedure to be adopted (see clause 8);
- e) the methods of adhesion testing to be employed (see 6.5);
- f) the nominal composition or specification and metallurgical condition of the basis metal.

4.2 Additional information

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

- a) any requirements for stress-relieving treatment before autocatalytic plating and/or hydrogen embrittlement reduction after plating (see 5.2 and 7.2);
- b) any requirements for treatment to induce compressive stress (for example peening before plating) (see 5.3);
- c) any special requirements for, or restrictions on, pretreatment;
- d) any special requirements for, or restrictions on, heat treatment (see 5.2 and clause 7);
- e) any requirements for maximum coating thickness, especially for the build-up of worn or over-machined parts. It shall also be specified whether these thicknesses shall be as-plated, or as obtained after any machining of the coating;
- f) the necessity for degaussing (demagnetizing) steel parts before plating to minimize the inclusion of magnetic particles or swarf into the coating;
- g) the final surface roughness of the coating (see 6.1 and 6.2);
- h) the hardness of the coating and the method of test to be used in verification (see 6.4, clause 7 and annex J);
- i) the type, size, extent and location of permissible surface defects in the coating (see 6.1);
- j) any special requirements for the chemical composition of the coating (see 6.11);
- k) any requirements for corrosion resistance;
- l) any requirement in respect of porosity and, where relevant, the method of test (see 6.6 and annex C);
- m) any requirements for wear resistance (see 6.9 and annex L);
- n) any requirements for solderability (see 6.10 and annex F);
- o) any other special requirements.

5 Treatment of basis metal before plating

5.1 Surface condition

The significant surfaces shall be examined by the plater using the unaided eye or corrected vision for visible surface defects which may be detrimental to the final finish. Any defects shall be brought to the attention of the purchaser before processing.