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Metallic and other inorganic coatings — Electrodeposited nickel-ceramics composite coatings

Revêtements métalliques et autres revêtements inorganiques — Dépôts électrolytiques composites de nickel-céramique

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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.

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*.

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Introduction

Electrolytic codeposition of ceramic particles into the metal matrix is a low-cost and low-temperature method suitable for producing composite coating. Ceramics particles can be hard oxide or carbides like Al_2O_3, SiC, Si_3N_4, TiO_2, WC or diamond. Also, it may include solid lubricants like PTFE, graphite, h-BN or MoS_2. Incorporation of such particles can improve mechanical, tribological and anti-corrosion properties of electrodeposited coatings. Nickel being an engineering material, nickel-ceramics composite coating can find wide application such as cutting tools for semiconductors, heat exchangers, automobile shackle pin, glass moulds. The applications cover machine elements, tools, electronics, micro-system technology, electrochemistry, acoustics, decoration and many more. In addition, electrodeposited nickel-ceramics composite coating can be applied in automotive parts including cylinder bores, piston and piston rings to increase engine performance. Nickel-based composites exist as many different types depending upon kind of ceramic particles incorporated, which can differ significantly in their properties. To increase hardness and corrosion resistance, hard ceramic particles such as SiC, Si_3N_4 and Al_2O_3 can be used, whereas to increase wear resistance property, mainly self-lubricating solid particles such as h-BN, PTFE or MoS_2 can be used. It is therefore important to choose the right ceramic particles for a given application. Typical solution compositions, operating conditions and mechanical properties of electrodeposits from Watts and nickel sulphamate solutions are given in Annex B.

The objective of this document is to provide processing and requirements that cover all nickel-based composite system. This enables both providers as well as users to easily fabricate the composite system.

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Metallic and other inorganic coatings — Electrodeposited nickel-ceramics composite coatings

1 Scope

This document specifies the requirements for electrodeposited nickel-ceramics composite coatings applied to ferrous and non-ferrous basis metals for engineering purposes. In addition, it enables both providers and users to offer a consistent methodology to fabricate electrodeposited nickel-ceramics composite system.

Nickel alloys or composites in which nickel content is less than 40 vol.% are outside the scope of this document.

The designation provides a means of specifying the type of nickel composite coatings appropriate for engineering applications.

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

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

ISO 2361, *Electrodeposited nickel coatings on magnetic and non-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 3882, *Metallic and inorganic coatings — Review of methods of measurement of thickness*

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

ISO 9220, *Metallic coatings — Measurement of coating thickness — Scanning electron microscope method*

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 12686, *Metallic and other inorganic coatings — Automated, controlled shot-peening of metallic articles prior to nickel, autocatalytic nickel or chromium electroplating, or as a final finish*

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ISO 14577 (all parts), *Metallic materials — Instrumented indentation test for hardness and materials parameters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2064, ISO 2080, ISO 4287 and ISO 4526 apply.

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

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

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

4 Designation

The designation shall comprise the following:

a) the term, electrodeposited composite coating;

b) the number of this document, ISO 19487;

c) a hyphen;

d) a solidus (/);

e) symbols for the nickel as well as coatings applied prior to and after electroplating, separated by solidi (/) for each stage in the coating sequence in the order of application. The coating designation shall include the thickness of the coatings in µm.

For example, electrodeposited composite coating ISO 19487-Ni30/SiC(25) designates nickel silicon carbide composite 30 µm thick which contains 25 vol.% of SiC.

5 Requirements

5.1 Special test specimens

Special test specimens may be used to measure adhesion, thickness, porosity, corrosion, hardness and other properties when the coated articles are of a size or shape that is not suitable for the test, or if it is not practical to submit the coated article to destructive tests because the parts are few in number or expensive. Special test specimens shall be of the same material, the same metallurgical condition, shall have the same surface condition as the coated articles and shall be processed along with the coated articles that they represent.

The use of special or representative test specimens to determine that the requirements of this document have been met, the number of test specimens to be used, the material from which they shall be made, and their shape and size shall be specified by the purchaser.

5.2 Appearance and surface roughness

The coating on the significant surface shall be smooth and free from visible defects, such as pits, cracks, blisters, exfoliation, flaking, burned deposits and non-coated areas. The boundaries of electroplating that cover only a portion of the surface, after being machined or otherwise finished as specified by the purchaser, shall be free of beads, nodules, growths, jagged edges and other defects.

Imperfections in the coating that arise from surface conditions of the basis metal and that persist despite the observance of good electroplating practice shall not be cause for rejection. The acceptance limits for defects of the basis metal shall be specified by the purchaser.

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