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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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# 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 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).

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



 

# 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.

# 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*