INTERNATIONAL STANDARD

ISO 1456

Fourth edition
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Metallic and other inorganic coatings — Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium

Revêtements métalliques et autres revêtements inorganiques — Dépôts électrolytiques de nickel, de nickel plus chrome, de cuivre plus nickel et de cuivre plus nickel plus chrome

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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 1456 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 3, *Electrodeposited coatings and related finishes*.

This fourth edition cancels and replaces the third edition (ISO 1456:2003), which has been technically and editorially revised. This edition also cancels and replaces ISO 1458:2002.

Introduction

This International Standard is a revised version of ISO 1456:2003: *Metallic coatings — Electrodeposited coatings of nickel plus chromium and of copper plus nickel plus chromium* incorporating ISO 1458:2002: *Metallic coatings — Electrodeposited coatings of nickel*.

Decorative, electrodeposited nickel coatings, with and without copper undercoats and without chromium top-coats, are suitable for applications in which tarnishing could be prevented by avoiding rubbing or handling in service or by the use of topcoats other than chromium. They are also suitable for those applications where tarnishing is of no importance. Corrosion resistance depends on the type and thickness of the coatings.

Decorative, electrodeposited nickel plus chromium and copper plus nickel plus chromium coatings are applied to manufactured articles to enhance their appearance and corrosion resistance. Corrosion resistance depends on the type and thickness of the coatings. In general, multilayer nickel coatings provide better corrosion resistance than single-layer nickel coatings of equal thickness, and micro-discontinuous chromium coatings provide better protection than conventional chromium.

Metallic and other inorganic coatings — Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium

WARNING — This International Standard may not be compliant with some countries' health and safety 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 user of this International Standard to establish appropriate health, safety and environmentally acceptable practices and take suitable actions to comply with any national and international regulations. Compliance with this International Standard does not in itself confer immunity from legal obligations.

1 Scope

This International Standard specifies requirements for decorative nickel, nickel plus chromium, copper plus nickel and copper plus nickel plus chromium coatings that are applied to iron, steel, zinc alloys, copper and copper alloys, and to aluminium and aluminium alloys, to provide an attractive appearance and enhanced corrosion resistance. Coating designations are specified that differ in thickness and type, and guidance is given on selecting the coating designation appropriate for the service conditions to which the coated product will be exposed.

This International Standard does not specify the surface condition required by the basis metal prior to the coating process, and is not applicable to coatings on sheet, strip or wire in the non-fabricated form nor to threaded fasteners or coil springs.

Requirements for decorative, electroplated copper plus nickel plus chromium coatings on plastic materials are specified in ISO 4525. ISO 4526 and ISO 6158 specify requirements for coatings of nickel and chromium, respectively, for engineering purposes.

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 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 other inorganic coatings — Review of methods of measurement of thickness*

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

ISO 4541:1978, *Metallic and other non-organic coatings — Corrodkote corrosion test (CORR test)*

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 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*

ISO 16348, *Metallic and other inorganic coatings — Definitions and conventions concerning appearance*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2064, ISO 2080, ISO 9587, ISO 9588 and ISO 16348 apply.

4 Information to be supplied by the purchaser to the processor

4.1 Essential information

When ordering articles to be electroplated in accordance with this International Standard, the purchaser shall provide the following information in writing, in, for example, the contract or purchase order, or on engineering drawings:

a) a reference to this International Standard, ISO 1456, and the designation (see Clause 5);

b) the significant surfaces, to be indicated on drawings of the parts or by providing suitably marked specimens;

c) the appearance required, e.g. bright, dull or satin, or high- or low-sulfur-containing bright, semi-bright or dull (see 5.5 and 6.1); alternatively, samples showing the required finish or range of finishes may also be supplied and approved by the purchaser, and used for comparison purposes (see 6.1);

d) the type of nickel coating, e.g. decorative, sulfur-containing bright, semi-bright, or satin containing a lamellar structure; or high-sulfur-containing bright, semi-bright or dull containing a lamellar structure without mechanical polishing; or dull or semi-bright with mechanical polishing; or sulfur-free dull or semi-bright with a columnar structure without mechanical polishing; or double- or triple-layer coating (see 5.5 and 6.3);

e) the type of chromium coating, e.g. regular, black, micro-cracked or micro-porous (see 5.6);

f) the type of corrosion test to be used (see 6.5 and Table 6);

g) the type of adhesion test and minimum local thickness to be used (see 6.4 and 6.2);

h) the extent to which defects shall be tolerated on non-significant surfaces (see 6.1);

i) positions on the significant surface for rack or contact marks, where such marks are unavoidable (see 6.1);

j) the tensile strength of the steel and any requirement for stress relief for pre- or post-coating embrittlement-relief treatments of iron or steel to reduce the risk of hydrogen embrittlement, as well as hydrogen-embrittlement test methods (see 6.8 and 6.9);

k) sampling methods and acceptance levels (see 6.10).

4.2 Additional information

The following additional information shall also be provided by the purchaser, when appropriate:

a) any requirements for STEP testing and the type of test method (see 6.6);

b) thickness requirements on those areas that cannot be touched by a ball 20 mm in diameter (see 6.2);

c) whether or not a copper undercoat is required (see 5.2 and 5.4).

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, the specific alloy (optional), stress-relief requirements, the type and thickness of undercoats (when present), the thickness and composition of the nickel or nickel-alloy coating or coatings (when double or multilayer coatings are specified), and supplementary treatments, such as heat treatment to reduce susceptibility to hydrogen embrittlement (for designation, see the Bibliography).

5.2 Designation specifications

The coating designation specifies the basis metal and the types and thickness of coatings appropriate for each service-condition number (see Tables 1 to 4 for various substrates and coatings) and comprises the following:

a) the term, “Electroplated coating”, the number of this International Standard, ISO 1456, followed by a hyphen;

b) the chemical symbol for the basis metal (or for the principal metal if an alloy) followed by a solidus (/) as follows:

   1) Fe/ for iron or steel;

   2) Zn/ for zinc or zinc alloys;

   3) Cu/ for copper and copper alloys;

   4) Al/ for aluminium or aluminium alloys;

c) the chemical symbol for copper (Cu), if copper, or brass containing greater than 50 % copper, is used as an undercoat;

d) a number indicating the minimum local thickness, in micrometres, of the copper coating, where applicable;

e) a letter indicating the type of copper coating (see 5.4), where applicable;

f) the chemical symbol for nickel (Ni);

g) a number indicating the minimum local thickness, in micrometres, of the nickel coating;

h) a letter designating the type of nickel coating (see 5.5);

i) if a topcoat is to be applied over the nickel, its chemical symbol and a number indicating its minimum local thickness; if the topcoat is an electrodeposited alloy, the chemical symbols of the principal alloy constituents; for example, the chemical symbol for chromium (Cr) if chromium is the top coat;

j) for a chromium topcoat, a letter or letters designating the type of chromium and its minimum local thickness (see 5.6);

k) the heat treatment requirements in brackets and designated as follows: the letters SR for stress-relief heat treatment prior to electroplating, and/or the letters ER for hydrogen-embrittlement-relief heat treatment after electroplating; in parentheses, the minimum temperature, in degrees Celsius (°C); the duration of the heat treatment in hours (h).

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 the Bibliography).

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

EXAMPLE

A coating on steel comprising 20 µm (minimum) ductile, levelling copper plus 30 µm (minimum) bright nickel plus 0,3 µm micro-cracked chromium is designated as follows:

Electroplated coating ISO 1456 – Fe/Cu20a/Ni30b/Crmc

A coating on steel, when stress-relief heat treatment prior to application of any coating is applied at 200 °C for 3 h and embrittlement-relief heat treatment after coating is applied at 210 °C for 8 h, is designated as follows:

Electrodeposited coating ISO 1456 – Fe/SR(200)3/Ni30b/ER(210)8/Crmc

For ordering purposes, the detailed product specification shall include not only the designation, but also clear written statements of other requirements that are essential for the serviceability of a particular product (see Clause 4).

5.3 Service-condition number

The service-condition number is used by the purchaser to specify the degree of protection required, as related to the severity of the conditions to which a product is to be subjected, in accordance with the following scale:

1	Mild	Service indoors in warm dry atmospheres, e.g. offices.
2	Moderate	Service indoors where condensation may occur, e.g. bathroom, kitchens.
3	Severe	Service outdoors where occasional or frequent wetting by rain or dew may occur, e.g. outdoor furniture: bicycles, hospital goods.
4	Very severe	Service outdoors in very severe conditions, e.g. components of automobiles, boat fittings.
5	Exceptionally severe	Service outdoors in exceptionally severe conditions where long-time protection, such as longer than about 10 years, of the substrate is required, e.g. vehicle components: bumpers, wheels.

Table 1 — Coatings on ferrous materials

Ni	Cu + Ni	Ni + Cr	Cu + Ni + Cr
Partial designation in Service condition 1			
Fe/Ni10p	Fe/Cu10a/Ni5p	Fe/Ni10p/Crr Fe/Ni10p/Crmc Fe/Ni10p/Crmp Fe/Ni10p/Crb	Fe/Cu10a/Ni5p/Crr Fe/Cu10a/Ni5p/Crmc Fe/Cu10a/Ni5p/Crmp Fe/Cu10a/Ni5p/Crb
Fe/Ni10s	Fe/Cu10a/Ni5s	Fe/Ni10s/Crr Fe/Ni10s/Crmc Fe/Ni10s/Crmp Fe/Ni10s/Crb	Fe/Cu10a/Ni5s/Crr Fe/Cu10a/Ni5s/Crmc Fe/Cu10a/Ni5s/Crmp Fe/Cu10a/Ni5s/Crb
Fe/Ni10b	Fe/Cu10a/Ni5b	Fe/Ni10b/Crr Fe/Ni10b/Crmc Fe/Ni10b/Crmp Fe/Ni10b/Crb	Fe/Cu10a/Ni5b/Crr Fe/Cu10a/Ni5b/Crmc Fe/Cu10a/Ni5b/Crmp Fe/Cu10a/Ni5b/Crb
Partial designation in Service condition 2			
Fe/Ni20p	Fe/Cu15a/Ni15p	Fe/Ni20p/Crr Fe/Ni15p/Crmc Fe/Ni15p/Crmp Fe/Ni15p/Crb	Fe/Cu15a/Ni15p/Crr Fe/Cu15a/Ni10p/Crmc Fe/Cu15a/Ni10p/Crmp Fe/Cu15a/Ni10p/Crb
Fe/Ni20s	Fe/Cu15a/Ni15s	Fe/Ni20s/Crr Fe/Ni15s/Crmc Fe/Ni15s/Crmp Fe/Ni15s/Crb	Fe/Cu15a/Ni15s/Crr Fe/Cu15a/Ni10s/Crmc Fe/Cu15a/Ni10s/Crmp Fe/Cu15a/Ni10s/Crb
Fe/Ni20b	Fe/Cu15a/Ni15b	Fe/Ni20b/Crr Fe/Ni15b/Crmc Fe/Ni15b/Crmp Fe/Ni15b/Crb	Fe/Cu15a/Ni15b/Crr Fe/Cu15a/Ni10b/Crmc Fe/Cu15a/Ni10b/Crmp Fe/Cu15a/Ni10b/Crb
Fe/Ni20d	Fe/Cu15a/Ni15d	Fe/Ni20d/Crr Fe/Ni15d/Crmc Fe/Ni15d/Crmp Fe/Ni15d/Crb	Fe/Cu15a/Ni15d/Crr Fe/Cu15a/Ni10d/Crmc Fe/Cu15a/Ni10d/Crmp Fe/Cu15a/Ni10d/Crb