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Electroplated coatings of nickel and chromium

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently JIS H 8617:1991 is replaced with JIS H 8617:1999.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to public which have the said technical properties.

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Electroplated coatings of nickel and chromium

Introduction This Japanese Industrial Standard has been prepared based on the corresponding parts of the International Standard shown in Remarks of clause 1 Scope, without any modification in technical content, however, the some specifications, which are not specified in the corresponding International Standard, have been supplemented in this Standard.

1 Scope This Japanese Industrial Standard specifies electroplated coatings (hereafter referred to as "coatings") ⁽¹⁾ ⁽²⁾ of nickel, copper plus nickel, nickel plus chromium, and copper plus nickel plus chromium that are applied on iron, steel, copper, copper alloy, zinc alloy, aluminium and aluminium alloy, to provide corrosive resistance and decorative appearance on significant surface.

Notes ⁽¹⁾ Duplex nickel plating, microcracked chromium coating, and microporous chromium coating are included.

⁽²⁾ Brass coating is included in copper coatings.

Remarks: The International Standard corresponding to this Standard is as follows.

ISO 1456: 1988 *Metallic coatings — Electrodeposited coatings of nickel plus chromium and copper plus nickel plus chromium*

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards indicated below shall be applied.

JIS H 0400 *Glossary of terms used in electroplating*

JIS H 0404 *Graphical symbol for electroplated coating*

JIS H 8501 *Methods of thickness test for metallic coatings*

JIS H 8502 *Methods of corrosion resistance test for metallic coatings*

JIS H 8504 *Methods of adhesion test for metallic coatings*

JIS K 8150 *Sodium chloride*

JIS K 8801 *Potassium hexacyanoferrate (III)*

JIS K 8802 *Potassium hexacyanoferrate (II) trihydrate*

JIS K 8951 *Sulfuric acid*

JIS K 8983 *Copper (II) sulfate pentahydrate*

JIS P 3801 *filter paper (for chemical analysis)*

JIS Z 9031 *Random sampling methods*

3 Definitions For the purpose of this Standard, the definitions given in **JIS H 0400** and the following definition apply.

- a) **significant surface** The surface of parts which was plated or to be plated and whose coating plays main performance and relates to main appearance.

4 Class, grade, symbol, and environment

4.1 Class, grade, and symbol Class, grade, and symbol are classified into Table 1 and Table 2 depending on basis metal, undercoat, finish coating, and the minimum thickness of coating, and their symbols are as shown in JIS H 0404.

4.2 Service environment, condition of service environment, and symbol Service environment, condition of service environment, and symbol are as in JIS H 0404.

Informative reference: When electroplated products are used for the purpose of ornamentation and corrosion resistance, the service environments are classified as in Informative reference Table 1, and they are represented by symbols.

Table 1 Class, grade, and symbol

Basis metal	Class of plated metal	Grade	Minimum thickness of coating μm	Symbol
Iron or steel	Copper plus nickel coating	Grade 1	3	Ep-Fe/Cu+Nib 3 or Ep-Fe/Cu+Nib [1]
		Grade 2	5	Ep-Fe/Cu+Nib 5 or Ep-Fe/Cu+Nib [2]
		Grade 3	10	Ep-Fe/Cu+Nib 10 or Ep-Fe/Cu+Nib [3]
		Grade 4	15	Ep-Fe/Cu+Nib 15 or Ep-Fe/Cu+Nib [4]
		Grade 5	20	Ep-Fe/Cu+Nib 20 or Ep-Fe/Cu+Nib [5]
Copper and copper alloy	Nickel coating	Grade 1	3	Ep-Cu/Ni 3 b or Ep-Cu/Nib [1]
		Grade 2	5	Ep-Cu/Ni 5 b or Ep-Cu/Nib [2]
		Grade 3	10	Ep-Cu/Ni 10 b or Ep-Cu/Nib [3]

Remarks: Each film thickness of copper plus nickel coating shall be subject to the agreement between the parties interested.

Table 2 Class, grade, and symbol

Unit: μm

Basis metal	Class of plated metal	Grade	Under-coat	Minimum thickness of undercoat	Finish coating	Minimum thickness of finish coating	Symbol
Iron or steel	Nickel plus chromium coating	Grade 1	Nib	3	Cr r	0.1	Ep-Fe/Ni 3 b, Cr 0.1 r or Ep-Fe/Nib, Cr r [1]
		Grade 2	Nib	5	Cr r	0.1	Ep-Fe/Ni 5 b, Cr 0.1 r or Ep-Fe/Nib, Cr r [2]
		Grade 3	Nib	10	Cr r	0.1	Ep-Fe/Ni 10 b, Cr 0.1 r or Ep-Fe/Nib, Cr r [3]
		Grade 4	Nib	15	Cr r	0.1	Ep-Fe/Ni 15 b, Cr 0.1 r or Ep-Fe/Nib, Cr r [4]
		Grade 5	Nib	20	Cr r	0.1	Ep-Fe/Ni 20 b, Cr 0.1 r or Ep-Fe/Nib, Cr r [5]
		Grade 6	Nid	25	Cr mp	0.1	Ep-Fe/Ni 25 d, Cr 0.1 mp or Ep-Fe/Nid, Cr mp [6]
			Nid	25	Cr mc	0.1	Ep-Fe/Ni 25 d, Cr 0.1 mc or Ep-Fe/Nid, Cr mc [6]
		Grade 7	Nid	30	Cr r	0.1	Ep-Fe/Ni 30 d, Cr 0.1 r or Ep-Fe/Nid, Cr r [7]
		Grade 8	Nib	40	Cr r	0.1	Ep-Fe/Ni 40 b, Cr 0.1 r or Ep-Fe/Nib, Cr r [8]
		Grade 9	Nid	30	Cr mp	0.1	Ep-Fe/Ni 30 d, Cr 0.1 mp or Ep-Fe/Nid, Cr mp [9]
			Nid	30	Cr mc	0.1	Ep-Fe/Ni 30 d, Cr 0.1 mc or Ep-Fe/Nid, Cr mc [9]

Remarks: Each film thickness of copper plus nickel coating shall be subject to the agreement between the parties interested.

Table 2 Class, grade, and symbol (concluded)

Unit: μm

Basis metal	Class of plated metal	Grade	Under-coat	Minimum thick-ness of undercoat	Finishing coating	Minimum thickness of finish coating	Symbol
Iron or steel	Copper plus nickel plus chromium coating	Grade 1	Cu, Nib	3	Cr r	0.1	Ep-Fe/Cu+Nib 3, Cr 0.1 r or Ep-Fe/Cu+Nib, Cr r [1]
		Grade 2	Cu, Nib	5	Cr r	0.1	Ep-Fe/Cu+Nib 5, Cr 0.1 r or Ep-Fe/Cu+Nib, Cr r [2]
		Grade 3	Cu, Nib	10	Cr r	0.1	Ep-Fe/Cu+Nib 10, Cr 0.1 r or Ep-Fe/Cu+Nib, Cr r [3]
		Grade 4	Cu, Nib	15	Cr r	0.1	Ep-Fe/Cu+Nib 15, Cr 0.1 r or Ep-Fe/Cu+Nib, Cr r [4]
		Grade 5	Cu, Nib	25	Cr r	0.1	Ep-Fe/Cu+Nib 25, Cr 0.1 r or Ep-Fe/Cu+Nib, Cr r [5]
		Grade 6	Cu, Nib	30	Cr r	0.1	Ep-Fe/Cu+Nib 30, Cr 0.1 r or Ep-Fe/Cu+Nib, Cr r [6]
		Grade 7	Cu, Nib Cu, Nib	30 30	Cr mc Cr mp	0.1 0.1	Ep-Fe/Cu+Nib 30, Cr 0.1 mc or Ep-Fe/Cu+Nib, Cr mc [7] Ep-Fe/Cu+Nib 30, Cr 0.1 mp or Ep-Fe/Cu+Nib, Cr mp [7]
		Grade 8	Cu, Nib Cu, Nid Cu, Nid	50 35 35	Cr r Cr mc Cr mp	0.1 0.1 0.1	Ep-Fe/Cu+Nib 50, Cr 0.1 r or Ep-Fe/Cu+Nib, Cr r [8] Ep-Fe/Cu+Nid 35, Cr 0.1 mc or Ep-Fe/Cu+Nid, Cr mc [8] Ep-Fe/Cu+Nid 35, Cr 0.1 mp or Ep-Fe/Cu+Nid, Cr mp [8]
		Grade 9	Cu, Nid Cu, Nid Cu, Nid	50 45 45	Cr r Cr mc Cr mp	0.1 0.1 0.1	Ep-Fe/Cu+Nid 50, Cr 0.1 r or Ep-Fe/Cu+Nid, Cr r [9] Ep-Fe/Cu+Nid 45, Cr 0.1 mc or Ep-Fe/Cu+Nid, Cr mc [9] Ep-Fe/Cu+Nid 45, Cr 0.1 mp or Ep-Fe/Cu+Nid, Cr mp [9]
		Copper and copper alloy	Nickel plus chromium coating	Grade 1	Nib	2	Cr r
Grade 2	Nib			5	Cr r	0.1	Ep-Cu/Ni 5 b, Cr 0.1 r or Ep-Cu/Nib, Cr r [2]
Grade 3	Nib			10	Cr r	0.1	Ep-Cu/Ni 10 b, Cr 0.1 r or Ep-Cu/Nib, Cr r [3]
Grade 4	Nib			25	Cr r	0.1	Ep-Cu/Ni 25 b, Cr 0.1 r or Ep-Cu/Nib, Cr r [4]
Grade 5	Nid Nid Nid			30 25 25	Cr r Cr mc Cr mp	0.1 0.1 0.1	Ep-Cu/Ni 30 d, Cr 0.1 r or Ep-Cu/Nid, Cr r [5] Ep-Cu/Ni 25 d, Cr 0.1 mc or Ep-Cu/Nid, Cr mc [5] Ep-Cu/Ni 25 d, Cr 0.1 mp or Ep-Cu/Nid, Cr mp [5]
Zinc alloy	Copper plus nickel plus chromium coating	Grade 1	Cu, Nib	10	Cr r	0.1	Ep-Zn/Cu+Nib 10, Cr 0.1 r or Ep-Zn/Cu+Nib, Cr r [1]
		Grade 2	Cu, Nib	15	Cr r	0.1	Ep-Zn/Cu+Nib 15, Cr 0.1 r or Ep-Zn/Cu+Nib, Cr r [2]
		Grade 3	Cu, Nib	20	Cr r	0.1	Ep-Zn/Cu+Nib 20, Cr 0.1 r or Ep-Zn/Cu+Nib, Cr r [3]
		Grade 4	Cu, Nib	25	Cr r	0.1	Ep-Zn/Cu+Nib 25, Cr 0.1 r or Ep-Zn/Cu+Nib, Cr r [4]
		Grade 5	Cu, Nib	30	Cr r	0.1	Ep-Zn/Cu+Nib 30, Cr 0.1 r or Ep-Zn/Cu+Nib, Cr r [5]
		Grade 6	Cu, Nib	40	Cr r	0.1	Ep-Zn/Cu+Nib 40, Cr 0.1 r or Ep-Fe/Cu+Nib, Cr r [6]
		Grade 7	Cu, Nib Cu, Nib	40 40	Cr mc Cr mp	0.1 0.1	Ep-Zn/Cu+Nib 40, Cr 0.1 mc or Ep-Zn/Cu+Nib, Cr mc [7] Ep-Zn/Cu+Nib 40, Cr 0.1 mp or Ep-Zn/Cu+Nib, Cr mp [7]
		Grade 8	Cu, Nib Cu, Nid Cu, Nid	50 30 30	Cr r Cr mc Cr mp	0.1 0.1 0.1	Ep-Zn/Cu+Nib 50, Cr 0.1 r or Ep-Zn/Cu+Nib, Cr r [8] Ep-Zn/Cu+Nid 30, Cr 0.1 mc or Ep-Zn/Cu+Nid, Cr mc [8] Ep-Zn/Cu+Nid 30, Cr 0.1 mp or Ep-Zn/Cu+Nid, Cr mp [8]
		Grade 9	Cu, Nid Cu, Nid Cu, Nid	50 40 40	Cr r Cr mc Cr mp	0.1 0.1 0.1	Ep-Zn/Cu+Nid 50, Cr 0.1 r or Ep-Zn/Cu+Nid, Cr r [9] Ep-Zn/Cu+Nid 40, Cr 0.1 mc or Ep-Zn/Cu+Nid, Cr mc [9] Ep-Zn/Cu+Nid 40, Cr 0.1 mp or Ep-Zn/Cu+Nid, Cr mp [9]
Alumi-nium and alumi-nium alloy	Nickel plus chro-mium coating	Grade 1	Nib	10	Cr r	0.1	Ep-Al/Ni 10 b, Cr 0.1 r or Ep-Al/Nib, Cr r [1]
		Grade 2	Nib	20	Cr r	0.1	Ep-Al/Ni 20 b, Cr 0.1 r or Ep-Al/Nib, Cr r [2]
		Grade 3	Nid Nid Nid	30 25 25	Cr r Cr mc Cr mp	0.1 0.1 0.1	Ep-Al/Ni 30 d, Cr 0.1 r or Ep-Al/Nid, Cr r [3] Ep-Al/Ni 25 d, Cr 0.1 mc or Ep-Al/Nid, Cr mc [3] Ep-Al/Ni 25 d, Cr 0.1 mp or Ep-Al/Nid, Cr mp [3]
		Grade 4	Nid Nid Nid	50 35 35	Cr r Cr mc Cr mp	0.1 0.1 0.1	Ep-Al/Ni 50 d, Cr 0.1 r or Ep-Al/Nid, Cr r [4] Ep-Al/Ni 35 d, Cr 0.1 mc or Ep-Al/Nid, Cr mc [4] Ep-Al/Ni 35 d, Cr 0.1 mp or Ep-Al/Nid, Cr mp [4]

Remarks: Each film thickness of copper plus nickel coating shall be subject to the agreement between the parties interested.

Informative reference Table 1 Service environment, condition of service environment, and symbol

Service environment	Condition of service environment	Symbol	Informative reference	
			Service condition number of ISO	Examples
D	Ordinary indoor environment	D	1	House, office, etc.
C	Indoor environment with high humidity	C	2	Bathroom, kitchen, etc.
B	Ordinary outdoor environment	B	3	Field, residence area, etc.
A	Outdoor environment with high corrosiveness	A	4	Beach, industrial area, etc.

5 Quality

5.1 Appearance of coatings When the appearance of coatings is tested according to 9.2, there shall be no defects on the significant surface, such defects of coating as rough surface, burnt deposits, crack, pits, or exposure of basis metal, and such signs of poor adhesion as blisters or peeling, and be no surface stains or flaws⁽³⁾.

Note ⁽³⁾ The defect on basis metal, which does not appear by ordinary test method, but appears as if to be the defects of coating itself only when the process of plating was carried out, shall be left to the agreement between the parties concerned with delivery.

Remarks 1 The degree of appearance is appointed, it shall follow the agreement between the parties concerned with delivery.

2 When the contact points for current were inevitably set up on significant surface, the spots for contact follow the agreement between the parties concerned with delivery.

5.2 Chemical composition of coating When the chemical composition of coating is tested according to 9.3, the test value shall follow the agreement between the parties concerned with delivery.

5.3 Minimum thickness of coating When the minimum thickness of coating is tested according to 9.4, test results shall conform to the requirements in Table 1 and Table 2.

Remarks: When no specified limit is on significant surface, the surface, on which the ball with 20 mm diameter cannot contact, shall not be regarded as the significant surface.

5.4 Number of micropores and microcracks on coating For microporous chromium coating and microcrack chromium coating, when carry out test according to 9.5, the number of micropores and microcracks shall be as specified in Table 3.

Table 3 Number of micropores and microcracks

Number of micropores on microporous chromium	10 000 pores/cm ² or more
Number of microcracks on microcrack chromium	100 cracks/cm or more

5.5 Corrosion resistance of coating When the corrosion resistance of coating is tested according to 9.6, the degree of corrosive defects on basis metal shall be at least No. 9 of rating number.

In ferroxyl test, the number of spots per cm² shall be less than 5.

5.6 Adhesiveness of coating When the adhesiveness of coating is tested according to 9.7, there shall be no blister or peeling of coating.

5.7 Malleability and ductility of coating When the malleability and ductility of coating are tested according to 9.8, the value to be achieved shall conform to the agreement between the parties concerned with delivery.

6 Base metal The condition of basis metal before plating gives serious influences on the quality of coating, so especially when the basis material is supplied from an orderer, the orderer must give the information data concerning the basis material on the process specification or others.

7 Stress relieving before plating When the stress relieving on basis metal as iron or steel or copper alloy is appointed to carry out before plating, the conditions shall conform to the agreement between the parties concerned with delivery.

The conditions for thermal treatment to relieve stress before plating have been mentioned in corresponding International Standard as informative reference, and therefore, the conditions are shown in Annex 5 (informative).

8 Hydrogen-embrittlement relieving after plating When hydrogen-embrittlement relieving on the basis metal of iron or steel is specified to carry out after plating, hydrogen-embrittlement relieving shall be carried out within 4 hours after plating by thermal treatment. The conditions for thermal treatment shall follow the agreement between the parties concerned with delivery.

The conditions for thermal treatment to relieve hydrogen embrittlement after plating have been mentioned in corresponding International Standard as informative reference, and thereafter, the conditions are shown in Annex 6 (informative).

Remarks: The thickness of coating may give the different influence on hydrogen relieving, therefore, it is necessary to set up appropriate temperature and duration for treatment.

9 Test

9.1 Preparation of test piece Generally, test piece is prepared from products. When, however, the product that was plated cannot be used for test piece, a substitute test piece is available for test.

The substitute test piece shall be prepared by using the same basis metal and under the same conditions as far as possible as those employed when product was manufactured.

9.2 Appearance test Appearance test shall be carried out with the naked eye to check the existence of such defects on coating as rough surface, burnt deposits, crack, pits, or exposure of basis metal, of the signs of poor adhesion, and of surface stains or flaws.

9.3 Analysis test The analysis test of chemical composition shall be carried out to determine sulfur content in coating in accordance with the method specified in Annex 1.

The analysis test of other elements than those shown in Annex 1 shall follow the agreement between the parties concerned with delivery.

9.4 Thickness test Thickness test shall be carried out by any one of microscopic sectional thickness test, coulometric thickness test, fluorescent X-ray thickness test, beta black scatter thickness test, eddy current thickness test, or mass weighing thickness test, which are specified in JIS H 8501, alternatively, the following method is also available.

STEP method This method can measure not only electrochemical relation (potential difference) between nickel layers in the coatings of double layers or triple layers but also the thickness of respective layer.

9.5 Test for micropores and microcracks The test for micropores and microcracks on chromium coating shall be carried out according to Annex 2.

9.6 Test for corrosion resistance The test for corrosion resistance shall be carried out according to any one of neutral-salt spray test method, CASS test method, acetic-acid acidic salt spray test method, corrodkote test method, which are specified in JIS H 8502, or the method specified in Annex 3.

The duration for test and appearance change, however, of acetic acid acidic salt spray test method and corrodkote test method shall follow the agreement between the parties concerned with delivery.

- a) **Neutral-salt spray test method** Carry out neutral-salt spray test continuously for duration specified in Table 4.
- b) **CASS test method** Carry out CASS test continuously for duration specified in Table 4.
- c) **Ferroxyl test method** Carry out ferroxyl test according to Annex 3.

9.7 Test for adhesion The adhesion test shall be carried out according to test method specified in JIS H 8504.

9.8 Test for malleability and ductility Malleability and ductility test shall follow Annex 4.

10 Inspection Inspection shall be carried out as follows.

- a) Coatings are tested according to 9, and if the test results conform to the requirements in 5, they shall be judged acceptable.
- b) Test piece shall be taken up from the lot composed of the same parts in accordance with JIS Z 9031.

Remarks 1 The choice of inspection items and test methods shall be left to the agreement between the parties concerned with delivery.

- 2 The number of test pieces, ordering of inspections, target spot to inspect, and use of substitute test piece, shall be left to the agreement between the parties concerned with delivery.

11 Nomination of coatings The nomination of coatings shall follow JIS H 0404.

Example 1 On basis metal of iron or steel, electroplated coating of 2 μm copper and electroplated coating of 3 μm glossy nickel

