INTERNATIONAL STANDARD 1458

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Metallic coatings — Electroplated coatings of nickel

Revêtements métalliques — Dépôts électrolytiques de nickel

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

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.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 107 has reviewed ISO Recommendation R 1458 and found it suitable for transformation. International Standard ISO 1458 therefore replaces ISO Recommendation R 1458-1970.

The Member Bodies of the following countries approved the Recommendation :

Australia	Iran	South Africa, Rep. of
Czechoslovakia	Israel	Spain
Egypt, Arab Rep. of	Italy	Sweden
Finland	Netherlands	Switzerland
France	New Zealand	Thailand
Germany	Norway	Turkey
Hungary	Poland	United Kingdom
India	Portugal	U.S.A.

No Member Body expressed disapproval of the Recommendation.

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Metallic coatings — Electroplated coatings of nickel

0 INTRODUCTION

This International Standard covers a range of coatings of nickel on iron or steel, zinc alloys, copper and copper alloys, for various service conditions.

The minimum thickness requirements apply only to those portions of the significant surface that can be touched by a ball 20 mm in diameter. If the design of the article is such that it cannot at all points be touched by a 20 mm ball, the minimum thickness permitted on specified areas shall be agreed between the interested parties.

Nickel coatings without chromium topcoats are suitable for applications in which tarnishing is prevented by rubbing or handling in service or in which loss of lustre is of no importance. In many applications resistance to wear and abrasion is as important as resistance to corrosion, while in other applications resistance to fracture or deformation in service is an essential feature. Thus the requirements for hardness and ductility as well as lustre should be borne in mind when selecting the type and thickness of nickel to be used.

It is essential that the purchaser state the classification number : merely to ask for plating to be carried out in accordance with ISO 1458 without this number is insufficient.

1 SCOPE AND FIELD OF APPLICATION

This International Standard applies to electroplated coatings of nickel on iron and steel, zinc alloys, copper and copper alloys, except for the following :

– coatings applied to machine screw threads (with tolerance);

– coatings applied to sheet, strip or wire in the unfabricated form, or to coil springs;

– coatings applied for other than protective and decorative purposes.

This International Standard does not specify the surface condition of the basis metal prior to plating; agreement on the degree of roughness which is acceptable shall be reached between the interested parties.

2 REFERENCE

ISO 1463, *Metal and oxide coatings — Measurement of the thickness — Microscopical examination of cross-sections.*

3 DEFINITION

For the purposes of this International Standard the following definition applies :

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

When necessary the significant surface shall be the subject of agreement, and shall be indicated on drawings or by the provision of suitably marked samples.

4 MANNER OF SPECIFYING REQUIREMENTS

When ordering the plating of articles in accordance with this International Standard, the purchaser shall state, in addition to the number of the International Standard, the classification number of the particular coating required (see 5.2).

5 CLASSIFICATION

5.1 Classification of coatings

The classification number comprises :

a) the chemical symbol for the basis metal (or for the principal metal if an alloy) as follows :

– Fe for iron or steel;

– Zn for zinc alloys;

– Cu for copper or copper alloys;

b) the chemical symbol for nickel, Ni;

c) a number indicating the minimum thickness (in micrometres) of the nickel coating;

d) a letter designating the type of nickel deposit as follows :

– b for nickel deposited in the fully bright condition;

– p for dull or semi-bright nickel requiring polishing to give full brightness;

– d for a double-layer or triple-layer nickel coating.

5.2 Coatings appropriate to each application grade

Tables 1 to 3 show, for the various basis metals, the coating classification number appropriate for each application grade.

TABLE 1 – **Coatings on steel (or iron)**

Application grade	Classification number
High	Fe/Ni30b
Medium	Fe/Ni20b
Low	Fe/Ni10b

* p or d nickel may be substituted for b nickel for each application grade.

TABLE 2 – **Coatings on zinc alloy**

Application grade	Classification number
High	Zn/Cu Ni25b
Medium	Zn/Cu Ni5b
Low	Zn/Cu Ni8b

* p or d nickel may be substituted for b nickel for each application grade.

All these coatings shall be applied over an undercoat of copper or brass (at least 50 % copper) having a minimum thickness of 8 μm, but for articles of complex shape the minimum thickness on the significant surface may need to be increased to 10 or 12 μm in order to achieve adequate coverage. The method for determining the thickness of the undercoat is given in Annex B.

TABLE 3 – **Coatings on copper or copper alloy**

Application grade	Classification number
High	Cu/Ni20b
Medium	Cu/Ni10b
Low	Cu/Ni5b

* p or d nickel may be substituted for b nickel for each application grade.

6 HEAT TREATMENT OF STEEL

When required by the purchaser, heat treatment as described below shall be performed on certain steels to reduce the risk of damage by hydrogen embrittlement.

6.1 Stress relief before plating

Severely cold-worked steel parts or parts made from steel of tensile strength of 1 000 N/mm^2 (or corresponding hardness [1]) or greater which have been ground or subjected to severe machining after tempering, shall normally be stress relieved. As a guide they may be maintained, preferably, at the highest temperature within the limit imposed by the tempering temperature for 30 min, or maintained at a temperature of 190 to 210 °C for not less than 1 h.

Some steels which have been carburized, flame-hardened or induction-hardened and subsequently ground would be impaired by the treatment given before as guidance and shall instead be stress relieved at a lower temperature; for example, at 170 °C for not less than 1 h.

6.2 Heat treatment after plating

Components subject to fatigue or sustained loading stresses in service and made from severely cold-worked steels or from steels of tensile strength of 1 000 N/mm^2 (or corresponding hardness [1]) or greater shall be heat treated after plating. Guidance is given in Annex A.

Where the heat treatment temperatures would be harmful, as for example, to certain surface-hardened articles, it may be necessary to apply a lower temperature for a longer time.

1) 30 HRC, 295 HV, 280 HB (approximate values).

7 REQUIRED CHARACTERISTICS

7.1 General requirements

7.1.1 *Appearance*

Over the significant surface, the plated article shall be free from clearly visible plating defects such as blisters, pits, roughness, cracks or unplated areas, and shall not be stained or discoloured. The extent to which blisters can be tolerated on non-significant surfaces shall be the subject of agreement between the interested parties. On articles where a contact mark is inevitable, its position should also be the subject of agreement between the interested parties.

The article shall be clean and free from damage. The purchaser shall state the appearance required, for example bright, dull or satin. Alternatively, a sample showing the required finish shall be supplied or approved by the purchaser.

7.1.2 *Thickness*

The number following the chemical symbol Ni indicates, in micrometres, the minimum thickness of the nickel deposit, measured by the method given in Annex B, at points on the significant surface agreed between the interested parties or at any point on the significant surface that can be touched by a ball 20 mm in diameter. This number shall satisfy the appropriate value in Table 1, Table 2 or Table 3.

If the design of the article is such that it cannot at all points be touched by a 20 mm ball, the minimum thickness permitted on specified areas shall be agreed between the interested parties.

7.1.3 *Adhesion*

Adhesion of the coating shall be tested by one of the methods specified in Annexes C and D. The coating shall continue to adhere to the basis metal when subjected to the test selected.

7.2 Particular requirements for various types of coating[1)]

7.2.1 *Dull or semi-bright coating* (p)

– Sulphur content : 0,005 % maximum.[2)]

– Elongation : 8 % minimum when tested by the method given in Annex E.

7.2.2 *Double-layer or triple-layer coating* (d)

a) Bottom layer

– Sulphur content : 0,005 % maximum[2)].

– Elongation : 8 % minimum when tested by the method given in Annex E.

– Minimum thickness : 60 % of the total nickel thickness in double-layer coatings; 50 % of the total nickel thickness in triple-layer coatings.

b) Top layer

– Sulphur content : more than 0,04 %[2)].

– Minimum thickness : 20 % of the total nickel thickness.

c) Intermediate layer (in case of triple-layer coatings)

– Sulphur content : more than the sulphur content of the top layer.

– Maximum thickness : 10 % of the total nickel thickness.

8 SAMPLING

The method of sampling should be agreed between the interested parties.

1) It will usually be possible to identify the type of nickel by microscopical examination of a polished and etched section of an article prepared according to Annex E.

2) The sulphur contents are specified in order to indicate the type of nickel plating solution that is to be used. No simple method exists for determining the sulphur content of a nickel deposit on a coated article. An accurate determination is possible on a specially prepared test specimen.

ANNEX A

GUIDANCE ON HEAT TREATMENT OF STEEL PARTS AFTER PLATING

Tensile strength	Maximum sectional thickness of part	Minimum period at 190 to 210 °C
N/mm²	mm	hours
1 000 to 1 150	Less than 12	2
	12 to 25	4
	Over 25	8
1 150 to 1 400	Less than 12	4
	12 to 25	12
	25 to 40	24 Heating to commence within 16 h of plating
	Over 40	Requires experimental determination

ANNEX B

DETERMINATION OF THICKNESS OF NICKEL AND COPPER OR BRASS : MICROSCOPICAL METHOD

Use the method specified in ISO 1463.

If etching is necessary, the following etchants are suitable :

1) equal parts by volume of nitric acid (ρ 1,42 g/ml) and glacial acetic acid;

2) equal parts by volume of solutions of sodium cyanide (100 g/l) and sodium or ammonium persulphate (100 g/l).

WARNING. Toxic fumes are evolved when solutions of these chemicals are mixed.

ANNEX C

FILE TEST FOR ADHESION

Saw off a piece of a plated article, hold it in a vice and apply a coarse file to the cut edge in such a maner as to try to raise the deposit. File in the direction from the basis metal to the coating at an angle of approximately 45° to the coated surface.

ANNEX D

QUENCHING TEST FOR ADHESION

Heat a plated article for 1 h in an oven at a temperature appropriate to the basis metal, as given below, with a tolerance of ± 10 °C :

- steel 300 °C
- zinc alloy 150 °C
- copper or copper alloy 250 °C

Then quench the article in water at room temperature.

CAUTION. This test may have an adverse effect on the mechanical properties of the article tested.

ANNEX E

DUCTILITY TEST[1)]

E.1 PREPARATION OF TEST PIECE

Prepare a plated test strip 150 mm long, 10 mm wide and 1 mm thick by the following method.

Polish a sheet of the appropriate basis metal, similar to that of the articles being plated except that the sheet may be of soft brass if the basis metal is zinc alloy. Use a sheet that is sufficiently large to allow the test strip to be cut from it after trimming off a border at least 25 mm wide all round. Plate the sheet on one side with nickel to a thickness of 25 μm under the same conditions and in the same bath as the corresponding articles.

Cut the test strip from the plated sheet with a guillotine. Round or chamfer the longer edges of the test strip, at least on the plated side, by careful filing or grinding.

E.2 PROCEDURE

Bend the test strip with the plated side in tension, by steadily applied pressure, through 180° over a mandrel of diameter 11,5 mm until the two ends of the test strip are parallel. Ensure that contact between the test strip and the mandrel is maintained during bending.

E.3 ASSESSMENT

The coating is deemed to comply with the minimum requirement of an elongation of 8 % provided that after testing there are no cracks passing completely across the convex surface. Small cracks at the edges do not signify failure.

1) This test is used to check that the type of nickel deposit complies with the appropriate definition given in 7.2.