INTERNATIONAL STANDARD

ISO 6158

Third edition
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Metallic and other inorganic coatings — Electrodeposited coatings of chromium for engineering purposes

Revêtements métalliques et autres revêtements inorganiques — Dépôts électrolytiques de chrome pour usages industriels

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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 6158 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 3, *Electrodeposited coatings and related finishes*.

This third edition cancels and replaces the second edition (ISO 6158:2004), of which it constitutes a minor revision.

Introduction

Electrodeposited chromium coatings are frequently deposited from hexavalent chromium solutions similar to those used for decorative electroplating. Engineering chromium coatings, however, are generally thicker than decorative ones. Regular or conventional chromium is the type most frequently specified, but porous, cracked or specially profiled surfaces and duplex chromium are also applied to achieve oil-retaining or non-sticking surfaces, or to improve corrosion resistance.

Electrodeposited chromium coatings for engineering applications are most often applied directly to the basis metal to increase wear and abrasion resistance, to increase fretting resistance, to reduce static and kinetic friction, to reduce galling and seizing, to increase corrosion resistance, and to build up undersize or worn parts. For protection against severe corrosion, nickel or other metallic undercoats may be applied prior to the electrodeposition of chromium, or the corrosion resistance of the chromium coating may be increased by alloying, e.g. with molybdenum.

Metallic and other inorganic coatings — Electrodeposited coatings of chromium for engineering purposes

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 electroplated coatings of hexavalent chromium, with or without undercoats, on ferrous and non-ferrous metals for engineering purposes. The coating designation provides a means of specifying the thickness of chromium appropriate for typical engineering applications.

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 2178, *Non-magnetic coatings on 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 method*

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 4516, *Metallic and other inorganic coatings — Vickers and Knoop microhardness tests*

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

ISO 4526, *Metallic coatings — Electroplated coatings of nickel for engineering purposes*

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 10309, *Metallic coatings — Porosity tests — Ferroxyl test*

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

ISO 15724, *Metallic and other inorganic coatings — Electrochemical measurement of diffusible hydrogen in steels — Barnacle electrode method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2064, ISO 2080, ISO 3882, ISO 9587, ISO 9588 and ISO 12686 apply.

4 Information to be supplied by the purchaser to the processor

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

a) the designation (see Clause 5);

b) the nominal composition or specification, and metallurgical condition of the basis metal including hardness (see 5.3); in the case of reclaimed articles, it may not be possible to supply this information, and it may, therefore, be difficult to guarantee the quality of the coating;

c) the nature, condition and finish of the basis metal if they are likely to affect the serviceability and/or appearance of the coating (see 6.3);

d) the significant surface, indicated by drawings of the articles or by suitably marked samples (see 6.2);

e) the requirements for special test specimens (see 6.1);

f) the appearance and surface finish of the chromium coating, e.g. as-plated, ground or machined (see 6.2 and 6.3); alternatively, samples showing the appearance and required finish shall be supplied or approved by the purchaser, and used for comparison purposes (see 6.2);

g) the necessity for any treatment to induce compressive stress, e.g. peening before or after electroplating (see 6.10);

h) any special requirements for, or restrictions on, pretreatment, e.g. vapour blasting instead of acid pretreatment;

i) positions, where unavoidable, contact marks and the type, size and number of other defects that are acceptable (see 6.2);

j) requirements for undercoats (see 5.5 and 6.11) and stripping (see 6.12);

k) the test method to be used to measure thickness (see 6.4) and additional segment of the surface where minimum thickness requirements apply;

l) the adhesion and porosity requirements, and test methods (see 6.6 and 6.7, respectively);

m) the tensile strength of parts and the requirement for stress-relief heat treatment before electroplating (see 6.8);

n) requirements for any embrittlement-relief heat treatment after electroplating, and for hydrogen embrittlement testing (see 6.9);

o) the sampling plan and acceptance levels (see Clause 7);

p) any additional information, e.g. any special requirements for adhesion (see 6.6).

5 Designation

5.1 General

The designation shall appear on engineering drawings, in the purchase order, the contract or in the detailed product specification.

The designation specifies, in the order given, the basis metal, the specific alloy (optional), stress relief requirements, the type and thickness of undercoats, the type and thickness of the electroplated chromium coating, and post-treatments such as heat treatment to reduce susceptibility to hydrogen embrittlement.

5.2 Designation specification

The designation shall comprise the following:

a) the term “Electrodeposited coating”;

b) the number of this International Standard, i.e. ISO 6158;

c) a hyphen;

d) the chemical symbol of the basis metal (see 5.3), e.g. Fe (iron or steel);

e) a solidus (/);

f) stress relief (SR) designation, (see 5.4);

g) a solidus (/);

h) chemical symbols for the chromium coating, as well as coatings applied prior to chromium electroplating, separated by solidi for each stage in the coating sequence in the order of application; double solidi or separators (//) to be used to indicate that a step has been omitted or is not a requirement;

i) a number indicating the minimum thickness, in micrometres, of the coating(s) followed by a solidus (/);

j) hydrogen-embrittlement-relief (ER) designation (see 5.4).

See 5.6 for examples of designations.

5.3 Designation of basis metal

The basis metal shall be designated by its chemical symbol, or its principal constituent if it is an alloy.

For example:

a) Fe for iron and steel;

b) Zn for zinc alloys;

c) Cu for copper and copper alloys;

d) Al for aluminium and aluminium alloys.

To ensure proper surface preparation and hence adherence of the coating to the substrate, it is essential to identify the specific alloy and its metallurgical condition (tempered, nitrided, etc.).

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 < > (see Bibliography).

EXAMPLE Fe<G43400> is the UNS designation for a high-strength steel.

5.4 Designation of heat treatment requirements

The heat treatment requirements shall be in brackets and designated as follows:

a) the letters SR, for heat treatment for stress relief purposes; the letters ER, for heat treatment for the purpose of reducing susceptibility to hydrogen embrittlement; the letters, HT, for heat treatment for other purposes;

b) in parenthesis, the minimum temperature, in degrees Celsius;

c) the duration of the heat treatment, in hours;

EXAMPLE [SR(210)1] designates stress relief heat treatment at 210 °C for 1 h.

d) when heat treatment prior to or after electrodeposition is specified, the requirements shall be included in the designation (see 5.6).

5.5 Designation of type and thickness of metal layers

The electrodeposited chromium coating shall be designated by the symbols given in Table 1 placed after a number giving the specified minimum local thickness of the coating, in micrometres. Annex A provides information on the typical thickness of chromium specified in engineering applications.

EXAMPLE Cr50hr designates a regular hard chromium coating that is 50 µm thick.

Table 1 — Symbols for different types of chromium

Type of chromium	Symbol
Regular hard chromium	hr
Hard chromium from mixed acid solutions	hm
Microcracked hard chromium	hc
Microporous hard chromium	hp
Duplex chromium	hd
Special types of chromium	hs

Nickel undercoats shall be designated in accordance with ISO 4526, i.e. the symbol sf for sulfur-free nickel coatings, sc for sulfur-containing nickel coatings, or the symbol pd for sulfur-free nickel coatings containing submicron particles dispersed throughout the nickel matrix, shall be used to designate the type of nickel undercoat by placing the appropriate symbol after the number giving the specified minimum local thickness of the coating, in micrometres.

EXAMPLE Ni10sf designates an electrodeposited nickel undercoat 10 µm thick prepared from a solution that does not introduce sulfur into the deposit.

5.6 Examples of designations

The examples of designations below describe the heat treatment and electroplating steps in the order that they are performed. The standard designation of the basis material is placed immediately after the chemical symbol for steel, Fe. It is especially important to know the standard designation of a metal or alloy that is difficult to prepare for electroplating and that is susceptible to hydrogen embrittlement.

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

An example of an electrodeposited coating of regular hard chromium 50 µm thick (Cr50hr) deposited on mild steel (Fe), ignoring omission of any step (double solidi), is as follows:

Electrodeposited coating ISO 6158 – Fe/Cr50hr

An example of an electrodeposited coating of porous, electrodeposited chromium that is 250 µm thick (Cr250hp) on an aluminium alloy (Al), ignoring omission of any step (double solidi), is as follows:

Electrodeposited coating ISO 6158 – Al/Cr250hp

An example of an electrodeposited coating of regular hard chromium 50 µm thick (Cr50hr) deposited on steel (Fe) over an undercoat of sulfur-free nickel 10 µm thick (Ni10sf), ignoring omission of any step (double solidi), is as follows:

Electrodeposited coating ISO 6158 – Fe/Ni10sf/Cr50hr

An appropriate designation of an electrodeposited coating of regular hard chromium 50 µm thick (Cr50hr) deposited on steel that is stress relieved prior to electroplating at 210 °C for 2 h and heat treated after electroplating for embrittlement-relief purposes at 210 °C for 22 h is as follows:

Electrodeposited coating ISO 6158 – Fe/[SR(210)2]/Cr50hr/[ER(210)22]