

Australian Standard™

**Electroplated coatings—Chromium for
engineering applications**



This Australian Standard was prepared by Committee MT-009, Metal Finishing. It was approved on behalf of the Council of Standards Australia on 23 February 2004 and published on 2 April 2004.

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- Australasian Institute of Metal Finishing
- Australian Aluminium Council
- Australian Chamber of Commerce and Industry
- Australian Industry Group
- Australian Paint Manufacturer's Federation
- Department of Defence
- Galvanizers Association of Australia
- Institute of Materials Engineering Australia
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STANDARDS AUSTRALIA

RECONFIRMATION
OF
AS 2453—2004
Electroplated coatings—Chromium for engineering applications

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Technical Committee MT-009 has reviewed the content of this publication and in accordance with Standards Australia procedures for reconfirmation, it has been determined that the publication is still valid and does not require change.

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NOTES

Australian Standard™

Electroplated coatings—Chromium for engineering applications

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee MT-009, Metal Finishing, to supersede AS 2453—1981, *Electroplated coatings of chromium for engineering applications*. After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian rather than an Australian/New Zealand standard.

The objective of this Standard is to specify the requirements for electroplating hard chromium for engineering applications.

The objective of this revision is to introduce the requirements for pre-treatment and post treatment for iron and steel to reduce hydrogen embrittlement and the service condition numbers, which relate to the corrosion categories that are specified in AS/NZS 2312.

During the preparation of this Standard, cognizance was taken of the following ISO Standards:

ISO

- 9587 Metallic and other inorganic coatings—Pretreatment of iron or steel to reduce the risk of hydrogen embrittlement
- 9588 Metallic and other inorganic coatings—Post-coating treatments of iron or steel to reduce the risk of hydrogen embrittlement

No international (ISO) Standards have been published on this subject which were acceptable to the Committee for adoption as Australian Standards.

The terms ‘normative’ and ‘informative’ has been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE	4
1.2 REFERENCED DOCUMENTS	4
1.3 DEFINITIONS	5
1.4 SERVICE CONDITION NUMBER	5
1.5 CONDITION OF THE ITEM BEFORE ELECTROPLATING	6
1.6 CLASSIFICATION	6
SECTION 2 COATING REQUIREMENTS FOR CHROMIUM	
2.1 GENERAL	8
2.2 APPEARANCE	8
2.3 COATING THICKNESS	9
2.4 ADHESION	10
2.5 HARDNESS	10
2.6 POROSITY OF POROUS CHROMIUM	10
2.7 SEPARATE SPECIMENS	11
2.8 HEAT TREATMENT AFTER ELECTROPLATING	11
2.9 CORROSION TESTING	11
APPENDICES	
A PURCHASING GUIDELINES	12
B MEANS FOR DEMONSTRATING COMPLIANCE WITH THIS STANDARD	13
C POROSITY TYPES	15
D PRETREATMENT OF IRON OR STEEL TO REDUCE THE RISK OF HYDROGEN EMBRITTLEMENT	22
E POST-COATING TREATMENTS OF IRON OR STEEL TO REDUCE THE RISK OF HYDROGEN EMBRITTLEMENT	25
F STRESS RELIEVING USING NON HEAT TREATMENT PROCESSES	29
G THICKNESS OF COATING AND UNDERCOAT APPLICATIONS	30
H ATMOSPHERIC CORROSIVITY CATEGORIES	32

STANDARDS AUSTRALIA

Australian Standard**Electroplated coatings—Chromium for engineering applications**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for electroplated coatings of hard chromium on ferrous and non-ferrous metals for engineering applications.

The minimum purchasing requirements are specified in Appendix A.

NOTES:

- 1 The means for demonstrating compliance with this Standard are shown in Appendix B.
- 2 The thickness of coating and undercoat applications are shown in Appendix G.
- 3 The categories for atmospheric corrosivity are shown in Appendix H.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- | | |
|-----------|--|
| 1199 | Sampling procedures for inspection by attributes |
| 1199.0 | Part 0: Introduction to the ISO 2859 attribute sampling system |
| 1199.1 | Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection |
| 1247 | Metallic coatings—Rating of test specimens and manufacturers articles subject to corrosion tests |
| 2331 | Method of test for metallic and related coatings |
| 2331.1.1 | Method 1.1: Local thickness tests—Micrographic examinations of cross-sections |
| 2331.1.2 | Method 1.2: Local thickness tests—Coulometric method |
| 2331.1.3 | Method 1.3: Local thickness tests—Magnetic method |
| 2331.3.1 | Method 3.1: Corrosion and related property tests—Neutral salt spray (NSS) test |
| 2331.3.9 | Method 3.9: Corrosion and related property tests—Metallic coatings—Porosity tests—Ferroxyl test |
| 2331.3.10 | Method 3.10: Corrosion and related property tests—Cracks and pores in chromium |
| 2331.4.1 | Method 4.1: Physical tests—Qualitative adhesion tests |
| 2331.4.4 | Method 4.4: Physical tests—Assessment of intensity of shot-peening |
| 2483 | Metal finishing—Recommended sampling plans for the inspection and testing of coatings (ISO 4519:1980, MOD) |
| 4108 | Metal finishing—Glossary of terms used in electroplating and related processes |
| 4291 | Mechanical properties of fasteners made of carbon steel and alloy steel |
| 4291.1 | Part 1: Bolts, screws and studs |

AS/NZS

2312 Guide to protection of structural steel against atmospheric corrosion by the use of protective coatings

AS/NZS ISO

9001 Quality management systems—Requirements

9004 Quality management systems—Guidelines for performance improvements

HB 18 Guidelines for third-party certification and accreditation

HB 18.28 Guide 28: General rules for a model third-party certification scheme for products

ISO

9223 Corrosion of metals and alloys—Corrosivity of atmospheres—Classification

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

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 4108 shall apply.

1.4 SERVICE CONDITION NUMBER

It is important that the surface condition of an item can reasonably be expected to satisfy ‘fitness for purpose’ criteria.

Although a higher category finished item can be used in lower service conditions, the use of a low service condition coating on items which are expected to meet severe conditions of service is not recommended.

For severe conditions (service condition numbers 3, 4 and 5), the purchaser shall state the coating classification required.

If only a service condition number is called for, the electroplater may apply any of the coatings specified in the respective category in this Standard.

Surface texture and cleanliness of substrate shall be such that the desired finish can be achieved.

NOTE: In general, the smoother the surface the more chance there is that the plating will comply with corrosion and brightness criteria.

The design of items which are unsuitable for the process may result in items not fulfilling their service function, cause a wastage of money and possibly result in consumer complaints.

NOTE: The design and production planning of items to be finished by a metal finishing process require due consideration of the functions of the item, especially with regard to its serviceability.

Service condition numbers are specified in Table 1.1, which also specifies corrosion categories.

NOTE: Corrosion categories, which are listed in AS/NZS 2312, are described in Appendix H.

TABLE 1.1
SERVICE CONDITION NUMBERS

Corrosion category		Service number
Category	Title	
A	Very low	1
B	Low	2
C & F	Medium	3
D	High	4
E	Very high	5

NOTE: When categories overlap go to the next highest category.

1.5 CONDITION OF THE ITEM BEFORE ELECTROPLATING

1.5.1 Surface finish

The surface finish of the item shall comply with the particular requirements of the purchaser, where any such requirements are so specified (see Appendix A).

NOTES:

- 1 The surface finish may be important to the appearance or serviceability of the item and it is the purchaser's responsibility to provide precise details to the electroplater at the time of order.
- 2 Moulding defects such as sinks, press marks, diemarks, cracks, moisture splays, obvious weld lines, gates blush, and foreign matter contamination can lead to difficulties in achieving a satisfactory coating and can be considered to be a cause for rejection by the electroplater.

1.5.2 Preplating condition

The item as delivered to the electroplater shall be in a condition suitable for electroplating.

If the item is to be supplied in a condition requiring mechanical pretreatment the details shall be agreed between the purchaser and the electroplater (see Appendix A).

Steel items which have been severely cold worked or steels having a tensile strength of 1000 MPa or above shall be heat treated before plating (see Appendix D).

Steels which have been chemically or electrolytically stripped of old coatings shall be heat treated within 6 h of stripping (see Appendix E).

NOTE: Heat treatment is not required for 17/4, 17/7, 15/5 type stainless steels or 300 type series stainless steels, copper alloys, nickel base alloys, or low alloy steels having a tensile strength below 1100 MPa. Aluminium and alloy parts should be heat treated for 1 h at $100 \pm 5^\circ\text{C}$.

For coatings that are ground after electroplating, the metal substrate surface shall have a fine ground finish free of pits, nodules, burns and splinters (see Clause 2.1).

1.6 CLASSIFICATION

Chromium coatings shall be classified according to thickness and the type of coating.

The full classification code comprises the following:

The chemical symbol for the principal substrate metal surface Fe

The chemical symbol 'Cr' for chromium Cr

A number indicating the minimum thickness of the coating, in micrometres 25

A letter indicating the type of chromium coating r

NOTE: The above example shows the code for 25 μm of regular chromium on iron or steel

Symbols for types of chromium coatings are as follows:

- r = regular chromium coating
- md = microdiscontinuous
- cf = crack-free type coating
- pp = pinpoint type porous coating
- cp = channel point type porous coating
- ip = intermediate porous coating
- mep = mechanically produced porous coating

NOTE: Types of mechanically produced coatings include ground or honed coatings.

SECTION 2 COATING REQUIREMENTS FOR CHROMIUM

2.1 GENERAL

The chromium coating shall be electroplated and be of the specified type.

Coatings on samples selected in accordance with the agreed sampling plan, shall comply with the requirements of Clauses 2.2 to 2.7.

NOTE: See Appendix B for the means for demonstrating compliance with this Standard.

Items, which are to be subsequently machined, shall be free from excessive nodulation and treeing at the edges and from imperfections detrimental to subsequent fabrication. There shall be no blistering or other signs of poor adhesion of the coating on any surface of an item.

NOTE: On the items where a contact mark is unavoidable, the position of the mark is subject to agreement between the purchaser and the electroplater (see Appendix A).

Electroplated items shall be clean and free from damage.

2.2 APPEARANCE

2.2.1 Regular chromium

The chromium coating of regular chromium on any significant surface which is not required to be subsequently machined shall be bright and lustrous, continuous, smooth and free from plating defects such as blisters, exfoliation or unplated areas when examined at a magnification of 8×.

All plated items shall be free from cracks, which are readily visible to the naked eye.

When tested in accordance with AS 2331.3.9, thick coatings (over 50 µm) shall be free from cracks extending to the basis metal.

There shall be no pitting likely to affect the performance of the finished item.

2.2.2 Crack-free chromium

The crack-free chromium layer shall be smooth and even and free from cracks.

When tested in accordance with AS 2331.3.10, there shall be no cracks extending to the basis metal.

NOTES:

- 1 Crack-free chromium coatings are not recommended in thicknesses exceeding 25 µm.
- 2 Heat treatment, as described in Clause 2.8, may adversely affect the corrosion protection characteristics of this type of coating.

2.2.3 Porous chromium

The chromium coating of porous chromium shall match the specified type when examined at a magnification of 50×.

NOTE: Photomicrographs of different types of porosity are reproduced as Figures C1 to C4 in Appendix C. These photomicrographs represent fields of illumination such that the plateaux of chromium coating appear bright and the surface voids, appear black.

The different types of porosity represented by these figures are as follows:

- | | |
|---|---------------|
| Channel point type (cp) | see Figure C1 |
| Pinpoint type (pp) | see Figure C2 |
| Intermediate type (ip)..... | see Figure C3 |
| Mechanically produced, honed type | see Figure C4 |

There shall be no pitting likely to affect the performance of the finished item.

Pits or unplated areas up to 1.5 mm in diameter, surrounded by an acceptable deposit of chromium may be present in any number, provided that in any 10 mm square, porosity, including pits, is not greater than 40 percent.

Pits or unplated areas greater than 1.5 mm in diameter, but not exceeding 3.0 mm in diameter at the finished surface, surrounded by an acceptable deposit of chromium may be present provided that there are not more than 4 in any 500 cm².

NOTE: Pits or unplated areas greater than 3 mm in diameter, but not exceeding 6 mm in diameter, measured at the finished surface are subject to agreement between the purchaser and the electroplater (see Appendix A).

Porous chromium coatings may be finished to final size by grinding, lapping, honing, or other such methods, provided that the degree of smoothness produced complies with the acceptance criteria (see Appendix A). Colour variation shall not be a cause for rejection.

2.2.4 Partially coated surfaces

Where chromium is specified to be deposited on part of a surface only, the area not to be plated shall be free of coating (see Appendix A).

2.3 COATING THICKNESS

2.3.1 Regular chromium and crack-free chromium

Thickness of regular and crack-free chromium coatings shall comply with the appropriate thickness classification specified in Table 2.1.

NOTE: See Appendix G.

Coating thickness may be called up by specifying the minimum thickness required expressed in whole numbers, in micrometres (see Clause 1.6).

TABLE 2.1
REGULAR AND CRACK-FREE HARD
CHROMIUM COATINGS

Grade
Cr2
Cr5
Cr10
Cr15
Cr20
Cr25
Cr30
Cr40
Cr50
Thereafter in steps of 25 µm

2.3.2 Porous chromium

Thickness of porous chromium coatings shall be not less than 125 µm.

NOTE: The purchaser should specify the required thickness if a coating thickness less than 125 µm is required (see Appendix A).