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**Conversion coatings on metallic  
materials — Determination of coating mass  
per unit area — Gravimetric methods**

*Couches de conversion sur matériaux métalliques — Détermination de la  
masse de revêtement par unité de surface — Méthodes gravimétriques*

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Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 734 10 79  
E-mail [copyright@iso.ch](mailto:copyright@iso.ch)  
Web [www.iso.ch](http://www.iso.ch)

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 3892 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 2, *Methods of inspection and coordination of test methods*.

This second edition cancels and replaces the first edition (ISO 3892:1980), which has been technically revised.

# Conversion coatings on metallic materials — Determination of coating mass per unit area — Gravimetric methods

**WARNING** — The materials, operations and equipment listed in this International Standard may be hazardous if suitable precautions are not observed. This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

## 1 Scope

This International Standard specifies gravimetric methods for determining the coating mass per unit area of conversion coatings on metallic materials.

The methods are applicable to

- phosphate coatings on iron and steel;
- phosphate coatings on zinc and cadmium;
- phosphate coatings on aluminium and its alloys;
- chromate coatings on zinc and cadmium;
- chromate coatings on aluminium and its alloys.

The methods are applicable only to conversion coatings that are free from any supplementary coating such as oil, water or solvent-based polymers, or wax.

The methods do not indicate the presence of bare spots or sites with thicknesses lower than the specified minimum in the measuring areas. In addition, the single values obtained from each measuring area is the mean thicknesses over that area. There can be no further mathematical analysis of this single value, e.g. for statistical control purposes.

## 2 Apparatus

**2.1 Vessel**, of glass or other appropriate material, in which the conversion coatings can be dissolved.

**2.2 Analytical balance**, capable of weighing to the nearest 0,1 mg, for weighing the test pieces under examination before and after dissolution of the conversion coatings.

**2.3 Electrical equipment**, for electrolytic dissolution (for chromate coatings on zinc and cadmium).

### 3 Test pieces

The test pieces shall have a maximum mass of 200 g and a total surface area large enough to give a loss of mass sufficient to be tested with adequate sensitivity, and conformity with the requirements of the relevant material or product specification. In order to achieve adequate accuracy in the determination, the total surface area shall be in accordance with the values given in Table 1.

Table 1 — Total surface areas of test pieces

Expected mass of coating per unit area g/m <sup>2</sup>	Minimum total surface area of coated test piece cm <sup>2</sup>
< 1	400
≥ 1 ≤ 10	200
> 10 ≤ 25	100
> 25 ≤ 50	50
> 50	25

NOTE In order to achieve an overall measurement uncertainty (see 5.2) of 5 %, the surface areas should be measured to within 1 %.

### 4 Reagents and procedures

#### 4.1 General

For the preparation of solutions, unless otherwise stated, use only reagents of recognized analytical grade and only distilled water or water of equivalent purity.

The sampling procedure shall be as specified in the product standard.

#### 4.2 Phosphate coatings on iron and steel

##### 4.2.1 Manganese phosphate coatings

###### 4.2.1.1 Reagent

4.2.1.1.1 Chromium(VI) oxide ( $\text{CrO}_3$ ), a 50 g/l aqueous solution.

###### 4.2.1.2 Procedure

Dry the test piece (area  $A$ , in square centimetres, see 5.1) and weigh it, to the nearest 0,1 mg, using the analytical balance (2.2) (mass  $m_1$ , in milligrams, see 5.1). Then immerse the test piece for 15 min in the reagent (4.2.1.1.1), maintained at  $75^\circ\text{C} \pm 5^\circ\text{C}$ . Rinse the test piece immediately in clean running water and then in distilled water; dry rapidly and reweigh. Repeat the procedure until a reasonably constant mass (differing by < 0,1 mg) is obtained (mass  $m_2$ , in milligrams, see 5.1).

Use freshly prepared reagent for every test piece.

## 4.2.2 Zinc phosphate coatings

### 4.2.2.1 Reagent

**4.2.2.1.1 Aqueous solution**, containing, per litre, 100 g sodium hydroxide, 90 g ethylenedinitrilo tetra-acetic acid, tetrasodium salt dihydrate (EDTA tetrasodium salt) and 4 g triethanolamine.

### 4.2.2.2 Procedure

Dry the test piece (area  $A$ , in square centimetres, see 5.1), and weigh it, to the nearest 0,1 mg, using the analytical balance (2.2) (mass  $m_1$ , in milligrams, see 5.1). Then immerse the test piece for 5 min in the reagent (4.2.2.1.1), maintained at  $75\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ . Rinse the test piece immediately in clean running water and then in distilled water; dry rapidly and reweigh (mass  $m_2$ , in milligrams, see 5.1).

Use fresh reagent for every test piece.

## 4.2.3 Iron phosphate coatings

### 4.2.3.1 Reagent

**4.2.3.1.1 Chromium(VI) oxide ( $\text{CrO}_3$ )**, a 50 g/l aqueous solution.

### 4.2.3.2 Procedure

Dry the test piece (area  $A$ , in square centimetres, see 5.1) and weigh it, to the nearest 0,1 mg, using the analytical balance (2.2) (mass  $m_1$ , in milligrams, see 5.1). Then immerse the test piece for 15 min in the reagent (4.2.3.1.1), maintained at  $75\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ . Rinse the test piece immediately in clean running water and then in distilled water; dry and reweigh. Repeat the procedure until a reasonably constant mass (differing by  $< 0,1$  mg) is obtained (mass  $m_2$ , in milligrams, see 5.1).

Use freshly prepared reagent for every test piece.

## 4.3 Phosphate coatings on zinc and cadmium

### 4.3.1 Reagent

**4.3.1.1 Ammonium dichromate**, solution in 25 % to 30 % mass fraction ammoniac. During preparation of the solution, its temperature shall not exceed  $25\text{ }^{\circ}\text{C}$ .

### 4.3.2 Procedure

Dry the test piece (area  $A$ , square centimetres, see 5.1), and weigh it, to the nearest 0,1 mg, using the analytical balance (2.2) (mass  $m_1$ , in milligrams, see 5.1). Then immerse the test piece for 3 min to 5 min in the reagent (4.3.1.1) at room temperature. Carry out this operation in a fume cupboard. Rinse the test piece immediately in clean running water and then in distilled water; dry rapidly and reweigh (mass  $m_2$ , in milligrams, see 5.1).

Use freshly prepared reagent for every test piece.

## 4.4 Crystalline phosphate coatings on aluminium and its alloys

### 4.4.1 Reagent

**4.4.1.1 Nitric acid solution**, mass fraction 65 % to 70 %.

#### 4.4.2 Procedure

Dry the test piece (area  $A$ , in square centimetres, see 5.1), and weigh it, to the nearest 0,1 mg, using the analytical balance (2.2) (mass  $m_1$ , in milligrams, see 5.1). Then immerse the test piece either for 5 min in the reagent (4.4.1.1) maintained at  $75\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  or for 15 min in the same reagent at room temperature. Rinse the test piece immediately in clean running water and then in distilled water; dry rapidly and reweigh (mass  $m_2$ , in milligrams, see 5.1).

Use freshly prepared reagent for every test piece.

### 4.5 Chromate coatings on zinc and cadmium

#### 4.5.1 Reagent

**4.5.1.1 Aqueous solution**, containing, per litre, 50 g sodium (or potassium) cyanide and 5 g sodium hydroxide.

#### 4.5.2 Procedure

Dry the test piece (area  $A$ , in square centimetres, see 5.1), aged naturally after application of the chromate coating for at least 24 h and not more than 14 d, and weigh it, to the nearest 0,1 mg using the analytical balance (mass  $m_1$ , in milligrams, see 5.1). Then immerse the test piece for approximately 1 min in the reagent (4.5.1.1) at room temperature and dissolve the coating under electrolytic conditions with the test piece as the cathode.

The anode shall be made from an insoluble material, e.g. graphite.

Immerse the test piece in the reagent, and withdraw it whilst the current is flowing. Use a cathodic current density of  $15\text{ A/dm}^2$ . When the coating has been dissolved (after approximately 1 min), withdraw the test piece from the reagent, rinse it immediately in clean running water and then in distilled water, and then dry it rapidly and reweigh (mass  $m_2$ , in milligrams, see 5.1).

Use freshly prepared reagent for every test piece.

### 4.6 Chromate and amorphous phosphate coatings on aluminium and its alloys

#### 4.6.1 Fresh coatings

##### 4.6.1.1 General

Fresh coatings are those dried between  $25\text{ }^{\circ}\text{C}$  and  $40\text{ }^{\circ}\text{C}$  for at least 3 h and not longer than 5 h.

##### 4.6.1.2 Reagent

**4.6.1.2.1 nitric acid**, diluted 1 + 1, prepared by adding 1 volume of nitric acid of mass fraction 65 % to 70 % to 1 volume of water.

##### 4.6.1.3 Procedure

Air-dry the test piece (area  $A$ , in square centimetres, see 5.1) and weigh it, to the nearest 0,1 mg, using the analytical balance (2.2) (mass  $m_1$ , in milligrams, see 5.1). Then immerse the test piece for 1 min in the reagent (4.6.1.2.1) at room temperature. Rinse the test piece immediately in clean running water and then in distilled water; dry rapidly and reweigh (mass  $m_2$ , in milligrams, see 5.1).

Use freshly prepared reagent for every test piece.