Doc : MTD 24 (25073)WC
January, 2025

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS

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भारतीय मानक प्रारूप

जिंक और कैडमियम लेपित वस्तुओं और जिंक आधार मिश्रधातुओं पर क्रोमेट परिवर्तन लेपन — विशिष्टि

(IS 9839 का पहला पुनरीक्षण)

Draft *Indian Standard*

Chromate Conversion Coating on Zinc and Cadmium Coated Articles and Zinc Base Alloys — Specification

(First Revision of IS 9839)

(Amalgamation of IS 1340 and IS 9839)

ICS 25.220.20

Corrosion Protection and Finishes Sectional Committee, MTD 24

Last date of comments is **21 February 2025**

FOREWORD

(Formal clause will be added to be later)

This Indian Standard was first published in 1981. First revision was under taken to amalgamate IS 1340 'Code of practice for chromate conversion coating on zinc and cadmium coated articles and zinc base alloys' and IS 9839 'Specification for chromate conversion coatings on electroplated zinc and cadmium coatings' to make one comprehensive standard which covers both specification and code of practice for chromate conversion coating on zinc and cadmium coated articles and zinc base alloys.

Former title of the Indian Standard IS 9839 was 'Specification for chromate conversion coatings on electroplated zinc and cadmium coatings' which was changed to 'Chromate conversion coating on zinc and cadmium coated articles and zinc base alloys — Specification'.

While preparing the standard, necessary assistance has been derived from ISO 4520 : 1981 'Chromate conversion coatings on electrodeposited zinc and cadmium coatings', issued by the International Organization for Standardization.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Chromate Conversion Coating on Zinc and Cadmium Coating Articles and Zinc Base Alloys — Specification

(*First Revision*)

1 SCOPE

This standard specifies requirements and lays down the procedure for chromate conversion coatings on zinc and cadmium coatings intended to give protection against corrosion. Finishes for giving particular colour or specifically to improve paint adhesion are not covered by this standard. Chromate treatment is particularly effective in retarding the formation of white corrosion products which form on zinc and cadmium coatings under certain conditions.

2 REFERENCES

The following standards contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicted were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

IS No.	*Title*
IS 245 : 2022	Specification for Trichloroethylene, Technical *(fourth revision)*
IS 573 : 1992	Trisodium phosphate ― Specification (*fourth revision*)
IS 8602 : 2024 / ISO 3613 : 2021	Metallic and Other Inorganic Coatings - Chromate Conversion Coatings on Zinc, Cadmium, Aluminium-Zinc Alloys and Zinc- Aluminium Alloys - Methods of Test (*first revision*)
IS 9838 : 1981	Method for determination of coating mass per unit area of conversion coatings on metallic materials by gravimetric method
IS 5528 : 2024/ ISO 9227 : 2022	Corrosion Tests in Artificial Atmospheres ― Salt Spray Tests (*second revision*)

3 QUALITY OF CHEMICALS

The quality of chemicals used in the preservation treatment shall be such that it does not affect the process.

4 CLASSIFICATION

Finishes can be applied ranging from thick, dark, olive-green coatings with good protective properties to thin, transparent, sometimes bluish films of attractive appearance but with limited protective value. Electroplaters can seldom guarantee to supply exact shades of colour with chromate conversion coatings. If it is necessary to have exact shades of colour, it is possible to dye bleached chromate coatings to obtain a wide range of colours, but they can only be expected to give an order of added corrosion resistance similar to that provided by the colourless bleached coatings.

Finishes are divided into two classes, each of which comprises two types; their most important characteristics are listed in table 1.

Table 1 Classification of Chromate Conversion Coatings
(*Clauses* **4** *and* **9**)

Class	Designation	Type	Typical appearance		Approximate Film Density g/m^2 (see IS 9838)	Typical Chromium Content mg/m^2	Extent of Corrosion Protection
1	A	clear	Colourless	Transparent clear, sometimes with a blushing tinge	Up to 0.5	5	Slight, for example against staining during handling or against high humidity in mildly corrosive conditions
	B	bleached		Transparent with slight iridescence	Up to 1.0	5 to 10	
2	C	iridescent	Coloured	Yellow iridescent	0.5 to 1.5	50 to 100	Considerable, including protection against certain organic vapours
	D	opaque		Olive green, shading to brown or bronze	More than 1.5	100 to 200	

NOTE — In addition, black coatings can be produced by several methods. Such coatings may have different degrees of corrosion protection and may also differ in coating mass per unit area.

Finishes may be characterized by class alone or by class and type designation. Typical examples are:

Fe/Cd 8 c 2

Fe/Zn 25 c 1A

where

Fe refers to the basis metal (iron or steel;

Cd and Zn refer to the electroplated coating (cadmium or zinc);

8 and 25 are the thicknesses, in micrometres, of the cadmium and zinc coatings;

c refers to the chromate conversion coating;

2 and 1 are the classes of the chromate conversion coatings; and

A designates the type of chromate conversion coating.

5 PROCEDURE FOR APPLICATION OF COATING

5.1 Preparation of Surface

5.1.1 All surfaces shall be free from oil and grease and residues of plating and cleaning solutions. Oily and greasy components shall be degreased in trichloroethylene (*see* IS 245) or other suitable solvent. Freshly plated components and those which have not been contaminated with oil or grease (for example, for handling) may not require degreasing.

5.1.2 After solvent degreasing, the component should be treated by immersion for 5 min to 15 min in a boiling solution containing 45 g to 50 g of trisodium phosphate ($Na_3PO_4 . 12H_20$) (*see* IS 573) per litre of water. While preparing the solution, soft water should preferably be used. Electrolytic treatment in the boiling or near boiling solutions may be used, if required, at a current density of 5 A/dm^2 for one minute.

5.1.3 *Washing Prior to Passivation*

Components shall be thoroughly washed in cold running water to remove all electrolyte or cleaning solution. Excess water shall be removed from the components by draining. Immediately before passivation, components

may be immersed for not more than 10 s in a weak solution of nitric or sulphuric acid. This acid dip shall not contain more than 1 ml of concentrated acid per litre.

5.2 Chromate Treatment

5.2.1 The components should be immersed in a solution containing 150 g to 200 g of potassium or sodium dichromate and 5.5 ml to 10.0 ml of concentrated sulphuric acid (r. d. = 1.84) per litre for 5 s to 10 s.

NOTES

1 The duration of immersion may be increased to 20 s, *Max*.
2 With the progressive use of the solution, the chemical composition of the water will change which will effect the formation of the film. Care will have to be taken therefore, to maintain the correct strength of the bath.
3 Instead of the dichromate solution mentioned above, any proprietary chromate conversion coating solution may be used.
4 Bleaching treatment shall not be used.

5.2.2 Chromate treated parts shall then be rapidly transferred to two successive tanks of cold running water. The normal time of rinsing is a few seconds in the first tank and about one minute in the second tank. The parts shall then be dried by circulation of hot air, taking care that the temperature of the component shall not be raised above 60 °C as heating above 60 °C would result in cracking due to dehydration of the chromate coating. (Any heat treatment for the relief of hydrogen embrittlement shall be carried out before a chromate conversion coating is applied).

When hot water is used as the final rinse after the chromating process, it is essential that the time of rinsing should be kept as short as possible in order to prevent the dissolution of the hexavalent chromium. Immersion in hot water not above 60 °C for a period not more than 30 s is permissible to assist drying. In no circumstances shall boiling water be used.

5.2.3 The time of immersion and the chemical composition of the bath should be strictly controlled and maintained.

5.2.4 The chromate film may have an iridescent green or yellowish green appearance but should be free from bare patches. Sometimes, there may be a tendency of light khaki or greyish film to be developed. The colour of the coating, however, may be agreed to between the supplier and the purchaser.

5.3 Factors Affecting Chromate Conversion Coatings

5.3.1 Chromate conversion coatings are normally applied by dipping. Chromating solutions are usually acidic and contain hexavalent chromium salts together with other salts which may be varied to modify the appearance and hardness of the film. The colour of the film and, therefore, the type of conversion coating depends on the composition of the chromating solution, but is also affected by its pH and temperature, the duration of treatment and the nature and surface condition of the coating being treated. Bright, transparent films on zinc coatings may be obtained by dipping in appropriate solutions. They can also be obtained by bleaching iridescent films in alkaline solutions or in phosphoric acid.

5.3.2 The drying of the article shall not be carried out at a temperature in excess of 60 °C

6 REQUIREMENTS FOR CHROMATE CONVERSION COATINGS

6.1 General

Chromate conversion coatings harden with age by gradual dehydration. They should, therefore, be handled carefully for the first 24 h after treatment, and any tests (including corrosion tests) shall be deferred until the expiry of that period.

6.2 Adhesion

The coatings shall be adherent, and coloured coatings shall be tested by one of the methods specified in IS 8602.

6.3 Presence of Colourless Chromate Coating

Presence of colourless chromate coating on zinc and cadmium coated articles and zinc base alloys shall be determined as per the procedure laid down in IS 8602.

6.4 Presence of Hexavalent Chromium

Presence of hexavalent chromium in chromate coatings shall be determined as per IS 8602.

6.5 Total Chromium Content

Total chromium content in chromate coatings shall be as determined as per IS 8602.

6.6 Mass per Unit Area

Mass per unit area shall be determined in accordance with IS 9838.

6.7 Corrosion Resistance

When subjected to the neutral salt spray test specified in IS 5528, the time for formation of white corrosion products on chromated cadmium or zinc coatings shall not be less than the values given in table 2.

6.7.1 *Zinc Coatings*

6.7.1.1 *Coloured Coatings*

Coloured coatings (Types C and D) on zinc coatings shall be subjected to neutral salt spray test specified in IS 5528. White corrosion products shall not be visible within 96 h.

6.7.1.2 *Colourless Coatings*

Colourless coatings (Types A and B) on zinc coatings shall be subjected to the neutral salt spray test without breakdown of the coatings or any appearance of white corrosion products within 12 h and 24 h respectively (for details of procedure, reference may be made to IS 5528).

6.7.2 *Cadmium Coatings*

6.7.2.1 Coloured coatings (Types C and D) and colourless coatings (Types A and B) on cadmium coatings shall be subjected to humidity test at a temperature of 55 °C ± 2 °C followed by cooling to 30 °C (5 h). There will be 2 cycles of 16 h each where the relative humidity shall not be less than 95 percent with condensation. There shall be no breakdown of the film or any appearance of the white corrosion products (white rust), slight staining may be allowed.

Table 2 Requirements or Corrosion Resistance
(Clause **6.7***)*

Designation	Possible Classifications	Time to Formation of White Corrosion Products, h, ***Min***
A	1, 1A	6
B	1B	24
C	2, 2C	72
D	2D	96

NOTE — Finishes may be characterized by class alone or by class and type designation. (*see* 4)

7 RETREATMENT

7.1 If the specific film is not satisfactory, components may be re-passivated either directly or after removal as far as possible of the old film by immersion for a few minutes in a boiling solution of sulphate-free chromic acid (100 g CrO_3/l) followed by the trisodium phosphate cleaning as in **5.1.2**. When a passivated component has been heated (for example, to stove a lacquer applied on part of the surface), direct re-passivation may be applicable to restore the passivation on the unlacquered surface.

8 USE OF CHROMATE CONVERSION COATINGS

The chromate conversion coatings which give most protection are types C and D, and these only give any significant increase in life to electroplated components. Types A and B are used when appearance is the main

consideration. They give some protection against high humidity in mildly corrosive conditions and help bright deposits to retain their appearance, for example, by providing protection against staining or handling.

9 SAMPLING

9.1 Lot

A lot shall consist of the articles, parts or components, electroplated at one time in the same bath.

9.2 Criteria for Acceptance

A lot shall be described as conforming to the requirements of this standard, if the test results of the coating satisfy all the requirements prescribed under Table 1.

10 PACKAGING AND MARKING

10.1 Packaging

The articles coated with chromate conversion coatings shall be securely packaged to prevent damage during handling, transportation, and storage. The specific packaging arrangements shall be mutually agreed upon by the supplier and purchaser. Suitable packaging materials, such as corrugated cardboard boxes, wooden crates, or plastic containers, should be used. It is essential to ensure that the packaging provides adequate protection against moisture, dust, and mechanical impact.

10.2 Marking

10.2.1 Packaging should be labelled with following information:

a) Article description;
b) Coating type (chromate conversion coating);
c) Quantity; and
d) Handling instructions.

10.2.2 Each coated article shall be marked with the following information:

a) Manufacturer's name or logo;
b) Article identification number or code;
c) Material of article;
d) Material of base coat (if applicable);
e) Class, Designation and Type of coating; and
f) Any relevant safety or handling symbols (if applicable).

10.2.3 Each coated article and/or the package containing coated articles shall be marked with the legend "FOR COATING ONLY" provided always that the material so marked conforms to each requirement of the specification.

10.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the product(s) may be marked with the Standard Mark.