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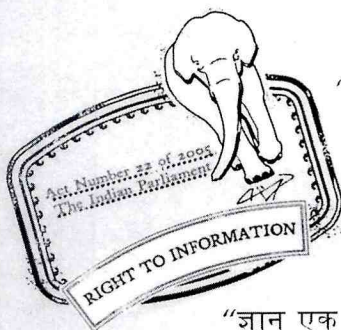
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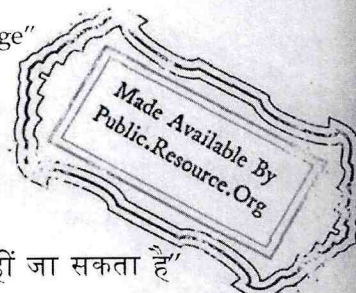
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Indian Standard
METHOD FOR TESTING
UNIFORMITY OF COATING ON
ZINC COATED ARTICLES
(Second Revision)

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METHOD FOR TESTING
UNIFORMITY OF COATING ON
ZINC COATED ARTICLES
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(Continued on page 2)

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(Continued on page 10)

Indian Standard

**METHOD FOR TESTING
UNIFORMITY OF COATING ON
ZINC COATED ARTICLES**

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 26 September 1986, after the draft finalized by the Hot-Dip Sprayed and Diffusion Coatings Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This test known as 'Preece Test' is designed as an inspection or acceptance test for determining the thinnest spot in a zinc coating (hot-dipped, electroplated, sherardized or sprayed) on iron or steel articles which are coated after the shape is produced. This standard was first published in 1964 and subsequently revised in 1972. In this revision, more details have been incorporated about preparation of samples and testing procedure for determining the uniformity of zinc coatings. In addition, qualitative tests for all types of zinc coatings have also been incorporated.

0.3 Preece test is designed for newly coated items. In case of aged or weathered zinc coated items, the method given in Appendix A may be used. Preece test should not be used for determining mass of zinc coatings as these are produced by different processes and have widely different rates of solubility in copper sulphate solution. Electroplated and sprayed zinc coatings (see IS:1573-1986* and IS:5905-1970† respectively) which consist essentially of pure zinc, dissolve rapidly than hot-dipped coatings which are composed of zinc iron alloy layer next to steel, and nearly pure zinc layer in the outer part of the coating.

0.4 The rate of reaction increases with increase in temperature. It has been found that to obtain accuracy of about 10 percent in this test, it is necessary to maintain temperature of copper sulphate solution (see 3) at $18 \pm 2^{\circ}\text{C}$.

*Electroplated coatings of zinc on iron and steel (*second revision*).

†Sprayed aluminium and zinc coatings on iron and steel.

0.5 This test is suitable for the following articles.

0.5.1 Sheet, wire, tube, bolts, nuts and other threaded articles of similar size.

0.5.2 Articles fabricated from strip, bar or tube up to a length of one metre and not exceeding 75 mm in width or 50 mm in diameter.

0.5.3 Castings, angle brackets and structural shapes with an overall size of not more than $200 \times 150 \times 100$ mm of approximate mass not more than 4 kg coated after fabrication.

0.5.4 Articles having dimensions greater than those specified in 0.5.2 and 0.5.3 shall be subjected to visual inspection only as laid down under 0.5.5.

0.5.5 Samples of such articles, after galvanizing, shall be stored for at least one week under cover, but with all surfaces as far as possible, exposed to free movement of air. The zinc coating as seen by visual inspection at the end of this period after storage shall be clean, smooth, continuous and free from acid spots.

0.6 In the preparation of this standard, assistance has been derived from the following publications:

BS:729-1971 Hot dip galvanized coatings on iron and steel tubes.
British Standards Institution.

ASTM A-239-1973 Locating the thinnest-spot in a zinc (galvanized) coating on iron and steel articles by the Preece test (copper sulphate dip). American Society for Testing and Materials.

JIS H: 0401-1983 Method of test for hot dip galvanized coatings.
Japanese Industrial Standards Committee.

0.7 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: 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the procedure for determining uniformity of zinc coating (hot-dipped, electroplated, sherardized or sprayed) on iron or steel articles.

*Rules for rounding off numerical values (revised).

2. SAMPLING AND PREPARATION OF TEST PIECES

2.1 Sampling — The number of samples to be tested shall be as specified in material specification. In the absence of such a standard, the degree of sampling shall be as agreed to between the galvanizer and the purchaser.

2.2 Preparation of Test Pieces

2.2.1 Sheet — A test piece of 100×100 mm shall be cut off from a sheet selected as per material specification.

2.2.2 Wire — The sample length of the wire shall be cut from one or both ends of the coil under test. Portions of wire which are obviously damaged shall not be used as sample. In case of stranded or armoured wire, or wire which has undergone any other similar process, care should be taken to avoid damage in preparing the sample. A sample of suitable length but not less than 150 mm, shall be cut from one or both ends of the selected coil.

2.2.3 Articles Other Than Sheets and Wires — Test specimens shall be selected from the material galvanized but if the material is of inconvenient length, shorter pieces of the same section and of the same steel composition, not less than 90 cm long, may be introduced as test specimens.

2.2.3.1 All test specimens shall be treated in the same manner, in the same bath and at the same time as the material whose coating characteristics they are intended to represent.

NOTE — The sample selected for test shall be such that it is free from abrasions or cuts in the zinc coatings except those which occur during manufacture or preparation of sample for testing. Where the area of uncoated surface may materially deplete the strength of copper sulphate solution, precautions may be taken such as plugs for tubular material or lacquer, paraffin or other suitable coatings for the uncoated surface.

2.3 Cleaning of Sample

2.3.1 The test piece shall be cleaned with a volatile organic solvent such as ether, trichloroethylene, carbon tetrachloride, etc, and then rinsed with alcohol and finally washed thoroughly with clean water and wiped dry with clean cotton cloth. Lacquer or varnish coatings shall be removed with a suitable clean volatile organic solvent which will not attack the zinc coating or leave a greasy or waxy deposit. Test pieces shall be brought to a temperature of 15 to 20°C prior to the beginning of the test.

2.3.2 Abnormal cases may arise when, by reason of unusual surface conditions, the copper sulphate solution may not act normally on the zinc coating, for example, the solution may have no apparent attack on all or part of the surface, or false deposits of copper may appear on the zinc coating. If there is any such abnormality of performance of test pieces,

they shall be discarded and new ones selected. The new test pieces shall be cleaned in alcohol, rinsed and wiped dry, and then immersed for 3 minutes in a solution consisting of one part by volume of ammonium hydroxide (sp gr 0.90) and nine parts of distilled water. The test pieces may be scrubbed with cotton cloth during this immersion. After cleaning, the test pieces shall be washed and wiped dry.

3. COPPER SULPHATE SOLUTION

3.1 Preparation

- a) Dissolve about 36 g of technical grade copper sulphate crystals conforming to IS:261-1982* in 100 ml of distilled water (*see* Note). Heat the water to aid solution, but if heated, the solution should be cooled before neutralizing.
- b) Neutralize the free sulphuric acid in solution by shaking with excess of copper carbonate (laboratory grade) or copper hydroxide (laboratory grade) (about 1 g/l of solution) and allow to stand for at least 24 hours before filtering or decanting the solution from the sediment.
- c) The specific gravity of the test solution during the test shall be $1.186 \pm 2^\circ\text{C}$. Adjustment may be made by adding distilled water or solution of higher specific gravity.

NOTE — Chemically pure copper sulphate crystals are preferable to commercial grade, although not necessary for this test.

3.2 Volume of Solution

3.2.1 Wire — Test pieces of wire shall be tested in a glass container of at least 50 mm inside diameter for 2.00 mm wires and smaller and with at least 75 mm inside diameter for wires of more than 2.00 mm in diameter. The container shall be filled with fresh test solution to a depth of at least 100 mm. This quantity of solution shall be used for simultaneous testing of one to seven test pieces. The solution shall be discarded after completion of the test and fresh solution used for any additional tests.

3.2.2 For Articles Other Than Wires — The volume of the solution shall be sufficient to immerse the test pieces completely and shall not be less than 6 ml/cm² of surface area of test piece.

3.3 Temperature of Solution — The temperature of solution shall not vary beyond the limits of $18 \pm 2^\circ\text{C}$, either at the commencement of the test or through the duration of the test.

*Specification for copper sulphate (*second revision*).

4. PROCEDURE

4.1 The clean test pieces shall be subjected to as many one-minute and half-minute successive dips as prescribed in the relevant standard, in copper sulphate solution (*see* 3) kept at a temperature of $18 \pm 2^\circ\text{C}$. Half-minute dips shall be carried out after completion of all the one-minute dips. If possible, immerse the test pieces completely, taking care that they do not touch each other. During the test, neither the test pieces nor the solution shall be agitated. After each dip, withdraw the test pieces, rinse immediately in clean running water (*see* Note 1). Remove any black deposit including holes and pockets by a suitable brush (*see* Note 2). Wipe and dry the test pieces with a clean soft cloth and return immediately to solution.

4.1.1 Successive dips of one-minute each shall be continued, with washing and wiping of the test pieces after each dip, until the test pieces have withstood the required number of dips or until the end point has been reached.

NOTE 1 — If no running water is available, the rinse water shall be changed often enough, preferably after each dip, to ensure that it is reasonably free from copper sulphate. The temperature of the rinse water should be 15 to 20°C .

NOTE 2 — Brush conforming to IS: 1104-1984* may be used for the purpose.

4.2 Interpretation of Test

4.2.1 The material passes this test if at the end of the specified number of dips, when the test piece is finally rinsed and wiped dry, it does not show any adherent red deposit of copper upon the base metal. In case of wire, any red deposit of copper within 25 mm of the cut end of the sample shall not be interpreted as a failure of the sample.

4.2.2 A fine line appearance of copper on top of screw threads, or on sharp edges of articles, or within 25 mm of a cut portion of a specimen, shall not be judged as failure. Likewise, the failure of a coating at or adjacent to any cut or abrasion present on the original test piece shall not be considered as a failure.

4.2.3 Detection of False End Point — If it is possible to remove the bright copper deposit with an ink eraser or to peel it with the edge of a blunt tool such as the back of a knife blade, and zinc appears underneath the copper, such an appearance of deposited copper shall be construed as false end point.

5. NUMBER OF DIPS

5.1 Wire — The sample, or samples shall be subjected to specified number of successive dips of exactly one-minute or exactly half-minute duration as

*Specification for brushes, lettering (*second revision*).

prescribed in IS:4826-1979* or any other relevant Indian Standard specification. The half-minute dips shall be carried out after the completion of all the one-minute dips.

5.2 Other Articles — Unless otherwise specified, the sample shall be subjected to four successive dips in the solution, each lasting one minute.

6. SUPPLEMENTARY TESTS

6.0 If at any time during the test, there is any doubt as to the presence of exposed base metal, as determined by visual inspection, one or more of the tests given in 6.1 or 6.2 may be used.

6.1 Supplementary Tests for All Types of Zinc Coatings

6.1.1 Microscopic Test — Section the test piece through the copper deposit, mount and polish it metallographically. Etch the polished surface using an etching solution composed of 20 g of chromic acid, 1.5 g of sodium sulphate and 100 ml of distilled water. After etching, wash the test piece with alcohol. Examine the etched test piece under a microscope, using a magnification of 100 diameters, or greater if necessary. Look for the exposed base metal.

6.1.2 Qualitative Test for Zinc — Apply a drop (or several drops) of dilute hydrochloric acid (1:1) to the area in question (depending on its size). The presence of zinc is indicated by immediate vigorous effervescence (evolution of hydrogen). If no appreciable zinc is present, the effervescence will be mild. By carefully removing the acid, a confirmatory test for zinc may be made as follows.

6.1.2.1 Neutralize the acid with ammonium hydroxide, acidify with acetic acid and pass hydrogen sulphide into the solution, a white precipitate (zinc sulphide) confirms the presence of zinc.

6.2 Supplementary Test for Electroplated, Sherardized and Sprayed Zinc Coatings

6.2.1 Water Immersion Test — Partially immerse the test pieces in distilled water at room temperature. Failure of the coatings is indicated by the appearance of iron rust spots in a few hours to several days. This test may be made on material as received, or to substantiate the Preece test at any stage.

*Specification for galvanized coatings on round steel wires (first revision).

APPENDIX A

(Clause 0.3)

APPLICATION OF PREECE TEST TO WEATHERED GALVANIZED WARE

A-1. Preece test is not applicable to aged or weathered material because of the corrosion film present on zinc coating. If it is desired to use the Preece test on such material, the corrosion film should be removed before testing, by immersing the test pieces in an ammonium hydroxide solution [1 part by volume of ammonium hydroxide (sp gr 0.90) to 9 parts by volume of distilled water], rinsing them in clean water and wiping them dry.

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