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मानक

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“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

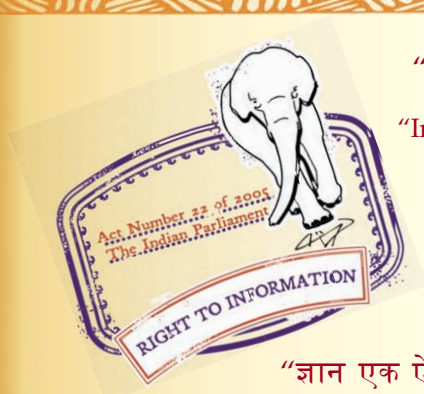
“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 101-5-1 (1988): Methods of sampling and test for paints, varnishes and related products, Part 5: Mechanical test on paint films, Section 1: Hardness tests [CHD 20: Paints, Varnishes and Related Products]



“ज्ञान से एक नये भारत का निर्माण”

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“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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*Indian Standard***METHODS OF SAMPLING AND TEST
FOR PAINTS, VARNISHES AND RELATED PRODUCTS****PART 5 MECHANICAL TEST ON PAINT FILMS****Section 1 Hardness Tests***(Third Revision)*

1. Scope — Prescribes the following hardness tests for films formed by paints and allied products:

- a) Pendulum test,
- b) Indentation test,
- c) Pencil hardness test, and
- d) Pressure test.

2. Pendulum Test

2.1 Principle — The resistance of a single coat film or multicoat system of paints, varnishes and related products is determined to a single blow impact by a pendulum. The method of test is to be completed by giving supplementary information as follows:

- a) Material and surface preparation of the substrate,
- b) Method of application,
- c) The thickness and coating, and
- d) Duration and conditions of coated panel.

2.2 Apparatus

2.2.1 Pendulum impact tester — As shown in Fig. 1 and 2. The apparatus consists of two arms, to the ends of which control steel test pieces are attached. The arms are free to swing in a vertical plane and the test pieces are so fixed that when the arms are released, the test pieces strike each other at right angles with a single blow, after which they slide over each other before parting. The apparatus is so arranged that test piece A makes an angle of not more than 180° with the line of the outer side of the arm which supports it and this arm is fitted with a ratchet device to ensure that the test pieces do not make contact on the return swing of the arms. The mass of the outer arm of the apparatus is 3.7 ± 0.1 kg, the length is 1000 ± 2 mm and the centre of gravity is 500 ± 5 mm from the centre of the top lugs. The mass of the inner arm (excluding the test piece) is 4.5 ± 0.1 kg, the length is 870 ± 2 mm and the centre of gravity is 560 ± 5 mm from the centre of the lugs. The test pieces shall be so arranged that they strike each other midway along their lengths.

2.2.2 Test pieces — Unless otherwise agreed or specified the test pieces shall be made of burnished steel tube in the 'as drawn and tempered' or 'normalized' condition with dimensions as 28 mm internal diameter, 38.0 ± 0.5 mm external diameter and 125 mm length.

2.2.3 Preparation and coating of test pieces — The test pieces shall be burnished with emery paper No. 200 (see IS : 715-1966 Specification for coated abrasives) and then thoroughly cleaned with white spirit [see IS : 1745-1978 Specification for petroleum hydrocarbon solvents (*second revision*)] to remove any traces of grease. Then it is coated with the given material to be tested or system under test by the methods given in relevant material specification. The coated test pieces shall be dried (or stored and aged) for the specified time as given in the material specification and shall be conditioned at $27 \pm 2^\circ\text{C}$ and relative humidity of 65 ± 5 percent for a minimum period of 16 h. Then the test shall be carried out without much delay. The thickness of coating shall be determined before test.

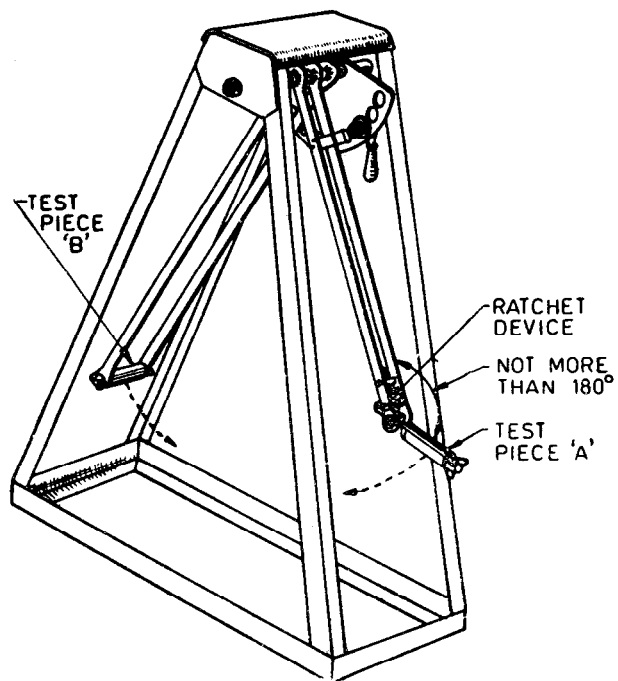


FIG. 1 PICTORIAL VIEW OF APPARATUS FOR RESISTANCE TO IMPACT (PENDULUM TEST)

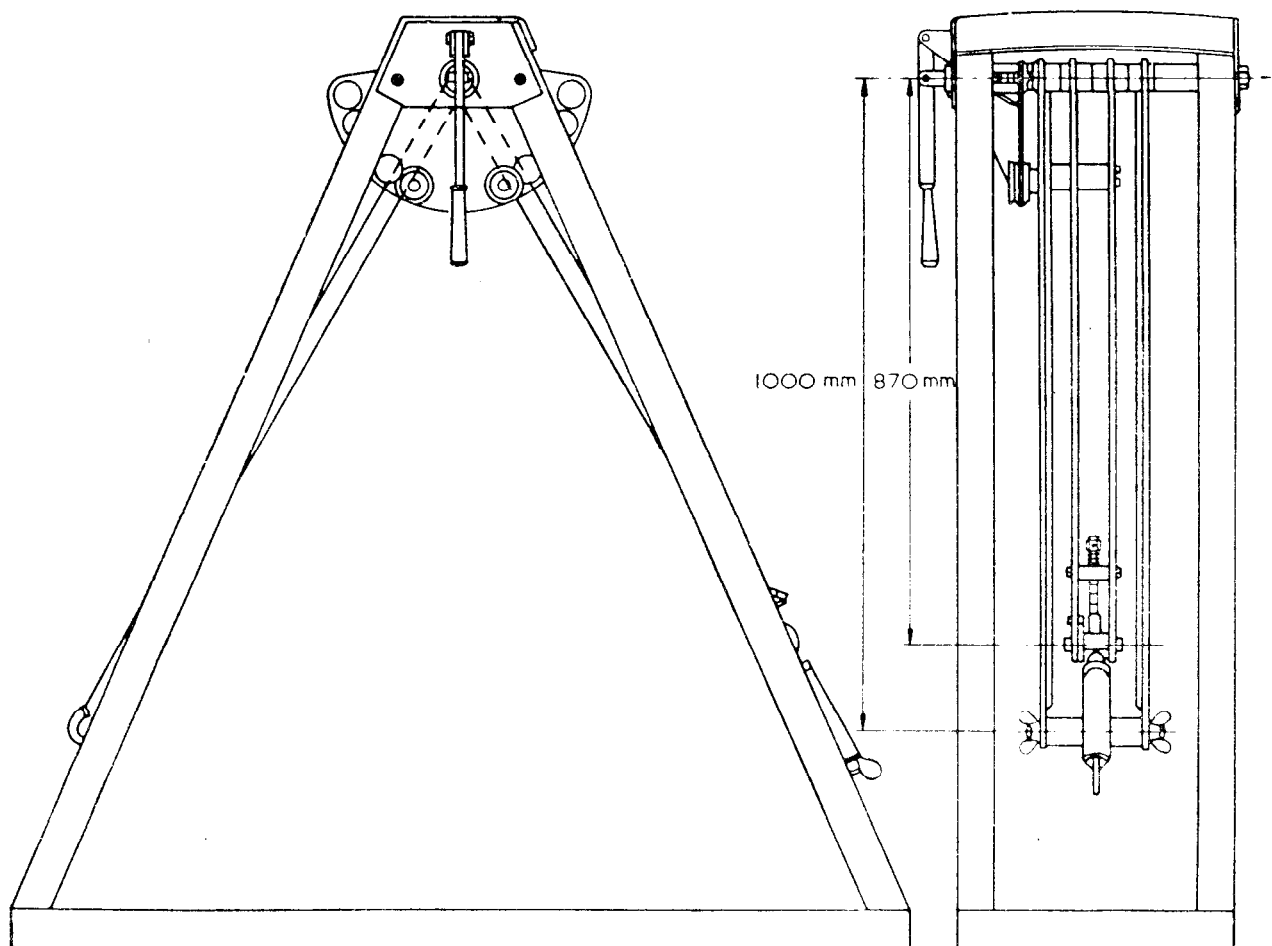


FIG. 2 APPARATUS FOR RESISTANCE TO IMPACT (PENDULUM TEST)

2.3 Procedure

2.3.1 Attach the test pieces to the arms of the apparatus and fix the arms at the specified inclination from the vertical. Release the arms. Remove the test pieces and examine the points of impact for the loss of adhesion or removal of the coating.

3. Indentation Test

3.1 Principle — A method known as Buchholz indentation test is carried out on single coat or multicoat systems. The length of indentation produced when an indenter of specified size and shape is applied to the coating under defined conditions is indicative of the residual deformation of the coating. The result is expressed as the reciprocal of the indentation length and this increases as the desired property increases.

3.2 Apparatus

3.2.1 Indentation apparatus — It consists essentially of a rectangular block of metal, which forms the body of the instrument, an indenter and two pointed feet, as shown in Fig. 3.

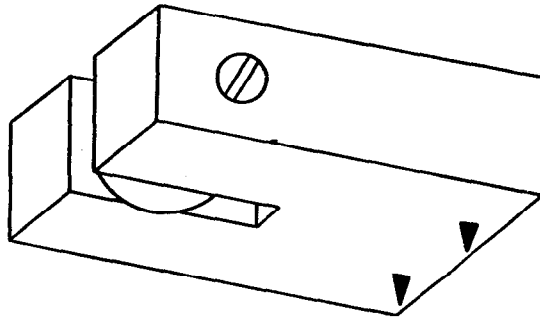
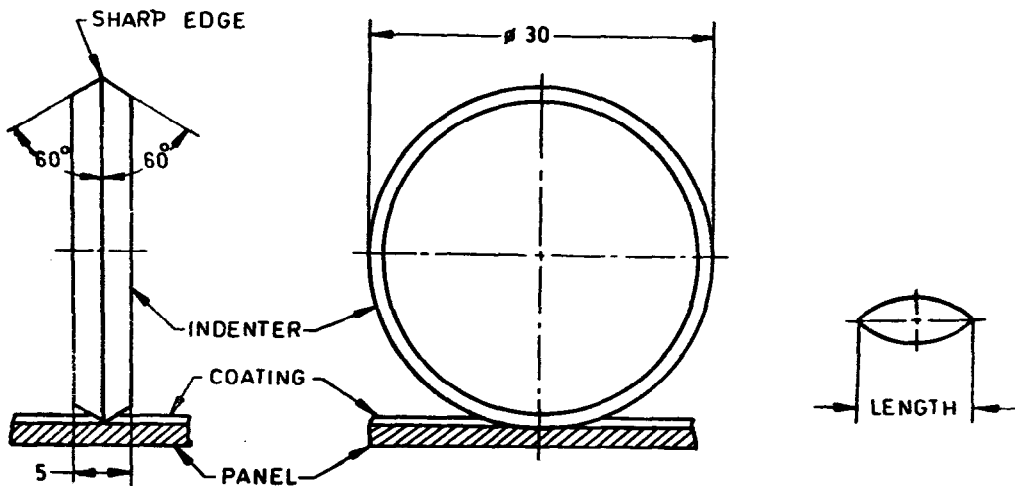


FIG. 3 INDENTATION APPARATUS (OBLIQUE UNDERSIDE VIEW)

The indenter is a sharp-edged metal wheel of hardened tool steel. The cross-section through its axis of rotation and its dimensions shall be as shown in Fig. 4, which also shows the shape of the indentation produced.



All dimensions in millimetres.

FIG. 4 INDENTOR AND (RIGHT) SHAPE OF INDENTATION (ENLARGED)

The complete apparatus weighs $1\,000 \pm 5$ g. The indenter and the two feet are so positioned in the body that when the instrument is placed on a level surface it is stable, its upper surface is horizontal and the effective load upon the indenter is 500 ± 5 g.

3.2.2 Measuring device — A suitable device for measuring the length of indentation consists of a microscope with $20 \times$ magnification and an eyepiece fitted with a graduated scale capable of reading to 0.1 mm. The area of indentation shall be illuminated by means of a light source so located that its angle of incidence exceeds 60° as shown in Fig. 5. The microscope shall be positioned vertically over the illuminated area and focussed to bring the shadow produced by the indentation (see Fig. 6) and the graduated scale together.

Note — The position of the indentation mark can be located by means of a suitable template prepared from a triangular sheet of transparent plastics film (see Fig. 7).

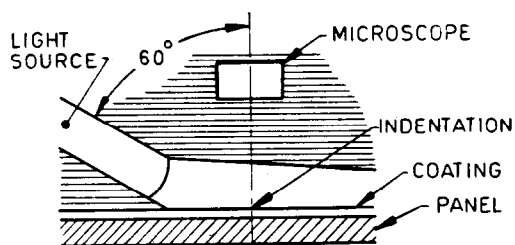


FIG. 5 POSITION OF THE LIGHT SOURCE AND THE MICROSCOPE

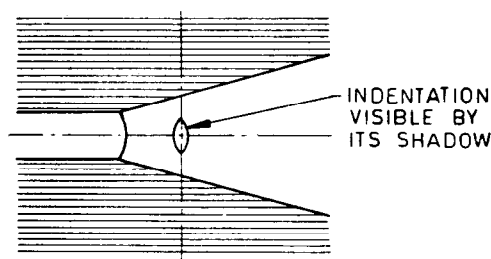


FIG. 6 SHADOW PRODUCED BY THE INDENTATION

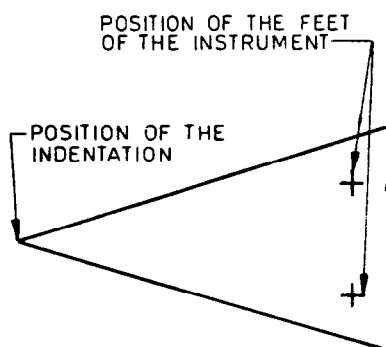


FIG. 7 TEMPLATE TO LOCATE THE POSITION OF INDENTATION

3.3 Test Panels

3.3.1 Materials and dimensions — Unless otherwise specified or agreed, the test panels shall be of metal or glass.

The test panels shall be flat and free from distortion and the surface shall be free from any visible ridges or cracks.

The test panels shall be rectangular and, unless otherwise specified, 150×100 mm in size and not less than 1 mm in thickness. The test panels may be cut to size after coating or drying, provided no distortion occurs.

3.3.2 Preparation and coating of panels — The test panels shall be prepared in accordance with IS : 101 (Part 1/Sec 3)-1986 'Methods of sampling and test for paints, varnishes and related products: Part 1 Test on liquid paints (general and physical), Section 3 Preparation of panels (*third revision*)' unless otherwise specified, and shall then be coated by the specified method with the product or system under test to the specified film thickness limits.

3.3.3 Drying and conditioning of the test panels — The coated test panels shall be dried (or stoved and aged) for the specified time and under the specified conditions and, unless otherwise specified, shall be conditioned at a temperature of $27 \pm 2^\circ\text{C}$ and a relative humidity of 65 ± 5 per cent for a minimum of 16 h. The test procedure shall then be carried out as soon as possible.

3.4 Procedure

3.4.1 Place the test panel, paint film uppermost, on a firm horizontal surface.

3.4.2 Take the apparatus specified in 3.2.1 and place it gently and without any tilting or lateral movement on to the test panel, leave the indenter in position for 30 ± 1 s and remove it carefully.

Note — The feet of the apparatus shall first of all be allowed to make contact with the test panel and then the indenter shall be lowered carefully until it touches the panel. The apparatus shall be lifted off the test panel indenter first and feet last.

3.4.3 Place the light source and microscope in position as specified in 3.2.2 and measure the length, in millimetres, of the shadow produced by the indentation 35 ± 5 s after removal of the indenter, unless otherwise specified. Record the results in millimetres, to the nearest 0.1 mm, as the indentation length.

3.4.4 Carry out five tests on different parts of the same test panel and calculate the mean value.

3.5 Calculation of Indentation Resistance — Round off the mean value to the nearest value in the first column of Table 1 and use this rounded-off value of the indentation lengths to calculate the indentation resistance.

TABLE 1 RELATION BETWEEN INDENTATION LENGTH AND INDENTATION RESISTANCE

Indentation Length mm	Indentation Resistance	Indentation Depth μm	Minimum Coating Thick- ness for Which a Measurement is Valid μm
0.8	125	5	15
0.85	118	6	20
0.9	111	7	20
0.95	105	7	20
1.0	100	8	20
1.05	95	9	20
1.1	91	10	20
1.15	87	11	25
1.2	83	12	25
1.3	77	14	25
1.4	71	16	30
1.5	67	18	30
1.6	63	21	35
1.7	59	24	35

4. Pencil Hardness Test

4.0 Outline of the Method — This method is primarily intended for use in the production shop and as such test panels are not normally used.

4.1 Apparatus — Range from 2B to 6H of high quality drawing pencils in accordance with IS : 1375-1981 'Specification for black lead pencils (first revision)'.

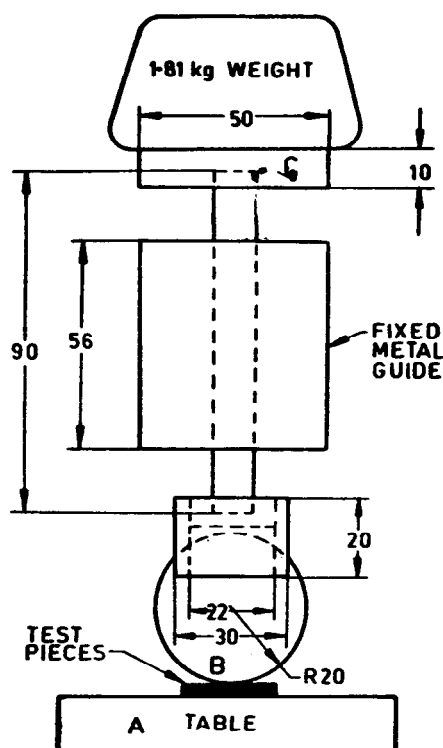
4.2 Procedure — The pencils shall be sharpened to a point with a pencil sharpener. The softest pencil shall be held normal to the paint film to be tested and pressed sufficiently to make the point crumble. Without altering the pressure, the pencil is drawn across the paint film for a distance of 6 mm. This procedure shall be repeated with pencils of higher grades of hardness until the paint film is scratched or penetrated. The grade of hardness of the pencil used immediately before that which caused scratching or penetration shall be taken as the hardness of the paint film.

4.2.1 Carry out three tests and record the observations.

5. Pressure Test

5.0 Outline of the Method — In this test, two painted film after specified drying period, facing each other and in close contact, are tested under pressure.

5.1 Apparatus — A suitable apparatus for carrying out this test is illustrated in Fig. 8.



All dimensions in millimetres.

FIG. 8 APPARATUS FOR PRESSURE TEST (WEIGHT OF BALL AND MOVING PARTS 340 g APPROX)

5.2 Procedure — Apply a coat of the material, on a tinned panel 0.315 mm thick (or 30 SWG) prepared as described in IS : 101 (Part 1/Sec 3)-1986 to give a dry film weight commensurate with the weight per 10 litres of the material as specified in IS : 101 (Part 1/Sec 7)-1986 'Methods of sampling and test for paints, varnishes and related products: Part 1 Test on liquid paints (general and physical), Section 7 Mass per ten litres (*third revision*)'. Allow it to air-dry under laboratory conditions in a horizontal position for a period as specified in the material specification. At the end of the period, cut two test pieces approximately 20 mm², superimpose them so that the paint films are in close contact, and place on the metal table A. Lower the steel ball B and plunger C to the centre of the metal test pieces and place a 1.81 kg weight on top of the plunger. Maintain the pressure on the paint film for 5 minutes. At the end of this period, separate and examine the test pieces.

5.2.1 The metal surface shall not be rendered visible when two test pieces are separated after the test is carried out as prescribed in 5.2.

EXPLANATORY NOTE

This standard is one of a series of Indian Standards on methods of sampling and test for paints, varnishes and related products. Considerable assistance has been drawn from ISO 1578-1970 'Paints and varnishes — Scratch test', prepared by the International Organization for Standardization (ISO), BS : 3900 E9 'Methods of test for paints Part E-9 Buchholz indentation test', prepared by the British Standards Institution, London, and BSAU 148 Part 6 'Hardness', prepared by the British Standards Institution, London. This standard supersedes clause 15.2 of IS : 101-1964 'Methods of test for ready mixed paints and enamels (*second revision*)'.