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IS : 5807 (Part VI) - 1978

Indian Standard

METHODS OF TEST FOR
CLEAR FINISHES FOR WOODEN FURNITURE
PART VI RESISTANCE TO MECHANICAL DAMAGE

UDC 684.4.041 : 684.59 : 667.613 : 620.17



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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Price Rs 8.50

September 1978

*Indian Standard*METHODS OF TEST FOR
CLEAR FINISHES FOR WOODEN FURNITURE

PART VI RESISTANCE TO MECHANICAL DAMAGE

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Indian Standard

METHODS OF TEST FOR CLEAR FINISHES FOR WOODEN FURNITURE PART VI RESISTANCE TO MECHANICAL DAMAGE

0. FOREWORD

0.1 This Indian Standard (Part VI) was adopted by the Indian Standards Institution on 31 January 1978, after the draft finalized by the Painting, Varnishing and Allied Finishes Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The method is designed to test finishes for wooden furniture which will invariably suffer from mechanical knocks and scrapes. It provides a method for comparing different finishes or may be used, in conjunction with an approved sample, to check the standard of supplies.

0.3 In view of the diversity of woods and finishing systems used in the furniture industry it is quite impracticable to specify a uniform standard test substrate and method of preparation of the finishing system. This shall necessarily be the subject of agreement between the purchaser and the seller and this method seeks only to lay down a standard procedure for testing a wooden panel coated with the appropriate finishing system.

0.4 Correlation trials between laboratory testing of finishes and subjective assessment of their resistance to mechanical damage in use, have shown that no single mechanical test is sufficient to define the mechanical properties of a finish. These trials, however, showed that a composite test, based on three component tests with a rating system of assessing the results, followed by simple additive combination of the individual results, gave good agreement with performance in use.

0.5 Although the rating systems used are apparently objective, they still contain a large subjective component. Consequently, to cater for the inherent variability present when subjective decisions have to be made, not less than five observers are necessary for assessing the test results.

0.5.1 No attempt has been made to take into account the possibility of restoring the finish by subsequent remedial action.

0.6 This standard describes a method of test only and should not be used or quoted as a specification.

0.7 In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing

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in different countries in addition to relating it to the practices in the field in this country. This has been met by basing the standard on BS 3962 : Part 6 : 1975 Methods of test for clear finishes for wooden furniture : Part 6 Resistance to mechanical damage published by the British Standards Institution.

0.8 This standard is one of a series of Indian Standards on methods of test for clear finishes for wooden furniture. Other standards in the series are:

- IS : 5807 (Part I)-1975 Methods of test for clear finishes for wooden furniture : Part I Resistance to dry heat (*first revision*)
- IS : 5807 (Part II)-1975 Methods of test for clear finishes for wooden furniture : Part II Resistance to wet heat (*first revision*)
- IS : 5807 (Part III)-1971 Methods of test for clear finishes for wooden furniture : Part III Resistance to marking by oils and fats
- IS : 5807 (Part IV)-1975 Methods of test for clear finishes for wooden furniture : Part IV Resistance to marking by liquids
- IS : 5807 (Part V)-1975 Methods of test for clear finishes for wooden furniture : Part V Test for low-angle glare

0.9 In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

0.10 This standard contains clauses **3.2** and **3.3** which call for an agreement between the purchaser and the seller.

1. SCOPE

1.1 This standard (Part VI) lays down the composite method of test, based on three independent tests, for assessing the resistance of a wood finishing system to damage as a result of mechanical action.

1.2 The composite test may be used either as a means of comparing a number of finishing systems or as control test to ensure that a consistent quality of supplies is being maintained.

2. PRINCIPLE

2.1 Impact Test — A standard steel ball is dropped from a specified height on to the test panel. The damage to the finish, in and around the indentation is assessed by not less than five observers by reference to a descriptive numerical rating code.

*Rules for rounding off numerical values (*revised*).

2.2 Cross-Cut Test — A lattice pattern consisting of two sets of cuts at right angles, each set consisting of 11 parallel cuts 2 mm apart, is made on the test panel using a standard sharp implement. Loose pieces of finish are removed with a soft brush. The test area is assessed by not less than five observers by reference to a descriptive and illustrative numerical rating code.

2.3 Scrape Test — A standard scraper blade is drawn over the test surface, across the grain, at a constant speed under a gradually increasing force. The forces acting upon the scraper blade, at the points at which it first penetrates the surface and at which it penetrates to the substrate, are measured and a numerical rating is given according to these forces. The result of the test is assessed by not less than five observers.

2.4 Method of Assessment — A rating for each of the three component tests is obtained. An overall assessment is then obtained from these ratings.

3. PREPARATION OF TEST SURFACE

3.1 The test panel shall be at least $400 \times 100 \times 10$ mm with the 400 mm dimension across the grain. The panel shall be substantially flat.

3.2 The full finishing system shall be applied by the appropriate method of application to an agreed wooden substrate suitably prepared and complying with the dimensions given in 3.1. The application rates of the individual coats of material, the drying periods and conditions and the surface preparation between coats, for example, sanding, shall be those agreed between the purchaser and the seller.

3.3 The final coat shall be allowed to age at a room temperature of not less than 15°C with free access of air for an agreed period before test. The period shall be not less than 28 days except for special purposes; in these cases the period shall be agreed between the purchaser and the seller.

4. TEST PROCEDURE

4.1 General — Three separate tests shall be carried out, namely the impact test, cross-cut test and the scrape test. Each of the three tests shall be carried out at not less than 2 positions so situated that they do not lie on the same grain structure. The tests shall be carried out at a temperature of $27 \pm 2^{\circ}\text{C}$.

4.2 Impact Test

4.2.1 Apparatus

4.2.1.1 Steel ball — A steel ball bearing diameter of 19.05 mm and of mass 28.1 ± 0.1 g.

4.2.1.2 Viewing light — Consisting of a source of direct light. A 60 W frosted bulb in an adjustable desk lamp is suitable.

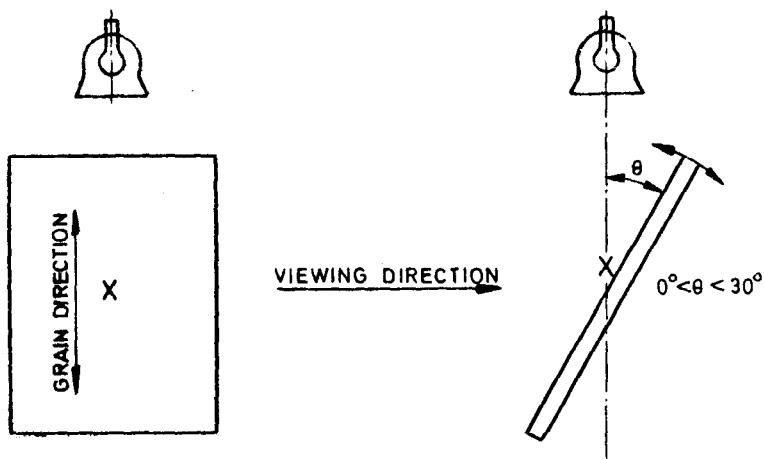
4.2.1.3 Viewing lens — A portable lens with a magnification of $\times 2$ to $\times 3$.

4.2.2 Procedure

4.2.2.1 With the test panel held in a stable horizontal position on a firm base, drop the steel ball on to it from a height 2.00 ± 0.01 m taking suitable measures to prevent multiple impacts of the ball.

4.2.2.2 Carefully examine the test area using the following procedure.

Place the light source at a convenient height shining vertically downward. Hold the panel vertically, directly under the light and as close to it as is convenient. The grain of the surface veneer shall also be vertical. Keeping the test area directly under the light, rock the panel such that the angle between the direction of the light and the plane of the panel varies between 0° and 30° (see Fig. 1). During this rocking movement examine the test area using the lens. Turn the test face of the panel through 180° and repeat the procedure. Assess the general appearance of the panel according to **4.2.3**.



X - TEST AREA

FIG. 1 METHOD OF VIEWING TEST AREA

4.2.3 Assessment of Results — Rate the test area according to the following code :

<i>Appearance of Test Area (see Note 1)</i>	<i>Rating</i>
a) No surface cracking	4
b) Slight cracking, for example, 1 or 2 circular cracks around the edge of the indentation (<i>see</i> Note 2)	3
c) Moderate or severe cracking confined to the area of the indentation (<i>see</i> Note 3)	2
d) Cracking extending outside the area of the indentation and/or slight flaking of the finish	1
e) More than 25 percent of finish removed from the area of the indentation	0

NOTE 1 — The assessment is to be made on the damage incurred by the finish and mechanical deformation of the substrate is not to be considered as damage.

NOTE 2 — The cracks need not be complete circles but may be arcs which will generally tend to be across the grain. In this case the number of cracks is taken as the number of arcs on one side of the indentation, for example, the number of broken circles. Using this criterion the number of cracks stated in the definition shall be treated literally.

NOTE 3 — Some discretion shall be shown when deciding whether cracks are outside the area of the indentation as this area is not always well defined. In general, these failures fall within a well defined radius.

4.3 Cross-Cut Test

4.3.1 Apparatus

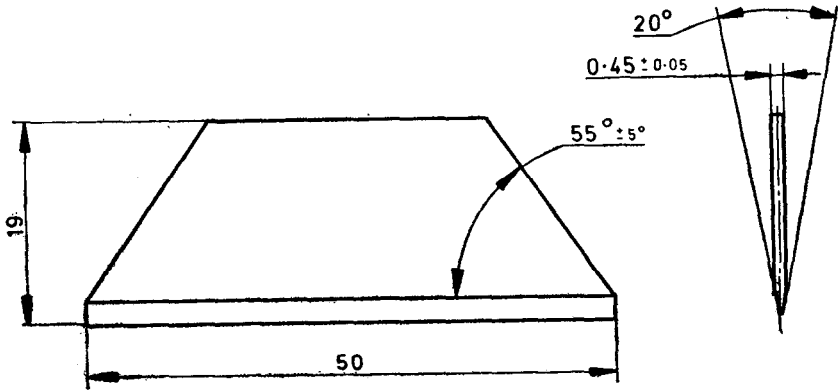
4.3.1.1 Cutting blade — A steel cutting blade 0.45 ± 0.05 mm thick with double bevelled cutting edge. The bevels are angled at approximately 10° to the blade faces and the side of the blade makes an angle of $55 \pm 5^\circ$ with the cutting edge (Fig. 2).

4.3.1.2 Template — A metal template to produce a grid consisting of 11 cuts 2 mm apart. A suitable design, illustrated in Fig. 3, consists of two Parts; Part 2 fits into Part 1 in two different positions so that groups of cuts can be made at right angles to each other.

4.3.1.3 Blade holder — A metal blade holder to hold the cutting blade in such a way that, when used with the template, the depth of cut is constant. A suitable design is given in Fig. 4.

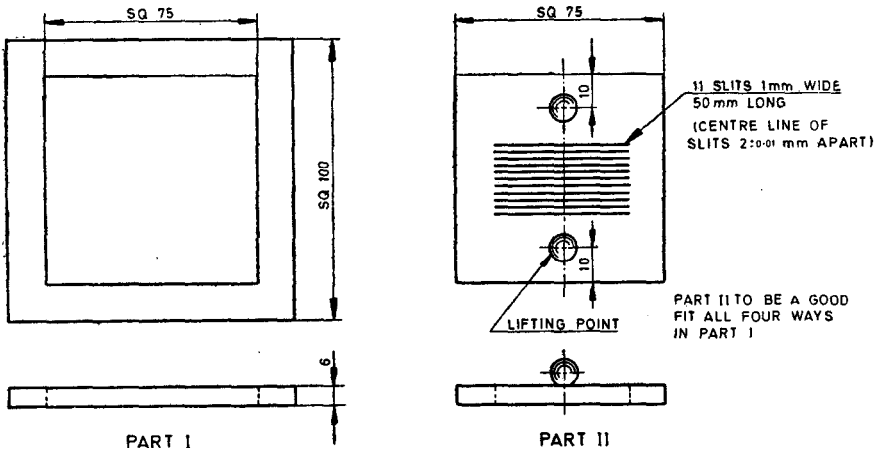
4.3.1.4 A soft brush

4.3.1.5 Viewing lens — A portable lens with a magnification of $\times 2$ to $\times 3$.



All dimensions in millimetres.

FIG. 2 DETAILS OF CUTTING BLADE



All dimensions in millimetres.

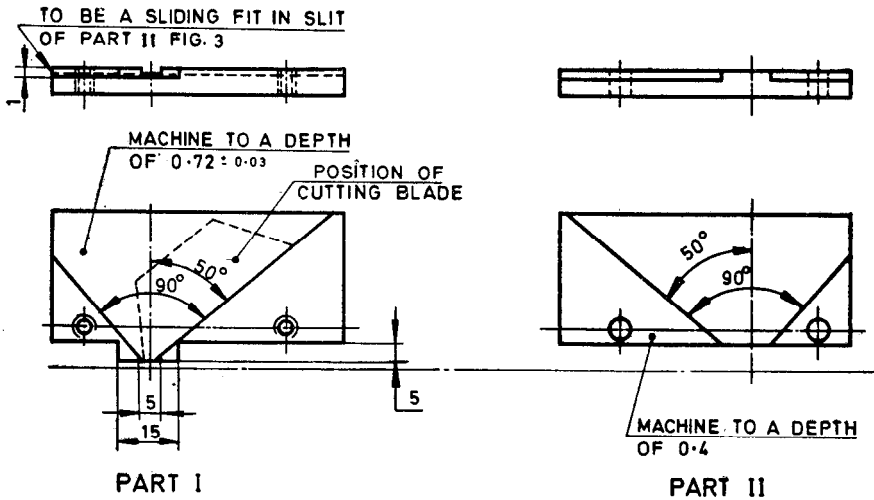
FIG. 3 DETAILS OF SUITABLE TEMPLATE

4.3.1.6 Viewing light — consisting of a source of direct light. A 60 W frosted bulb in an adjustable desk lamp is suitable.

4.3.2 Procedure

4.3.2.1 Fix the cutting blade in the blade holder such that, when used with the template, the depth of cut shall be 0.3 mm.

NOTE — This depth of cut is sufficient to penetrate most finishes without giving excessive penetration of the substrate. The major exceptions are some polyester finishes. In these cases the excessive force required to cut through the film makes the test impracticable.



All dimensions in millimetres.

FIG. 4 DETAILS OF SUITABLE BLADE HOLDER

4.3.2.2 With the cutting edge of the blade in the holder facing the direction of movement, make a lattice pattern on the surface of the test panel using the template. The lattice pattern shall consist of two sets, at right angles, of 11 singly applied cuts approximately 35 mm long with a separation of 2 mm. The direction of the component cuts shall be at approximately 45° to the grain direction of the test panel surface.

4.3.2.3 Brush the test area lightly with the soft brush five times backwards and five times forwards along both diagonals of the lattice pattern.

4.3.2.4 Carefully examine the test area in a good light using the magnifying lens. During the viewing process rotate the panels so that viewing and lighting of the test area is not confined to one direction only.

4.3.3 Inspect the cutting corner of the blade frequently and when signs of wear or chipping are visible insert a new blade.

4.3.4 *Assessment of Results* — Rate the test area according to the following code:

Appearance of Test Area

Rating

- a) Cuts are smooth, no finish removed, except for small chips at the intersections of the cuts and an occasional small chip along the cut

4

<i>Appearance of Test Area</i>	<i>Rating</i>
b) Finish removed at intersections and intermittently along the cuts	3
c) Finish consistently removed along the cuts	2
d) Finish removed along the cuts and completely from one or more of the squares, but from less than 50 percent of them	1
e) Finish removed completely from more than 50 percent of the squares	0

4.4 Scrape Test

4.4.1 Apparatus — The apparatus shall consist of a machine (Fig. 5) capable of drawing a standard scraper blade, as detailed in Fig. 6, over the test panel under a force varying from 4 N to 25 N over a distance of approximately 200 mm at a constant speed of 20 ± 5 mm/s.

4.4.1.1 The scraper blade shall be fixed in a blade holder (Fig. 7) so designed that the angle of the blade can be varied but locked at the required angle. At the same time the blade holder can be placed on, or removed from, the scrape head (Fig. 8) without disturbing the setting of the blade. This facility is necessary for calibration purposes.

4.4.1.2 The table shall be horizontal and its height shall be adjustable. A reference bar fixed parallel with the scrape head support arm shall be fitted.

4.4.2 Calibration of Scraper Blade

4.4.2.1 Each testing station requires a station standard blade calibrated against the master standard blade and a working reference blade calibrated against the station standard blade. Each of these blades requires its own blade holder in which it is kept permanently. A third blade and holder, known as the working blade, shall be used for all testing. References to a blade in the remainder of this standard imply a blade in its holder.

4.4.2.2 The working blade shall be calibrated at regular intervals against the working reference blade to determine the required angle of the blade to the test surface. This angle will change slowly as the edge blunts with use.

4.4.2.3 Calibration shall be carried out by placing the relevant working reference blade on the machine and applying a scrape to any suitable finished wooden panel using the test procedure described in **4.4.3**. The reference blade shall be replaced by the blade to be calibrated and the panel again scraped. The angle of the blade shall be adjusted until the measured forces at failure agree with those obtained using the reference blade. The blade shall be firmly clamped in this position.

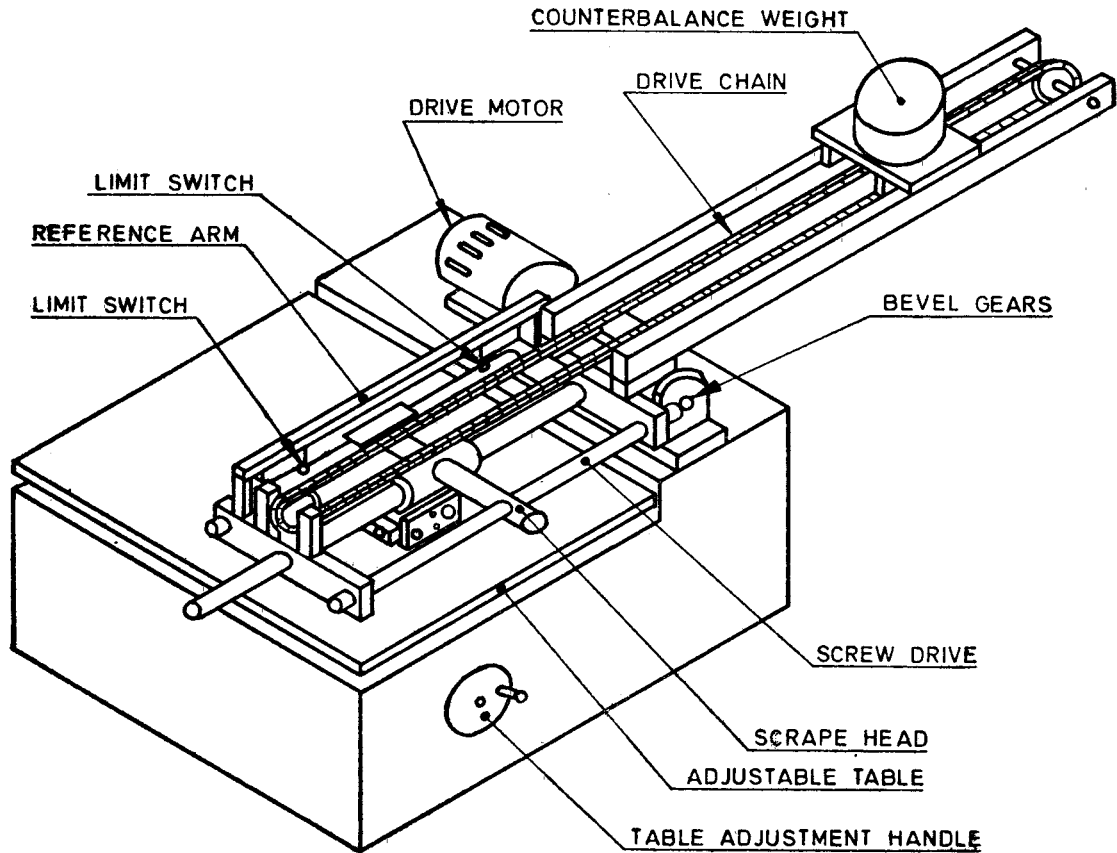
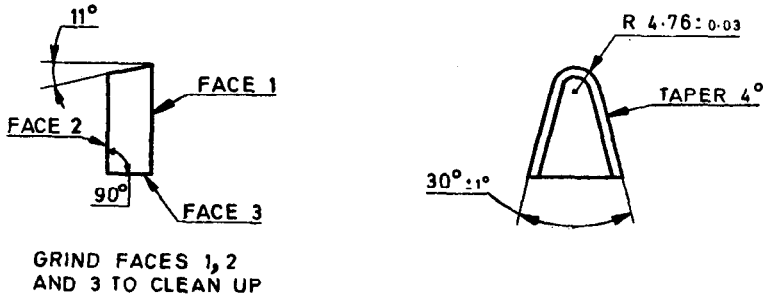


FIG. 5 GENERAL LAYOUT OF SCRAPE TEST MACHINE



All dimensions in millimetres.

FIG. 6 DETAILS OF SCRAPER BLADE

4.4.2.4 Should the edge of the working blade become damaged, or worn to such a degree that the required angle is outside the range of the equipment, the working reference blade shall be used as the working blade and a new blade, calibrated against the station standard blade shall be used as the working reference blade.

4.4.3 Procedure

4.4.3.1 Place the test panel on the machine table such that the direction of the scrape is across the grain. With the scraper blade resting on the panel; adjust the height of the table until the reference arm is horizontal. The angle of the blade to the test surface is now the required angle and this angle should remain constant over the length of the scrape.

4.4.3.2 Draw the blade over the test panel commencing with the lowest force, after ensuring that the blade and the panel are free from particles, or debris from previous tests, which could become lodged under the blade to give a false result.

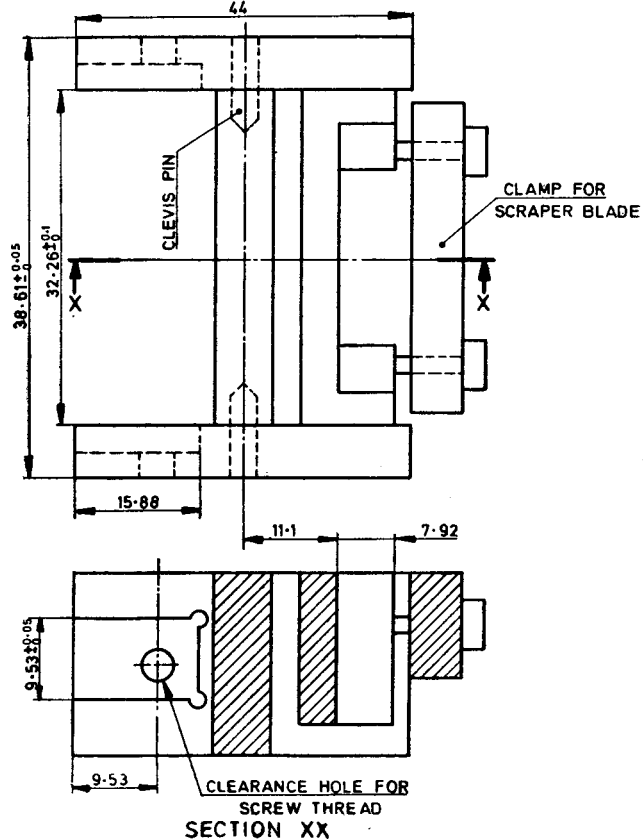
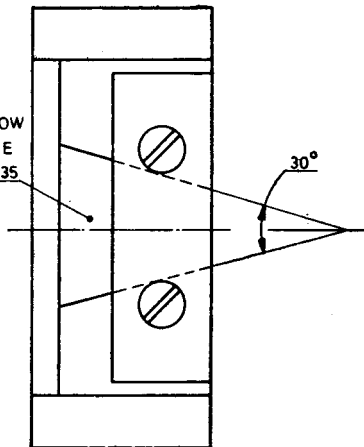
4.4.3.3 Carefully examine the scrape in good direct lighting (a 60 W frosted bulb in a desk lamp is suitable), and note the positions at which the blade first penetrates the surface of the finish and completely penetrates the finish to reveal the substrate.

NOTE— The surface will often be marked before the surface of the finish is penetrated.

4.4.3.4 Determine the force on the blade at these points, either by direct measurement or from a previously determined calibration.

4.4.3.5 Note any other observations, for example, the nature of the failure could indicate poor intercoat or finish to substrate adhesion.

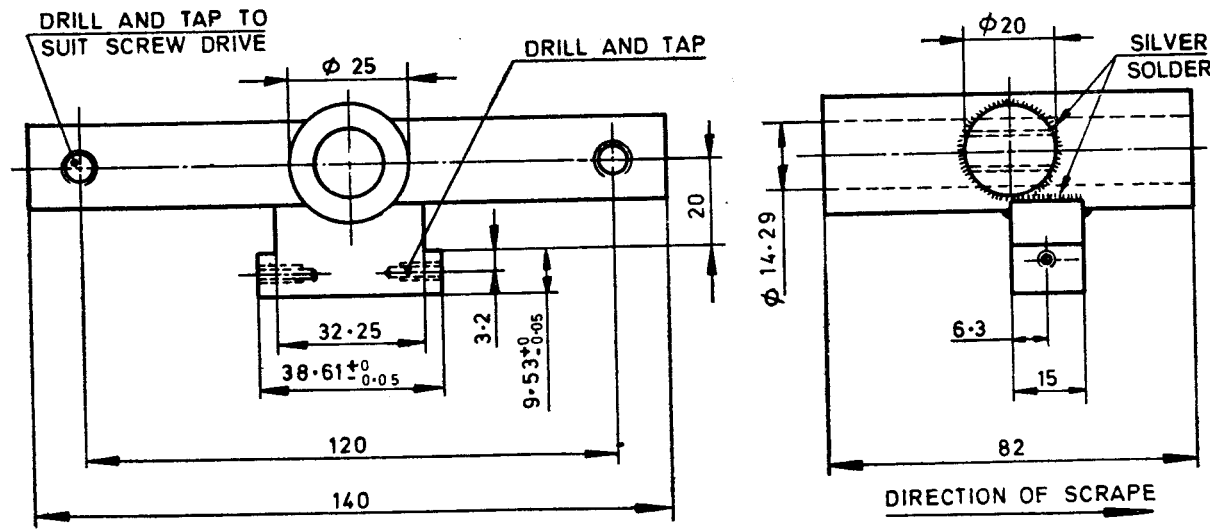
RECESS TO ALLOW
SCRAPER BLADE
TO PROJECT 6.35



All dimensions in millimetres.

All dimensions are ± 0.1 mm unless otherwise stated.

FIG. 7 DETAILS OF SCRAPER BLADE HOLDER



All dimensions in millimetres.

All dimensions are ± 0.1 mm unless otherwise stated.

FIG. 8 DETAILS OF SCRAPE HEAD

4.4.4 Assessment of Results

4.4.4.1 General — The scrape resistance of a finish is basically the force required to produce a surface scrape, namely, surface penetration. Other properties, for example, toughness, brittleness, adhesion, have an important effect upon the behaviour of the finish after surface penetration and consequently affect the additional force required to penetrate through the finish film. To take all these factors into account a basic rating is determined from the force at surface penetration, which is then modified taking into account the force required to penetrate the finish film.

4.4.4.2 Basic Rating — The basic rating shall be obtained from the force required to penetrate the surface according to the following table:

<i>Force at Surface Penetration</i>	<i>Rating</i>
a) Equal to, or greater than 14 N	4
b) Less than 14 N but equal to, or greater than 9 N	3
c) Less than 9 N but equal to, or greater than 6 N	2
d) Less than 6 N but equal to, or greater than 4 N	1
e) Less than 4 N	0

4.4.4.3 Modified rating — A modifying factor shall be obtained by inserting the measured forces in the following formula:

$$\frac{\text{Force at penetration to substrate (N)} - \text{Force at surface penetration (N)}}{\text{Force at surface penetration (N)}}$$

The value of this factor shall be determined to one decimal place and shall be limited to a value of 4; any result greater than this value shall be given the value 4. The modified rating shall be obtained by the addition of the basic rating and the modifying factor.

5. DETERMINATION, REPORTING AND ASSESSMENT OF RESULTS

5.1 Determination of Ratings

5.1.1 Impact rating — Each test area shall be rated according to the code given in 4.2.3 by at least five observers. Intermediate ratings, for example, 3-2 or $2\frac{1}{2}$, shall not be used. The impact rating shall be the largest rating value which is equalled or exceeded by the majority of observers, for example,

Individual ratings : 1, 2, 3, 3, 3 : impact rating : 3

Individual ratings : 1, 2, 2, 3, 3 : impact rating : 2

5.1.1.1 If the impact ratings for the individual test areas differ by more than one unit, the test shall be repeated on a further two areas. If those test results again differ by more than one unit, abnormal variation over the panel is indicated and shall be reported.

5.1.2 Cross-Cut Rating — Each test area shall be rated according to the code given in 4.3.4 by at least five observers. Intermediate ratings, for example, 3-2 or $2\frac{1}{2}$, shall not be used. The cross-cut rating shall be the largest rating value which is equalled or exceeded by the majority of observers, for example,

Individual ratings : 1, 2, 3, 3, 3 : cross-cut rating : 3

Individual ratings : 1, 2, 2, 3, 3 : cross-cut rating : 2

5.1.2.1 If the cross-cut ratings for the individual test areas differ by more than one unit, the test shall be repeated on a further two areas. If these test results again differ by more than one unit, abnormal variation over the panel is indicated and shall be reported.

5.1.3 Scrape Rating — The forces at surface penetration and penetration to substrate shall be measured and converted to the modified rating as described in 4.4.4 by at least five observers. No marks should be made on the test panels which might influence the decision of subsequent observers.

5.1.3.1 For each test the largest measured modified rating value equalled or exceeded by the majority of observers shall be recorded as the scrape rating together with the average of the forces at surface penetration and the average of the forces at penetration to substrate, for example,

Individual modified ratings : 2.0, 1.8, 1.7, 2.6, 1.5; scrape rating : 1.8

Average force at surface penetration : 5.4 N

Average force at penetration to substrate : 9.7 N

5.1.4 Overall Rating — Sum the three separate average ratings derived in accordance with 5.1.1, 5.1.2 and 5.1.3.

5.2 Reporting of Results

5.2.1 Report the following:

- a) The average impact rating for all test areas and any abnormality of results;
- b) The average cross-cut rating for all test areas and any abnormality of results;
- c) The average scrape rating for all test areas, with the average force at surface penetration and the average force at penetration to substrate; and
- d) The overall rating.

5.2.2 In the case of ageing periods of other than 28 days (*see 3.3*) report the period used and the reasons, if known for selecting it.

5.3 Assessment of Results — It is recommended that a finishing system should only be assessed as acceptable if it satisfies all the following requirements:

- a) The average impact rating is greater than 2,
- b) The average cross-cut rating is greater than 2,
- c) The average scrape rating is at least 1·0, and
- d) The overall rating is at least 7.

INDIAN STANDARDS

ON

PAINTING, VARNISHING AND ALLIED FINISHES

IS:

- 1477 (Part I)-1971 Code of practice for painting of ferrous metals in buildings : Part I
Pretreatment (*first revision*)
- 1477 (Part II)-1971 Code of practice for painting of ferrous metals in buildings : Part II
Painting (*first revision*)
- SP : 1650-1973 Standard colours for building and decorative finishes (*first revision*)
- 2338 (Part I)-1967 Code of practice for finishing of wood and wood based materials : Part I
Operations and workmanship
- 2338 (Part II)-1967 Code of practice for finishing of wood and wood based materials :
Part II Schedules
- 2395 (Part I)-1966 Code of practice for painting concrete, masonry and plaster surfaces :
Part I Operations and workmanship
- 2395 (Part II)-1967 Code of practice for painting concrete, masonry and plaster surfaces :
Part II Schedules
- 2524 (Part I)-1968 Code of practice for painting of non-ferrous metals in buildings : Part I
Pretreatment
- 2524 (Part II)-1968 Code of practice for painting of non-ferrous metals in buildings : Part II
Painting
- 3140-1965 Code of practice for painting asbestos cement building products
- 4597-1968 Code of practice for finishing of wood and wood based products with nitrocellulose
and cold catalysed materials
- 5807 (Part I)-1975 Methods of test for clear finishes for wooden furniture : Part I Resistance
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