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METHODS OF TEST FOR VULCANIZED RUBBERS

PART II HARDNESS

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Indian Standard

METHODS OF TEST FOR VULCANIZED RUBBERS

PART II HARDNESS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 27 November 1965, after the draft finalized by the Rubber Products Sectional Committee had been approved by the Chemical Division Council.

0.2 The need for Indian Standards on the test methods for the determination of physical properties of rubber and rubber products has been felt since quite a long time. This standard is expected to furnish the rubber industry with standard procedures and terminology in the testing field.

0.3 This standard is substantially based on ISO/DR 742 ' Determination of hardness of vulcanized natural and synthetic rubbers ' issued by the International Organization for Standardization. Standards of other countries have also been freely drawn upon.

0.4 In reporting the result 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*.

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1. SCOPE

1.1 This standard prescribes the method for determining the hardness of vulcanized rubber and rubber-like materials in International Rubber Hardness Degrees.

1.1.1 This standard is not applicable to the testing of materials ordinarily classified as ebonite or hard rubber, latex films, or sponge, or cellular rubbers.

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

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Stress — The average load per unit area of the original cross-section.

2.2 Strain — The alteration of the shape or dimension resulting from stress, this alteration being expressed as a fraction of the original shape or dimension.

2.3 Young's Modulus — The ratio of either linear compressive stress to linear compressive strain, or tensile stress to tensile strain, when the strain is very small.

3. PRINCIPLE OF THE METHOD

3.1 The International Standard Hardness test is based on measurement of the indentation of a rigid ball into the rubber specimen under specified conditions. The measured indentation is converted into International Rubber Hardness Degrees, the scale being so chosen that zero represents a material having an elastic modulus zero and 100 represents a material of infinite elastic modulus, and that the following conditions are fulfilled over most of the normal range of hardness:

a) One International Rubber Hardness Degree always represents approximately the same proportionate difference in Young's modulus.

b) Readings in International Rubber Hardness Degrees are approximately the same as those of the Shore Durometer Type A. The relation is presented in Table 1.

TABLE 1 RELATION BETWEEN INTERNATIONAL AND SHORE RUBBER HARDNESS DEGREES

	Hardness Degrees							
Shore A	30·0	40·0	50·0	60·0	70·0	80·0	90·0	100·0
IRHD	28·9	39·5	50·0	60·5	70·0	80·0	89·5	100·0

within 2°C of the desired value. The foot and vertical plunger extend through the top of the chamber and the portion passing through the top is constructed from a material having a low thermal conductivity. A sensing device is located within the chamber near or at the location of the test piece for measuring the temperature.

4.1.1 The dimensions of parts of the apparatus and the loads are given in Table 3.

TABLE 3 DIMENSIONS OF APPARATUS AND LOADS

[*Clause* 4.1 (c) *and* 4.1.1]

Part of Apparatus	Diameter mm	Loads on Ball			Load on Foot gf
		Contact gf	Indenting gf	Total gf	
Ball	2·38 ± 0·01	30 ± 2	534 ± 1	564 ± 3	850 ± 150
Foot	20 ± 1				
Hole	6 ± 1				
	OR				
Ball	2·50 ± 0·01	30 ± 2	550 ± 1	580 ± 3	850 ± 150
Foot	20 ± 1				
Hole	6 ± 1				

5. TEST PIECE

5.1 The test piece shall have its upper and lower surfaces flat, smooth and parallel to one another; two pieces of rubber (but not more than two) may be superposed to obtain the necessary thickness.

5.2 The standard test piece shall be 8 to 10 mm thick. The lateral dimensions of test piece shall not be less than 20 mm and no test shall be made at a distance from the edge of the test piece less than the appropriate distance shown in Table 4.

5.3 Non-standard test pieces may be thicker or thinner than the standard but in no case it shall be less than 4 mm thick. The lateral dimensions of test pieces shall not be less than 20 mm and such that no test be made at a distance from the edge less than the appropriate distance shown in Table 4.

5.4 Tests intended to be comparable shall be made on test pieces of the same thickness.

6. PROCEDURE

6.1 Preparation of Sample

6.1.0 This method is applicable only where moulded sheet is not made available.

TABLE 4 MINIMUM DISTANCE FROM POINT OF IMPACT TO EDGE OF TEST PIECE WITH RESPECT TO ITS TOTAL THICKNESS

(*Clauses* 5.2 *and* 5.3)

TOTAL THICKNESS OF TEST PIECE	MINIMUM DISTANCE FROM POINT OF IMPACT TO EDGE OF TEST PIECE
mm	mm
4	7·0
5	7·5
8	9·0
10	10·0
15	11·5
25	12·5

6.1.1 If fabric is attached to or embedded in the rubber sample, remove the same before cutting the test pieces. In the method of removal, preferably avoid the use of swelling liquid, but benzene, chloroform or carbon tetrachloride may be used to wet the contacting surface, if necessary. Take proper care to avoid stretching of the rubber during the separation from the fabric, and if swelling liquid is used, allow the same to evaporate completely from the rubber surfaces after separation. Make the cloth marked surfaces smooth by buffing and also buff as necessary a rubber sample, which is of uneven thickness, or of thickness above the maximum specified for the test pieces which are to be cut from it.

6.1.2 In abrasive wheel 150 mm in diameter and rotating at about 1 400 revolutions per minute, or a machine driving an endless band of abrasive cloth, is suitable for buffing. In either case, use a fine abrasive (No. 60 or 80 grit) for the final buffing and avoid undue heating of the rubber.

NOTE — The surfaces produced by this buffing treatment lead to slightly different values for hardness from those with a smooth mould finish, the magnitud of the effect depending on the type of rubber.

6.2 Conditioning of Test Pieces and Samples

6.2.1 The properties of vulcanized rubbers change continually with time, these changes being particularly rapid during the first 24 hours after vulcanization. Therefore, do not carry out any test within this period; for accurate comparisons between different rubbers, it may be necessary to ensure that these are tested at substantially the same interval after vulcanization. Protect samples and test pieces from light as completely as possible during the interval between vulcanization and testing.

6.2.2 Condition samples, after any preparation as necessary, at 27° ± 2°C for at least 12 hours before the test pieces are cut. Keep these test pieces at 27° ± 2°C until tested.

6.3 Temperature of Test — Carry out the test at 27° ± 2°C, unless otherwise specified.

6.4 Method of Measurement

6.4.1 Dust the upper and lower surfaces of the test piece slightly with talc and support the test piece on a horizontal rigid surface. Lower the foot first so as to rest on the surface of the test piece. Press the plunger and indenting ball for five seconds vertically on to the rubber, the load on the ball being the contact load given in Table 3.

6.4.2 If the gauge is graduated directly in International Rubber Hardness Degrees, adjust it to read 100 (care being taken not to exert any vertical pressure on the gauge). Apply an additional indenting load and maintain on the ball indicator for 30 seconds. A direct reading of hardness in International Rubber Hardness Degrees is thereby obtained.

6.4.3 During the loading periods gently vibrate the apparatus to overcome any friction.

6.4.4 If the gauge is graduated in metric units, note the indentation *P* (in hundredths of a millimetre) of the plunger caused by applying the additional indenting load (Table 3) applied for 30 seconds and convert it into International Rubber Hardness Degrees by using Table 2 or the graph constructed therefrom.

6.5 Number of Readings — Make one measurement at each of four different points distributed over the test piece and determine the average of results.

7. REPORT

7.1 Report hardness as the nearest whole number and as the median of three or five measurements in International Rubber Hardness Degrees, stating the following additional data:

a) Dimensions and thickness of test pieces and whether made up of one or two pieces;

b) Temperature of test; and

c) Type of surface tested, that is, moulded or buffed or otherwise.

INDIAN STANDARDS

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