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ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION
R 1818

DETERMINATION OF HARDNESS
OF VULCANIZED RUBBERS OF LOW HARDNESS
(10 to 35 IRHD)

1st EDITION
January 1971

For each individual country the only valid standard is the national standard of that country.

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BRIEF HISTORY

The ISO Recommendation R 1818, *Determination of hardness of vulcanized rubbers of low hardness (10 to 35 IRHD)*, was drawn up by Technical Committee ISO/TC 45, *Rubber*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led to the adoption of Draft ISO Recommendation No. 1818, which was circulated to all the ISO Member Bodies for enquiry in March 1969. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	Hungary	Spain
Austria	India	Sweden
Brazil	Israel	Switzerland
Canada	Italy	Turkey
Ceylon	Netherlands	U.A.R.
Czechoslovakia	New Zealand	United Kingdom
France	Poland	U.S.S.R.
Germany	Romania	
Greece	South Africa, Rep. of	

The following Member Body opposed the approval of the Draft :

U.S.A.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

ISO Recommendation | R 1818 | January 1971

DETERMINATION OF HARDNESS
OF VULCANIZED RUBBERS OF LOW HARDNESS
(10 to 35 IRHD)

INTRODUCTION

The hardness test described in this ISO Recommendation is based on the measurement of the indentation of a rigid ball into the rubber test piece under specified conditions and is for use with rubbers in the lower end of the hardness scale specified in ISO Recommendation R 48*, *Determination of hardness of vulcanized rubbers*, that is, for rubbers of hardness of 10 to 35 international rubber hardness degrees (IRHD). For such rubbers it is desirable to decrease the indentation for a given hardness below that produced in the normal test so that the indentation produced in the softer rubbers is not excessive. For this purpose a larger indentor should be used than that required for the normal method of ISO Recommendation R 48, with the same indenting force.

The measured indentation is converted into international rubber hardness degrees (IRHD), the scale of degrees being so chosen that 0 represents the hardness of a material having an elasticity modulus of zero and 100 represents the hardness of a material of infinite elasticity modulus.

For substantially elastic isotropic materials like well vulcanized natural rubbers, the hardness in IRHD bears a known relation to Young's modulus, although for markedly plastic or anisotropic rubbers the relationship will be less precisely known.

This ISO Recommendation at present only gives details of a normal test method but a scaled down (micro-test) procedure may be added for use with thinner material as has been done in ISO Recommendation R 48.

* 2nd edition, 1968.

1. SCOPE

This ISO Recommendation describes a method of hardness testing for vulcanized rubbers with hardness in the range 10 to 35 IRHD.

The range of applicability of this and other ISO hardness test methods for vulcanized rubbers is indicated in Figure 1 :

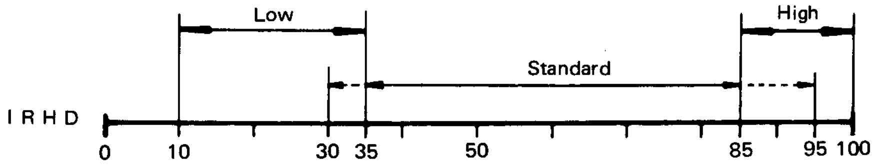

FIG. 1 – **Range of applicability of hardness tests**

2. PRINCIPLE

The hardness test consists in measuring the difference between the depths of indentation of the ball into the rubber under small contact force and a large total force. From this difference, the hardness in international rubber hardness degrees (IRHD) is derived by using either Table 3, or a graph based on this table, or a scale, reading directly in international rubber hardness degrees and derived from the table, fitted to the indentation-measuring instrument.

The relation between the difference of indentation and the hardness expressed in international rubber hardness degrees is based on

(1) the known relation, for a perfectly elastic isotropic material, between indentation P, expressed in hundredths of a millimetre, and Young's modulus M, expressed in meganewtons per square metre, namely :

$$\frac{F}{M} = 0.0038\,R^{0.65}\,P^{1.35}\,*$$

where

F is the indenting force, expressed in newtons;

R is the radius of the ball, expressed in millimetres;

(2) the use of a probit (integrated normal error) curve to relate $\log_{10}M$ to the hardness in international rubber hardness degrees; the relevant section of this curve is shown in Figure 2. This curve is defined by :

(*a*) the value of $\log_{10}M$ corresponding to the midpoint of the curve
= 0.364 (M being expressed in meganewtons per square metre);

(*b*) the maximum slope
= 57 international rubber hardness degrees per unit increase in $\log_{10}M$.

* This formula is approximate and is included as an indication.

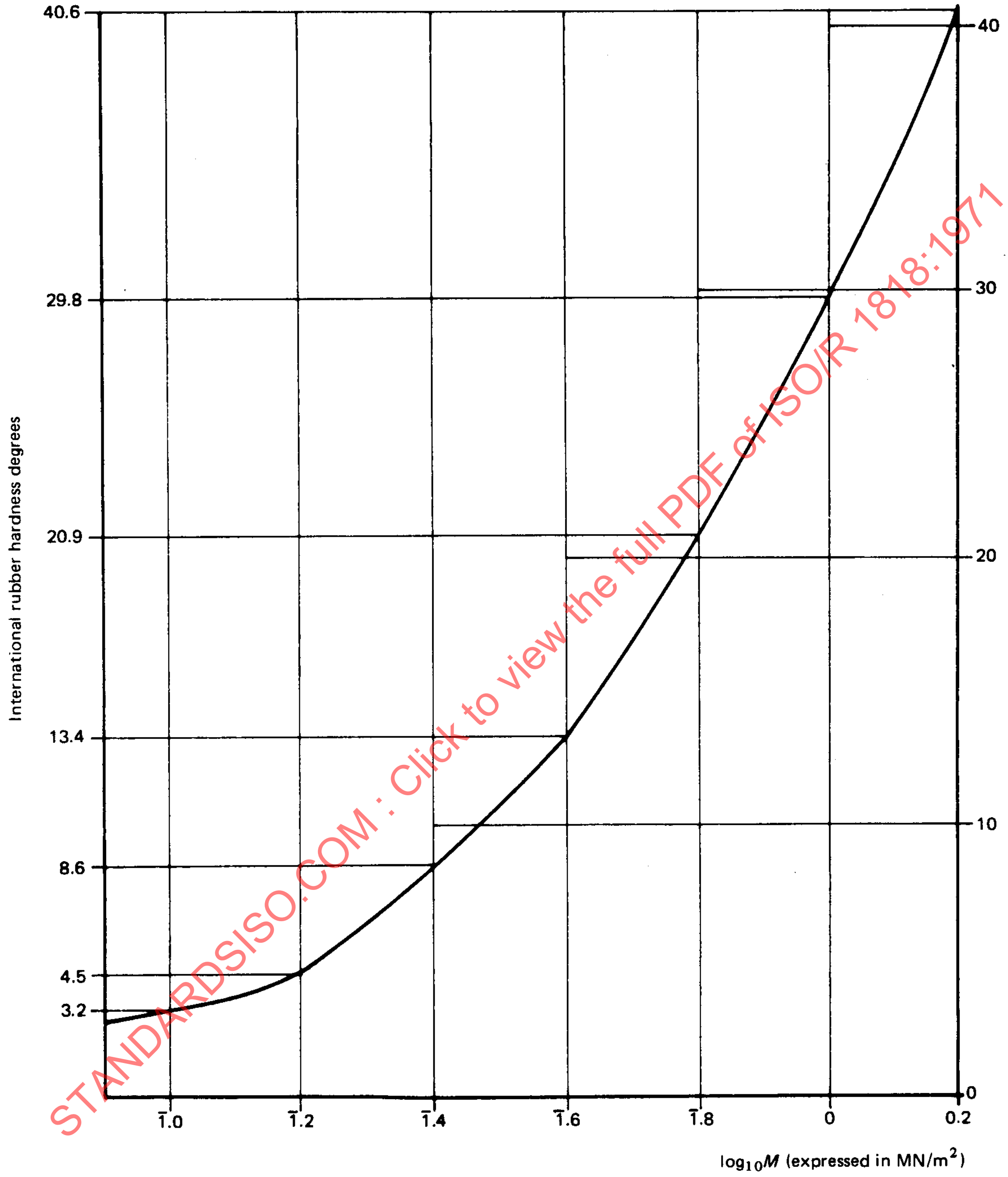

FIG. 2 – **Relation of $\log_{10}M$ to hardness in international rubber hardness degrees**

3. APPARATUS

The essential parts of the apparatus are as follows, the appropriate dimensions and forces being shown in Table 1 :

3.1 *Vertical plunger* having a rigid ball or spherical surface on the lower end, and means for supporting the plunger so that the spherical tip is kept above the surface of the annular foot prior to applying the contact force.

3.2 *Means for applying a contact force and an additional indenting force to the plunger*, making allowance for the weight of the plunger including any fittings attached to it and for the force of any spring acting on it, so that the forces actually transmitted through the spherical end of the plunger shall be as specified.

3.3 *Means for measuring the increase in depth of indentation of the plunger* caused by the indenting force either in metric units or reading directly in IRHD. The means employed may be mechanical, optical or electrical.

NOTE. – A dial having a travel of 4 mm per revolution is suggested.

3.4 *Flat annular foot* normal to the axis of the plunger and having a central hole for the passage of the plunger. The foot rests on the test piece and exerts a pressure on it of 30 ± 5 kN/m^2, provided the total load on the foot does not fall outside the values given in Table 1. The foot should be rigidly connected to the indentation-measuring device, so that a measurement is made of the movement of the plunger relative to the foot (i.e. the top surface of the test piece), not relative to the surface supporting the test piece.

3.5 *Means for gently vibrating the apparatus*, to overcome any slight friction, for example an electrically operated buzzer. This may be omitted in instruments where friction is completely eliminated.

3.6 *Chamber for the test piece* when tests are made at temperatures other than a standard laboratory temperature. This chamber should be equipped with a means of maintaining the temperature within 2 °C of the desired value. The foot and vertical plunger should extend through the top of the chamber, and the portion passing through the top should be constructed from a material having a low thermal conductivity. A sensing device should be located within the chamber, near or at the location of the test piece, for measuring the temperature.

TABLE 1 – **Forces and dimensions of apparatus**

Diameters	Forces on ball			Force on foot
	Contact	Indenting	Total	
mm	N	N	N	N
Ball 5.00 ± 0.01 Foot 22 ± 2 Hole 10 ± 2	0.30 ± 0.02	5.40 ± 0.01	5.70 ± 0.03	8.3 ± 1.5

NOTE. – Not all possible combinations of dimensions and forces in Table 1 will meet the pressure requirements of clause 3.4.

4. TEST PIECE

The test piece should have its upper and lower surfaces flat, smooth and parallel to one another.

Tests intended to be comparable should be made on test pieces of substantially the same thickness.

To obtain the necessary thickness it is permissible to superimpose two pieces of rubber (but not more than two), provided these have flat parallel surfaces.

4.1 Normal test

The standard test piece should be 10 to 15 mm thick; non-standard test pieces may be either thicker or thinner but not normally less than 6 mm. The lateral dimensions of both standard and non-standard test pieces should be such that no test is made at a distance from the edge of the test piece less than the appropriate distance shown in Table 2.

TABLE 2 – Minimum distance of point of contact from edge

Total thickness of test piece	Minimum distance from point of contact to edge of test piece
mm	mm
6	8.0
8	9.0
10	10.0
15	11.5
25	13.0

5. TIME LAPSE BETWEEN VULCANIZATION AND TESTING

Unless otherwise specified for technical reasons the following requirements for time lapses should be observed.

5.1 For all test purposes the minimum time between vulcanization and testing should be 16 hours. In cases of arbitration the minimum time should be 72 hours.

5.2 For non-product tests the maximum time between vulcanization and testing should be 4 weeks and for evaluations intended to be comparable, the tests, as far as possible, should be carried out after the same time interval.

5.3 For product tests, whenever possible, the time between vulcanization and testing should not exceed 3 months. In other cases tests should be made within 2 months of the date of receipt by the customer of the product.

6. CONDITIONING OF TEST PIECES

6.1 When a test is made at a standard laboratory temperature, the test pieces should be maintained at the conditions of test for at least 3 hours immediately before testing.

6.2 When tests are made at higher or lower temperatures, the test pieces should be maintained at the conditions of test for a period of time sufficient to reach temperature equilibrium with the testing environment, or for the period of time required by the specification covering the material or product being tested, and then immediately tested.