

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 33 *withdrawn 1970*

DU PONT CONSTANT LOAD METHOD OF MEASURING ABRASION RESISTANCE OF VULCANIZED NATURAL AND SYNTHETIC RUBBERS

1st EDITION

Library / Bibliothèque
Do not remove / Ne pas enlever

COPYRIGHT RESERVED

The copyright of ISO Recommendations and ISO Standards belongs to ISO Member Bodies. Reproduction of these documents, in any country, may be authorized therefore only by the national standards organization of that country, being a member of ISO.

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

Printed in Switzerland

Also issued in French and Russian. Copies to be obtained through the national standards organizations.

BRIEF HISTORY

The ISO Recommendation R 33, *Du Pont Constant Load Method of Measuring Abrasion Resistance of Vulcanized Natural and Synthetic Rubbers*, was drawn up by the Technical Committee ISO/TC 45, *Rubber*, the Secretariat of which is held by the British Standards Institution (B.S.I.).

The draft proposal put forward by the Secretariat was considered and amended at the meetings held in London (1948), the Hague (1949), Akron (1950), Oxford (1951) and Paris (1953).

On 28 August 1954, the Draft ISO Recommendation proposed by the Technical Committee ISO/TC 45 was submitted to all ISO Member Bodies and approved, subject to certain editorial amendments, by the following 20 (out of a total of 34) Member Bodies:

Austria	Netherlands
*Canada	*New Zealand
Denmark	Pakistan
Finland	Portugal
India	Spain
*Ireland	Sweden
Israel	Union of South Africa
Italy	United Kingdom
Japan	*U.S.S.R.
*Mexico	Yugoslavia

One Member Body opposed the Draft:

U.S.A.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council which decided, in March 1957, to accept it as an ISO RECOMMENDATION.

* These Member Bodies stated that they had no objection to the Draft being approved.

Date of the first edition: April 1957.

DU PONT CONSTANT LOAD METHOD OF MEASURING ABRASION RESISTANCE OF VULCANIZED NATURAL AND SYNTHETIC RUBBERS

FOREWORD

The world-wide use of the *du Pont* constant load method of measuring abrasion resistance and the absence of a recognized method whose results correlate with wear in service justify the standardization of those features of the *du Pont* method on which agreement has been reached in the last three years.

Some improved methods, now used experimentally, may be internationally agreed upon in a few years' time. Meanwhile, there is much to be gained by standardizing the *du Pont* method as far as possible. Close relation between the test results and service performance is not, however, necessarily implied.

An alternative method of test, using very similar apparatus and procedure, but imposing constant torque on the sample-holder instead of constant load, will be considered for recommendation when further experimental evidence has been received.

1. STANDARD COMPARISON RUBBERS

According to the type of rubber to be tested, one of the following two standard rubber compounds is selected for comparison: either the high quality tyre tread type or the footwear sole and heel type.

A high standard of mixing technique should be employed in the preparation of these compounds, to ensure proper dispersion of the ingredients.

The compounds are:

"A" tyre tread type standard compound

Natural rubber first-grade smoked sheet	100
Zinc oxide	5
Stearic acid	3
E.P.C. black	50
Benzothiazyl disulphide	1
Sulphur	3
Phenyl-beta-naphthylamine	1

Vulcanization: 40 minutes at 144 °C.

"B" footwear sole and heel type standard compound

Natural rubber first-grade smoked sheet	100
Zinc oxide	4
Stearic acid	3
Di-(2-ethyl hexyl)phthalate	3
E.P.C. black	60
Whiting	60
Mercaptobenzothiazole	1
Sulphur	3
Phenyl-beta-naphthylamine	1

Vulcanization: 40 minutes at 153 °C.

2. TEST PIECE

Two test pieces are tested at the same time and compared with two test pieces of the appropriate standard rubber. The pieces should be either 2 cm \pm 0.05 cm or 0.8 inch \pm 0.02 inch square and approximately either 1 cm or 0.4 inch thick, with suitable lugs for fixing in the sample-holder.

If desired, a small sample 2 cm \times 2 cm \times 0.5 cm or 0.8 inch \times 0.8 inch \times 0.02 inch may be prepared from a finished product or cut out with dies from moulded sheet and attached by cold vulcanizing solution to the base portion of a worn down used test piece, for test purposes.

3. APPARATUS

A disc which carries an abrasive surface is mounted on a shaft and rotated at a uniform speed within the range from 34 r.p.m. to 40 r.p.m. The provision of a revolution counter is desirable.

The test pieces from the same compound are mounted, with their 2 cm or 0.8 inch square faces on the abrasive, on a bar, diametrically disposed across the disc so that the centre of each sample is either 6.25 cm or 2.5 inches from the centre of rotation.

The samples are held in contact with the abrasive by a force of either 3.62 kg or 8 lb weight by any suitable means free from friction and able to follow axial movement of the sample-holder as wear takes place. (If the abrasive disc is horizontal, dead weight can be used; if the abrasive disc is vertical, a wire led through a central hole in the shaft with a weight of either 3.62 kg or 8 lb attached at the rear can be used, as in the current design of the *du Pont* machine.)

A lever arm attached to the sample-holder is provided with means (weights and/or a spring balance) to restrain rotation and enable measurement of frictional torque to be made, if desired.

The abrasive is in the form of an annular disc of either 16.5 cm or 6.5 inches outside diameter with a central hole of either 7 cm or 2.75 inches in diameter for fixing the disc to the rotating member.

Silicon carbide abrasive grains mounted on stiff paper* have been found to be suitable and the paper backing should have the following characteristics:

- (a) the weight or paper substance should be at least 224 g/m² with a tolerance of ± 5 per cent;
- (b) the paper and the glue used to bond the abrasive grains should be waterproof so that a minimum of softening occurs under moist conditions.**

Papers should be capable of at least 6 hours useful life and should generally be discarded when the rate of weight loss from the standard compound has fallen by about 10 per cent, but not more, of the rate of loss at the first measuring after the running-in period (20-30 minutes—see clause 4). The rate of loss of cutting power is dependent on the compound being tested, high-grade carbon black compound causing much less loss of cut than lower-grade compounds containing whiting or hard mineral fillers.

The abrasive surface is continuously cleaned by means of air jets, directed on the working surface at two positions between the samples. The air supply is at a pressure of not less than either 1.75 kg/cm² or 25 lb/in² and free from oil or water.

On each side there is a set of jets radially disposed and consisting of three 1 mm or 0.04 inch holes, 6 mm or 0.25 inch apart, arranged to leave a space of about 6 mm or 0.25 inch between the jets and the surface of the abrasive.

(The addition of stiff bristle brushes, set at an angle to the track, is advantageous in some circumstances, but their use is optional.)

4. PROCEDURE

Preparation and conditioning of test pieces follows the general procedure adopted for all physical tests, as regards interval between vulcanization and testing, and conditions of storage.

Mounting of the test pieces in the holder is carried out without undue distortion of the abraded surface, but with no possibility of movement of the test piece on the bar or the sample-holder.

A running-in period to give even seating of the samples on the abrasive should be made without weighing, and in the case of a new abrasive disc, it is preferable to use the first 20 minutes for running-in samples, before weighed tests begin. Change of cutting power appears to be less rapid after this initial period.

Samples replaced for successive runs should be arranged to rub in the same direction on the abrasive.

Systematic reversal of order in a set of tests to overcome bias due to gradual change of abrasive cutting power or random distribution of test runs of pairs of test pieces should be employed.

* See Appendix on abrasive papers.

** It is not recommended that the test should be performed in a relative humidity greater than 90 per cent.

The duration of any one test is recorded in terms of revolutions of the abrasive rather than time.

It should be arranged that the duration of test is adjusted so that a roughly equal amount of rubber is abraded from each of the test rubbers and the standard. This is desirable, as there is some evidence for a systematic effect on the weight loss of the amount of sample projecting from the clamp bar.

A useful discarding point for the samples is when approximately 0.3 cm or 0.125 inch has been abraded away, that is, about half the projecting height above the clamp.

The volume losses are derived from the weight losses by dividing the latter by the density of the particular sample, determined by the usual weight in air and water method, either before commencing abrasion tests or on the remaining rubber after completing the tests.

The repetition of density determinations on duplicate samples from one batch may be dispensed with but is a useful check on uniformity and possible errors due to accidental confusion of a series of samples of similar appearance.

5. TEMPERATURE OF TEST

The test is carried out at a standard laboratory temperature.

6. EXPRESSION OF RESULTS

Results are expressed as a figure of merit or abrasion resistance index of which higher values denote better performance, derived as follows:

$$\text{Abrasion resistance index} = \frac{S}{T} \times 100$$

where S = volume loss, in millilitres per 1 000 revolutions of the abrasive, from the appropriate standard compound (which should be stated as either standard "A" or standard "B"),

and T = volume loss, in millilitres per 1 000 revolutions of the abrasive, from the test pieces of the sample rubber.

The values of S and T , as well as the type of abrasive used and the temperature of test, should be stated.

APPENDIX

NOTE ON ABRASIVE PAPERS FOR THE DU PONT TEST

This note has been added to serve as a guide in the choice of a suitable abrasive paper, in view of the difficulty of defining the paper in internationally acceptable terms.

1. The silicon carbide grain size is known commercially as 180, in the widely used system for specifying abrasive grains. The system is empirical, and no correlation exists between these numbers and the nominal apertures of the sieves expressed in microns.
2. We understand that many factors are involved in the control of manufacture of a satisfactory abrasive paper, which are difficult to define. These include the shape of the particles, their orientation on the paper, the density of deposition and the degree to which they are embedded in the glue or resin support.

It is necessary to refer at present to a commercial specification of a paper which has been found satisfactory:

Wetordry Tri-M-ite 180 E

from the Minnesota Mining and Manufacturing Company.

3. It has been found that there are variations between batches of paper of the same nominal characteristics, which are undesirable in a standardized test. To overcome this, the manufacturers have offered to make a large uniform batch with the desired characteristics and hold this at the disposal of laboratories wishing to undertake the ISO test.

The behaviour of subsequent supplies should be compared with that of the first supply.

Arrangements have been made for the supply of this material from the United Kingdom branch of Minnesota Mining and Manufacturing Company, Arden Road, Adderley Park, Birmingham 8. The paper should be referred to as *Special ISO Batch*, when ordering.

If a member country wishes to manufacture it locally, samples of the standard series of paper can be sent and may be reproduced at will by local laboratories.

By agreement between the parties, any other abrasive paper manufactured in any country may be used, provided its properties are sufficiently near to those of the *Special ISO Batch* for the test forming the basis of this Recommendation.

[STANDARDSISO.COM](https://standardsiso.com) : Click to view the full PDF of ISO/R 33:1957