IS 3660 (Part 12) : 1989

Indian Standard

METHODS OF TEST FOR NATURAL RUBBER

PART 12 DETERMINATION OF PLASTICITY RETENTION INDEX (PRI)

[NR : 13]

(First Revision)

भारतीय मानक

प्राकृतिक रबड़ को परीक्षण विधियाँ

भाग 12 प्लास्टिसिटी रिटेन्शन इंडेक्स

[एन आर : 13]

(पहला पुनरीक्षण)

UDC 678·4 : 539·214

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

February 1990

Price Group 2

Indian Standard

METHODS OF TEST FOR NATURAL RUBBER

PART 12 DETERMINATION OF PLASTICITY RETENTION INDEX (PRI)

[NR : 13]

(First Revision)

1 SCOPE

1.1 This standard (Part 12) prescribes a method for determination of plasticity retention index (PRI) of the raw natural rubber.

2 REFERENCES

2.1 The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
3660 (Part 1) : 1972	Methods of test for natural rubber : Part 1 Determination of ash, total copper, manganese, rubber hydrocarbon, viscosity (shearing disc viscometer), and mixing and vulcanizing of rubber in a standard compound (*first revision*) [*under revision* as 5660 (Part 16) (NR : 17)]
3660 (Part 11) : 1989	Methods of test for natural rubber : Part 11 Determination of plasticity (*first revision*)

3 OUTLINE OF THE METHOD

3.1 Plasticity of natural rubber test pieces before and after heating in an oven for 30·00 ± 0·25 minutes at 140°C is measured using parallel plate plastimeter with a platen 10 mm in diameter and following the procedure specified in IS 3660 (Part 11) : 1989 (NR : 12). The PRI is then calculated as the percentage ratio of plasticities before and after heating.

4 APPARATUS

4.1 Parallel Plate Plastimeter

With a platen 10 mm in diameter, and punch for preparation of test pieces, as specified in IS 3660 (Part 11) : 1989 (NR : 12).

4.2 Thickness Gauge

Having a scale graduated in unit divisions of 0·01 mm, fitted with a flat contact of diameter about 4 mm, and operating with a pressure of 20 ± 3 kPa.

4.3 Laboratory Mixing Mill

The laboratory mixing mill has two parallel and cylindrical hardened-steel rolls 152·5 ± 2·5 mm in outside diameter. The rolls are fitted with adjustable guides to allow a maximum working width of 255 ± 15 mm. The mill has provision for maintaining the temperature of the roll surfaces at 70 ± 5°C during the mixing of the rubber. The two rolls rotate at different speeds. The speed of the slow roll is 24 ± 2 rev/min and the friction ratio is 1 : 1·4.

a) If the mills having ratios of fast to slow rolls speed lower than 1·4 are used, modifications in the mixing conditions given under procedure may be required to obtain results comparable to those obtained with the standard mill.

b) The mill is designed to permit adjustment of the distance between the rolls from 0·2 mm or less to 3·0 mm or more.

4.4 Oven

Capable of the following performance at 140°C:

a) Control of temperature in the vicinity of the test pieces to be within ± 0·2°C over a 30 min period,

NOTE — A larger tolerance will impair the accuracy of test.

b) Allowing temperature recovery of the oven and the inserted tray and dishes to within 1°C of the set temperature in a time not exceeding two minutes after insertion of the tray in the oven, and

c) Changing the air ten times per hour.

NOTE — Ovens designed to achieve this performance are commercially available.

4.5 Light Weight Disposable Aluminium Dishes and Trays

Suitable dishes have a thickness of 0·2 mm and a diameter of 40 to 50 mm. Any dishes and

trays used shall have low thermal capacity; the total mass of tray and dishes shall not exceed 35 g, and their volume shall not exceed 5 percent of the volume of the oven chamber.

5 PROCEDURE

5.1 Test Piece

Homogenize the raw rubber as specified in **3** of IS 3660 (Part 1) : 1972. Take a test portion of about 30 g from the homogenized piece and pass three times (doubling the sheet between passes) between the rolls of the mill at ambient temperature, running with the nip adjusted so that the final sheet thickness is about 1·7 mm. Immediately double the sheet, which shall be uniform in texture and free from holes, and lightly press the two halves together by hand, avoiding the formation of air bubbles. Cut test pieces as specified in IS 3660 (Part 11) : 1989 (NR : 12) from the doubled sheet with the punch and measure their thicknesses with the gauge until six test pieces are obtained with thicknesses between 3·2 and 3·6 mm. Randomly divide these into sets of three, one set each for test before ageing and after ageing. The preparation of test pieces, as described above, shall be carried out with care since the PRI is affected by the sheet thickness. The required nip setting shall be ascertained by a preliminary trial; it may vary with the rubber and with the mill. If six test pieces of the required thicknesses as above are not obtained, a fresh doubled sheet shall be prepared.

5.2 Ageing

Before ageing is started, check that the temperature of the oven is remaining at 140·0 ± 0·2°C for at least five minutes. The aluminium trays for loading test pieces also may be preheated at this stage. While the trays are kept for preheating in the oven, tissue papers cut to the size of the bottom area of the trays may be kept in them. These papers are kept to prevent sticking of the rubber pieces to the trays while being aged.

NOTE — To ensure that all test pieces are aged at the correct temperature, the oven shall not be overloaded. This may cause a severe prolonged drop and may upset temperature uniformity.

5.2.1 The aluminium trays may be taken out and loaded with test pieces and quickly inserted back to the oven. Close the oven door and start timing. Care shall be taken to ensure that the dishes and trays are arranged within the calibrated region of the oven. Check that the correct temperature is quickly regained and retained.

5.2.2 After 30·00 ± 0·25 min, remove the tray from the oven and the dishes from the tray. Allow them to cool to ambient temperature.

5.3 Determination of Plasticity

Carry out the rapid plasticity determination as specified in IS 3660 (Part 11) : 1989 (NR : 12). These determinations shall normally be made at least 0·5 h and not more than 2 h after ageing, with the provison that the test pieces have been allowed to cool to ambient temperature. Plasticity determinations on unaged and aged test pieces shall preferably be made concurrently. The paper used shall conform to the requirements given in IS 3660 (Part 11) : 1989 (NR : 12) and the rapid plasticity number shall be read to the nearest 0·5 unit.

6 REPORTING OF RESULTS

6.1 The median values for the rapid plasticity numbers of three unaged and three aged test pieces shall be used to calculate the PRI using the formula:

$$\text{Plasticity retention index (PRI)} = \frac{\text{median aged rapid plasticity number}}{\text{median unaged rapid plasticity number}} \times 100$$

7 REPEATABILITY OF RESULTS

7.1 The coefficient of variation V is dependent on the accuracy of the ageing temperature. For PRI calculated as in **6** from the median plasticity values, V is 3 percent when ageing at 140·0 ± 0·2°C and ± 6 percent at 140 ± 1°C. Both values of V are consistent with an accuracy of ± 3 percent for single determination of rapid plasticity number.

8 TEST REPORT

8.1 The test report shall include the following particulars:

a) Reference to this standard,

b) Sample identification including lot and bales,

c) Median rapid plasticity number for unaged and aged test pieces from each sample tested,

d) PRI for each sample tested, and

e) Type of oven used.

ANNEX A

(*Foreword*)

TABLE SHOWING CORRESPONDENCE OF THE VARIOUS METHODS OF TEST COVERED IN THE EXISTING IS 3660 (PART 1) : 1972, IS 3660 (PART 2) : 1968, IS 3660 (PART 3) : 1971 AND IS 3660 (PART 4) : 1979 WITH THE REVISION/ PROPOSED REVISION OF THE FOUR PARTS OF IS 3660

Existing Test Methods			Proposed Revision		Remarks
Test Methods	IS No.	Part (Series)	IS No.	(Series)	
(1)	(2)	(3)	(4)	(5)	(6)
NR Series					
Determination of dirt	IS 3660 : 1972	Part 1 (NR : 1)	IS 3660 (Part 1) : 1985	(NR : 1)	
Determination of volatile matter	IS 3660 : 1972	Part 1 (NR : 2)	IS 3660 (Part 2) : 1985	(NR : 2)	
Determination of ash	IS 3660 : 1972	Part 1 (NR : 3)	IS 3660 (Part 3) : 1988	(NR : 3)	
Determination of total copper	IS 3660 : 1972	Part 1 (NR : 4)	IS 3660 (Part 4) : 1988	(NR : 4)	
Determination of manganese	IS 3660 : 1972	Part 1 (NR : 5)	IS 3660 (Part 5) : 1989	(NR : 5)	
Determination of iron	IS 3660 : 1972	Part 1 (NR : 6)	Deleted since this test is no longer being done		
Determination of rubber hydrocarbon	IS 3660 : 1972	Part 1 (NR : 7)	IS 3660 (Part 6) : 1988	(NR : 7)	
Determination of viscosity by shearing disk viscometer	IS 3660 : 1972	Part 1 (NR : 8)	IS 3660 (Part 7) : 1988	(NR : 8)	
Mixing and vulcanizing in a standard compound	IS 3660 : 1972	Part 1 (NR : 9)	IS 3660 (Part 8) :	(NR : 9)	Under revision
Determination of solvent extract	IS 3660 : 1968	Part 2 (NR : 10)	IS 3660 (Part 9) : 1989	(NR : 10)	
Determination of nitrogen content	IS 3660 : 1968	Part 2 (NR : 11)	IS 3660 (Part 10) :	(NR : 11)	
Determination of plasticity	IS 3660 : 1971	Part 3 (NR : 12)	IS 3660 (Part 11) : 1989	(NR : 12)	
Determination of plasticity retention index (PRI)	IS 3660 : 1971	Part 3 (NR : 13)	IS 3660 (Part 12) : 1989	(NR : 13)	
Determination of colour	IS 3660 : 1979	Part 4 (NR : 14)	IS 3660 (Part 13) :	(NR : 14)	Under revision
Determination of storage-hardening test	IS 3660 : 1979	Part 4 (NR : 15)	IS 3660 (Part 14) :	(NR : 15)	
Determination of vulcanization characteristics (MOD test)	IS 3660 : 1979	Part 4 (NR : 16)	IS 3660 (Part 15) :	(NR : 16)	
Method for preparation of test samples	IS 3660 : 1972	Part 1 (Clause 3)	IS 3660 (Part 16) :	(NR : 17)	