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Indian Standard

METHODS OF TEST FOR RUBBER LATEX

PART II DETERMINATION OF VISCOSITY

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Indian Standard

METHODS OF TEST FOR RUBBER LATEX

PART II DETERMINATION OF VISCOSITY

0. FOREWORD

0.1 This Indian Standard (Part II) was adopted by the Indian Standards Institution on 28 October 1979, after the draft finalized by the Rubber Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

0.2 Test methods for natural rubber latex have been covered in IS : 3708 (Part I)-1966* and IS : 3708 (Part II)-1967† ; and IS : 4511 (Part I)-1967‡ covers styrene butadiene rubber latex. However, some of the test methods covered in these standards are common. Further, a need was felt to align these test methods with the corresponding ISO standards. It has, therefore, been decided to unify and publish a separate series of those methods of test which are applicable to all types of latices — natural, as well as, synthetic. This standard forms a part of this series.

0.3 The method for determination of viscosity for natural rubber latex and for SBR latex was prescribed in NRL : 4 of IS : 3708 (Part I)-1966* and SBRL : 7 of IS : 4511 (Part I)-1967‡, respectively. With the publication of this standard NRL : 4 of IS : 3708 (Part I)-1966* and SBRL : 7 of IS : 4511 (Part I)-1967‡ stand superseded.

0.4 This standard is essentially based on ISO 1652-1974 ' Rubber latex — Determination of viscosity ' published by the International Organization for Standardization.

0.5 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§.

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*Methods of test for natural rubber latex: Part I Dry rubber content, total solids, coagulum content, viscosity, sludge content, density total alkalinity, KOH-number, mechanical stability, volatile fatty acid number, *p*H, total nitrogen, total copper, total iron, total manganese, and total ash.

†Methods of test for natural rubber latex, Part II.

‡Methods of test for styrene-butadiene rubber (SBR) latices: Part I Determination of dry polymer, total solids, coagulum, *p*H, surface tension, density, viscosity, residual styrene, bound styrene and soap content.

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

1. SCOPE

1.1 This standard (Part II) prescribes a method for the determination of the viscosity of both natural and synthetic rubber latices.

2. APPARATUS

2.1 Viscometer* — It consists of an electric synchronous motor which drives, at a constant speed of rotation, a shaft to which spindles of different shapes and dimensions may be attached. There is provision for selecting different rpm for the spindle. The spindle is partially immersed in latex and the drag on the spindle rotating in the latex causes a torque to be developed on the spindle shaft. The equilibrium torque developed is indicated by means of a pointer and scale which is calibrated in units from 0 to 100. Two instruments depending on the viscosity to be measured are to be used as follows:

a) The *L instrument* which uses a spring torque of 67·37 ± 0·07μN.m (673·7 ± 0·7 dyne.cm) at full scale deflection is applicable for viscosities up to 2 000 mPa.s (2 000 cP), and

b) The *R instrument* which uses a spring torque of 718·7 ± 0·7μN.m (7 187 ± 7 dyne.cm) at full scale deflection is applicable for viscosities above 200 mPa.s (200 cP).

The spindles shall be accurately made in accordance with Fig. 1 and to the dimensions given in Table 1.

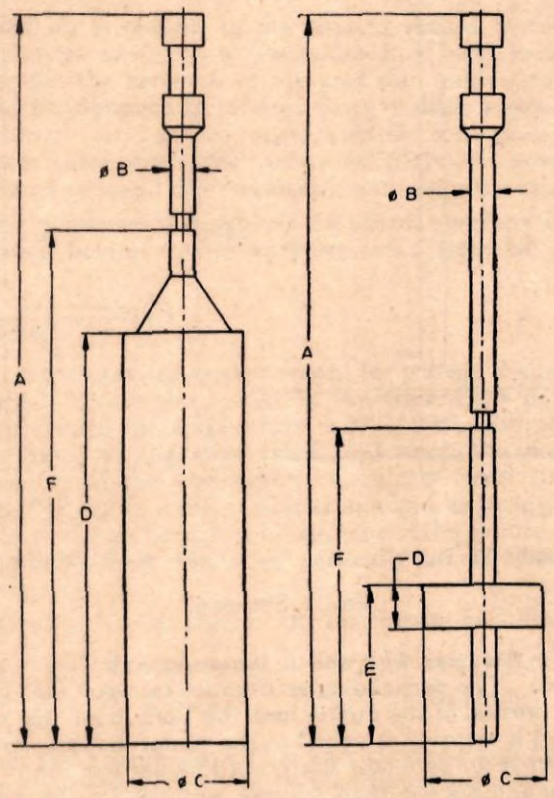
TABLE 1 SPINDLE DIMENSIONS

Spindle No.	*A* ±1·3	*B* ±0·03	*C* ±0·03	*D* ±0·06	*E* ± 1·3	*F* ±0·15
(1)	(2) mm	(3) mm	(4) mm	(5) mm	(6) mm	(7) mm
L_2	115·1	3·18	18·84	65·10	—	81·0
L_2	115·1	3·18	18·72	6·86	25·4	50·0
L_3	115·1	3·18	12·70	1·65	25·4	50·0
R_1	133·3	3·18	56·26*	22·48†	27·0	61·1
R_2	133·3	3·18	46·93	1·57	27·0	49·2
R_3	133·3	3·18	34·69	1·65	27·0	49·2

*Wall thickness approximately 0·6 mm.
†Wall thickness approximately 1·0 mm.

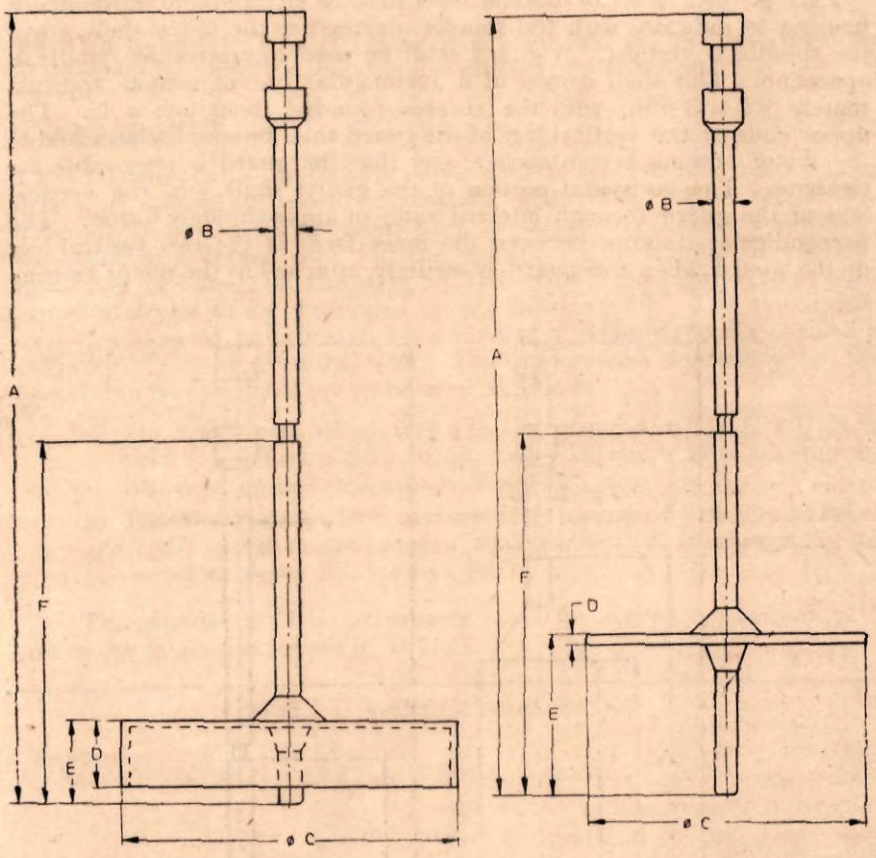
*Suitable instruments are obtainable from Brookfield Engineering Laboratories Inc Models LVF and LVT meet the requirements for the *L instrument*, and models RVF and RVT meet the requirement for the *R instrument*.

2.1.1 A spirit level or bubble level shall be incorporated in the motor housing to indicate, with the spindle attached to the motor shaft, when the spindle is vertical. A guard shall be used to protect the spindle in operation. This shall consist of a rectangular bar of section approximately 9·5 × 3 mm, with the corners rounded, bent into a U. The upper ends of the vertical legs of the guard shall be securely attached to the motor housing but in such a way that the guard is removable for cleaning. The horizontal portion of the guard shall join the vertical legs of the guard through internal radii of approximately 6 mm. The perpendicular distance between the inner faces of the two vertical legs of the guard when the guard is securely attached to the motor housing



1A Spindle No. L_1 1B Spindle No. L_2 and L_3

FIG. 1 SPINDLES — *Contd*



1C Spindle No. R_1 1D Spindle Nos. R_2 and R_3

FIG. 1 SPINDLES

shall be 31·8 ± 0·8 mm with the *L instrument* and 76·2 ± 0·8 mm with the *R instrument*. The perpendicular distance between the upper face of the horizontal portion of the guard and the bottom of the spindle shaft, when the guard is securely attached to the motor housing and when the spindle is attached to the motor shaft, shall be not less than 10 mm with the *L instrument* and not less than 4·5 mm with the *R instrument*.

2.2 Beaker — glass beaker of internal diameter at least 85 mm and capacity at least 600 ml.

2.3 Water-Bath — controlled at 27°C.

3. PRINCIPLE

3.1 Determination of the viscosity by means of a viscometer involves the measurement of the torque produced on a specified spindle rotating at a specified constant rpm while immersed to a known depth in the latex. Measurements may be made on the undiluted latex or on the latex after dilution to a *required total solids content.*

4. PREPARATION OF SAMPLE

4.1 Determine the total solids content of the latex and then, if necessary, accurately adjust to the required value by the addition of distilled water. Add the water slowly to the latex and stir the mixture gently for 5 minutes, taking care to avoid inclusion of air.

4.2 If occluded air is present in the latex it should be removed before testing. For latices having low viscosities it is sufficient to keep for 15-30 minutes for the removal of air and the bubble formed on the surface should be removed by using a piece of filter paper. If the latex contains occluded air and no other volatile component, and has a viscosity greater than about 200 mPa.s (200 cP), remove the air by allowing the latex to stand under vacuum until foaming ceases.

4.3 Should the presence of coagulum be noted, carefully strain the latex through a screen having square apertures with sides of approximately 500 μm.

5. PROCEDURE

5.1 Pour the latex into the beaker meant for testing, taking care that no air is entrapped. Place the beaker in the water-bath at 27°C and stir the latex gently until its temperature is 27 $\pm$ 2°C. Immediately attach the spindle securely to the motor shaft and attach the guard securely to the motor housing of the viscometer. Carefully insert the spindle and guard into the latex, in such a way as to avoid air being trapped, until the surface of the latex is at the mid-point of the groove on the spindle shaft. The spindle shall be placed vertically in the latex and in the centre of the beaker.

Select the speed of rotation of the instrument as follows:

L instrument	60 $\pm$ 0·2 rev/min
R instrument	20 $\pm$ 0·2 rev/min

5.2 Switch on the viscometer motor and take the equilibrium reading to the nearest unit scale division, in accordance with the manufacturers operating instructions. Twenty to thirty seconds may elapse before the equilibrium reading is attained. The reading should be taken at the elapse of 60 seconds.

5.3 Use the lowest numbered spindle able to record the viscosity.

6. EXPRESSION OF RESULTS

6.1 When the reading has been obtained, calculate the viscosity of the latex in millipascal seconds (centipoises), using the appropriate factor obtained from Table 2.

TABLE 2 FACTORS NECESSARY TO CONVERT READING ON SCALE 0 TO 100 MILLIPASCAL SECONDS (CENTIPOISES)

SPINDLE NO.	FACTOR
L_1	× 1
L_2 2 or R_1	× 5
L_3 or R_2	× 20
R_3	× 50

6.2 Viscosity test values depend on model of instrument, rpm used, spindle number used and temperature of experiment. Hence, as far as possible, standard conditions should be adopted. For natural rubber latex the following is recommended:

Instrument	L type
Rpm	60
Rotor	2
Temperature	27°C

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INDIAN STANDARDS
ON
NATURAL, SYNTHETIC AND RECLAIMED RUBBER

IS:

3660 Methods of test for natural rubber:
(Part I)-1972 Part I Determination of dirt, volatile matter, ash, total copper, manganese, iron, rubber hydrocarbon, viscosity (shearing disc viscometer), and mixing and vulcanizing of rubber in standard compound (*first revision*)
(Part II)-1968 Part II Determination of solvent extract and nitrogen content
(Part III)-1971 Part III Plasticity and plasticity retention index
3708 Methods of test for natural rubber latex:
(Part I)-1966 Part I Dry rubber content, total solids, coagulum content, viscosity, sludge content, density, total alkalinity, KOH-number, mechanical stability, volatile fatty acid number, *p*H, total nitrogen, total copper, total iron, total manganese and total ash
(Part II)-1968 Part II Determination of boric acid and magnesium in latex
4511 (Part I)-1967 Methods of test for styrene-butadiene rubber (SBR) latices: Part I Determination of dry polymer, total solids, coagulum, *p*H, surface tension, density, viscosity, residual styrene, bound styrene and soap content
4518 Methods of tests for styrene-butadiene rubber (SBR):
(Part I)-1967 Part I Determination of volatile matter, total ash, organic acid, soap, antioxidants, bound styrene and mooney viscosity
(Part II)-1971 Part II Determination of solvent and oil content
4588-1977 Rubber, raw, natural (*second revision*)
5188-1969 Cold polymerized oil extended styrene-butadiene rubber
5189-1969 Cold polymerized styrene-butadiene rubber
5190-1969 Code for packaging of natural rubber latex in drums
5430-1969 Ammonia preserved concentrated natural rubber latex
5598-1969 Code of practice for bale coating and marking of rubber
5599-1970 Methods for sampling of raw rubber
6306-1971 Methods of test for reclaimed rubber
6611-1972 Symbols for rubber and latices
7490-1974 Reclaimed rubber
7499-1974 Formulae for evaluation of natural rubber
7503 (Part I)-1975 Glossary of terms used in rubber industry, Part I
7503 (Part II)-1976 Glossary of terms used in rubber industry, Part II
7503 (Part III)-1979 Glossary of terms used in rubber industry, Part III
8683-1977 Methods of test for raw acrylonitrile butadiene rubber