

IS : 3400 ( Part XV ) - 1971

*Indian Standard*      CDC 6:9

METHODS OF  
TEST FOR VULCANIZED RUBBERS

**PART XV VOLUME RESISTIVITY OF ELECTRICALLY  
CONDUCTING AND ANTISTATIC RUBBERS**

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG  
NEW DELHI 1

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# Indian Standard

## METHODS OF TEST FOR VULCANIZED RUBBERS

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## *Indian Standard*

### METHODS OF TEST FOR VULCANIZED RUBBERS

#### PART XV VOLUME RESISTIVITY OF ELECTRICALLY CONDUCTING AND ANTISTATIC RUBBERS

#### 0. FOREWORD

**0.1** This Indian Standard ( Part XV ) was adopted by the Indian Standards Institution on 1 December 1971, after the draft finalized by the Rubber Products Sectional Committee had been approved by the Chemical Division Council.

**0.2** In some rubber vulcanizates it may be essential to fulfil the safety requirements along with antistatic properties. In such cases normally lower limit of resistance of  $5 \times 10^4$  ohms for 250 volt mains should be specified. As the resistance depends on the strain, temperature and rate of generation of charge, the safety requirements may not be recommended unless standard conditions are specified.

**0.3** 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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#### 1. SCOPE

**1.1** This method ( Part XV ) covers the determination of volume resistivity of electrically conducting and antistatic rubbers.

**1.2** The method assumes that the surface conductivity is negligible compared to the conductivity through the specimen.

#### 2. TERMINOLOGY

**2.1 Antistatic Rubber** — The rubber products which are able to dissipate static charges but fulfil the minimum safety requirements.

**2.2 Conductive Rubber** — The rubber products which easily conduct electrical energy and do not fulfil the minimum safety requirements.

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

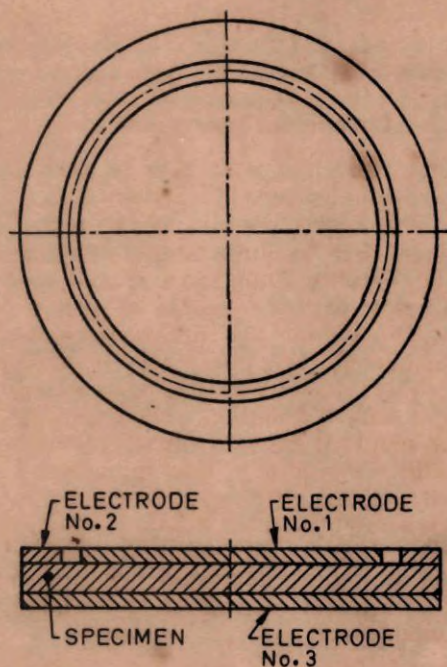


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**2.3 Volume Resistivity** — The resistance offered by a metre cube of a material to the passage of electricity between opposite faces.

**3. APPARATUS**

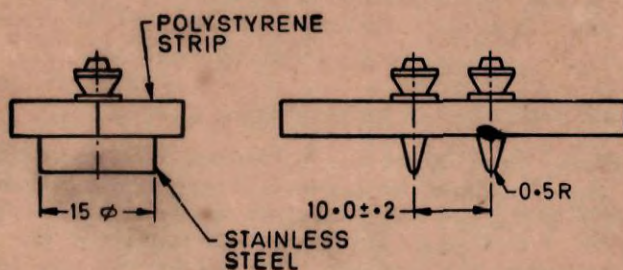
**3.1 Plate Type Electrode** — The electrode assembly consists of the test piece provided on one face with a central circular electrode 5 or 15 cm diameter and concentric with it an annular electrode giving a uniform spacing across the leakage surface of 10 mm ( *see* Fig. 1 ). The electrode may be of mercury or graphite applied in the form of colloidal suspension in water.



**FIG. 1 MEASUREMENT OF VOLUME RESISTANCES BY PLATE TYPE ELECTRODES**

**3.2 Contact Point Electrode** — The electrode assembly consists of two current electrodes placed on a rigid insulating base (insulation resistance  $10^{12}$  ohms) fastened to two potential electrodes with base 15 mm wide, tapered to a radius of 0.5 mm on the top. The distance between two

potential electrodes shall be  $10.2 \pm 0.2$  mm and the current electrode shall be equidistant outside the potential electrodes ( see Fig. 2 ).



All dimensions in millimetres.

FIG. 2 POTENTIAL ELECTRODE MASS  $120 \pm 5$ g

#### 4. TEST PIECE

**4.1** The test specimen shall be in the form of flat plate with width between 10 to 15 mm, length between 70 to 150 mm and thickness approximately 2 mm uniform all over with a tolerance of  $\pm 1$  percent. The thickness between different test pieces shall not vary by more than 5 percent. Standard dumb-bell mould test pieces may be used provided the surface of the uncured rubber is kept free of soap stone or any other mould lubricant. To avoid surface distortion while removing from the mould, the test pieces shall be moulded between moisture sensitive cellophane paper which can be readily removed after brief immersion in water. The paper should be removed without bending or scratching and should be patted dry. If specimen is to be collected from a product, the test piece is to be cut from the portion where it is not buffed or abraided. It can be cleaned with Fuller's earth and water and washed with distilled water and dried in air. The specimen should be uniform in thickness and should not be distorted during preparation.

#### 5. CONDITIONING

**5.1** The time between vulcanization and testing shall not be less than 16 hours and not more than 6 days for moulded specimen. For finished products, this shall be not more than 2 months after receipt by the customer.

**5.2** The specimen shall be conditioned for at least 16 hours and tested at a temperature of  $27 \pm 2^\circ\text{C}$  and a relative humidity of 65 percent.



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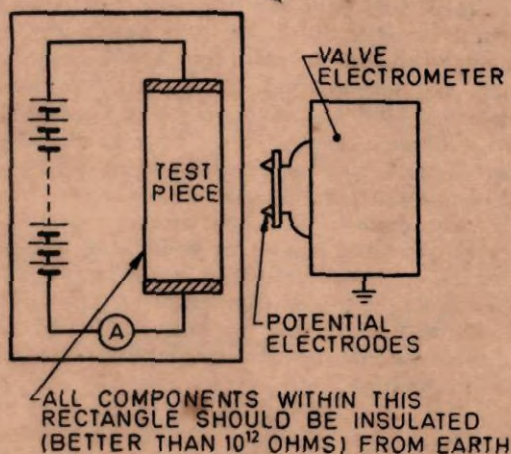
**5.3** Immediately prior to the test, the current electrodes shall be connected to the end of test piece by grips extending to 5 cm along the test piece and heated on a sheet of highly insulating material for 2 hours at  $70 \pm 2^\circ\text{C}$  to remove strains or irregularities and allowed to cool for at least one hour and tested at room temperature without any disturbance to the test piece.

**6. PROCEDURE**

**6.1 For Plate Type Electrode**—Measure the dimensions of the electrodes and determine the effective area of the measuring electrode and width of the guard gap. Measure the volume resistance between electrodes No. 1 and 3 (see Fig. 1) with a suitable device having the required sensitivity and accuracy. Unless otherwise specified, the time of electrification shall be 1 min and the applied direct voltage shall be  $500 \pm 5\text{ V}$ .

**6.2 For Contact Point Electrode**

**6.2.1** The test piece, milliammeter and electrometer having an input resistance greater than  $10^{12}$  ohms shall be arranged as shown in Fig. 3.



**FIG. 3 CIRCUIT DIAGRAM**

**6.2.2** The test piece shall be placed between two current electrodes without any distortion or flexing. A steady measured direct current, which shall not cause an energy dissipation of more than 1 watt in the test piece, shall be fed to the current electrodes. Measure the voltage drop by voltmeter along the test piece between the potentiometric electrode system

with total contact force of  $120 \pm 5$  g on the surface of the test piece. Five readings are taken on each test piece at points evenly distributed between the current electrodes and the appropriate resistance calculated.

## 7. CALCULATION

7.1 Calculate the volume resistivity as follows:

$$\text{Volume resistivity in ohm-cm} = \frac{A}{h} R_v$$

where

$A$  = the effective area of the measuring electrode for the particular arrangement employed;

$h$  = average thickness of the specimen in cm; and

$R_v$  = measured volume resistance in ohms.

## 8. REPORT

8.1 The report shall include the following:

- a) Temperature and relative humidity,
- b) Current through the test piece in amperes,
- c) Dimensions of the test piece in mm, and
- d) Voltage across the potential electrodes.



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- ( Part IX )-1967 Relative density and density
- ( Part X )-1969 Compression set at constant strain
- ( Part XI )-1969 Determination of rebound resilience
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