International Standard ISO 3915

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Plastics — Measurement of resistivity of conductive plastics

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

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It has been approved by the member bodies of the following countries :

Australia	Germany, F.R.	Philippines
Austria	Hungary	Romania
Belgium	India	South Africa, Rep. of
Brazil	Ireland	Spain
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Egypt, Arab Rep. of	Korea, Rep. of	USA
Finland	Mexico	USSR
France	Netherlands	

No member body expressed disapproval of the document.

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Plastics — Measurement of resistivity of conductive plastics

0 Introduction

The method specified in this International Standard is technically similar to that specified for rubber in ISO 1853, *Conducting and antistatic rubbers — Measurement of resistivity.*

However, it differs from that method in certain details, especially those associated with the greater stiffness of the plastic samples, and in particular in the limitation on specimen width. It takes into account two problems encountered in the measurement of resistivity of conductive plastics, namely the sensitivity of these materials to their temperature-history and strain-history, and the difficulty of making adequate electrical contact with them.

The prescribed width of the specimen is mandatory for reference purposes; however, a wider strip may be used, with correspondingly wider electrodes. There is a danger in using a wide strip, if the strip is slightly twisted and at the same time somewhat non-uniform in its resistivity. It is then possible to obtain erroneous results; the potential electrode nearer to the positive current electrode may even be found to be negative with respect to the other potential electrode.

Effect of temperature changes and strain on conductive plastics

As mentioned above, the resistance of these materials is sensitive to their temperature-history and strain-history. The relationships are complex and arise from the kinetic energy and structural configuration of the carbon particles in the polymer.

The resistivity may be increased by the effects of strain produced by (or subsequent to) removal from the mould, and a treatment is described for reducing specimens to a constant strain and temperature condition before measurements are carried out on them. Specimens are also cut in two perpendicular directions to assess anisotropy.

Electrode systems (see 3.3)

Certain types of electrode, when applied to these polymers, have a contact resistance which may be many thousand times greater than the intrinsic resistance of the specimen. Dry contacts under light pressure or point contacts give very high resistances. However, the present test method eliminates the effects of contact resistances unless these are excessively high. (In such a case, no result, rather than a wrong one, is generally obtained.)

1 Scope and field of application

This International Standard specifies the requirements for the laboratory testing of the resistivity of specially prepared specimens of plastics rendered conductive by the inclusion of carbon black. The test is suitable for materials of resistivity less than 10^6 Ω·cm (10^4 Ω·m). The result is not strictly a volume resistivity, because of surface conduction, but the effects of the latter are generally negligible.

The principle of the four-terminal method of test is mandatory and the recommended specimen size and electrode design must be adhered to for reference purposes, but it may sometimes be necessary to test a wider strip with electrodes of a different construction.

2 Principle

A stable d.c. current of magnitude (I) is passed between electrodes at the two ends of a strip of the material under test. The voltage drop (ΔU) between two potential electrodes is measured with an electrometer. The resistance of the portion of the strip between the potential electrodes is given by $R = \Delta U/I$ and is independent of contact resistances. Thus the resistivity may be calculated.

3 Apparatus (see figure 1 for schematic diagram of test circuit)

3.1 Current source : a source of direct current which has a minimum resistance to earth of 10^{12} Ω (effected by placing it on a highly insulating sheet), and which will not cause a dissipation of power greater than 0,1 W in the specimen.

3.2. Milliammeter or **microammeter**, as appropriate, for measuring the current to an accuracy of ± 5 %.

NOTE — Small currents may be computed from measurement of the voltage drop across a known resistance in series with the specimen, using the electrometer (3.4)

3.3 Electrodes

3.3.1 Current electrodes, of clean metal, together with either suitable clamps or grips approximately 5 mm long and extending across the full width of the specimen, or **conductive paint** to cover the same area.