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**Electrostatics—Methods of test for
determining the resistance and
resistivity of solid planar materials
used to avoid electrostatic charge
accumulation**

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standard Law:

This Standard has been made based on IEC 61340-2-3:2000 *Electrostatics—Part 2-3 : Methods of test for determining the resistance and resistivity of solid planar materials used to avoid electrostatic charge accumulation* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

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Electrostatics—Methods of test for determining the resistance and resistivity of solid planar materials used to avoid electrostatic charge accumulation

Introduction This Japanese Industrial Standard has been prepared based on the first edition of IEC 61340-2-3 *Electrostatics—Part 2-3 : Methods of test for determining the resistance and resistivity of solid planar materials used to avoid electrostatic charge accumulation* published in 2000 without modifying the technical contents.

Portions underlined with dots are the matters not stated in the original International Standard.

Measurements of resistances and related calculations of resistivities belong to the fundamental objectives of electrical measuring techniques along with measurements of voltage and current.

Resistivity is the electrical characteristic having the widest range, extending over some thirty orders of magnitude from the most conductive metal to almost perfect insulators.

The basis is Ohm's law and is valid for d.c. current and instantaneous values of a.c. current in electron conductors (metals, carbon, etc.). Values of resistance measurements using a.c. current can be influenced by capacitive/inductive reactance, depending on the frequency. Thus, existing national and international standards dealing with resistance measurements of solid materials normally require the application of d.c. current.

Most non-metal materials such as plastics are classified as polymers and ion conductors. The transport of charges can be dependent upon the applied electrical field strength during the measurement. Beside the measuring current, there exists a charging current that polarizes and/or electrostatically charges the material, indicated by an asymptotic decay of the measuring current with time and causing an apparent change in resistance. If this effect is observed, it will be advisable to repeat the measurement immediately after a definite electrification time has elapsed using the reverse polarity for the measuring current and averaging both obtained values.

1 Scope This International Standard describes test methods for the determination of the electrical resistance and resistivity of solid materials in the range from $10^4 \Omega$ to $10^{12} \Omega$ used to avoid electrostatic charge accumulation.

It takes account of existing IEC/ISO standards and other published information, and gives recommendations and guidelines on the appropriate method.

NOTE : The International Standard corresponding to this Standard is as follows.

In addition, symbols which denote the degree of correspondence in the

contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21.

IEC 61340-2-3:2000, *Electrostatics—Part 2-3 : Methods of test for determining the resistance and resistivity of solid planar materials used to avoid electrostatic charge accumulation* (IDT)

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. If the indication of the year of publication is given to these referred standards, only the edition of the indicated year constitutes the provision of this Standard but the revision and amendment made thereafter do not apply.

IEC 60093:1980	<i>Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials</i>
IEC 60167:1964	<i>Methods of test for the determination of insulation resistance of solid insulating materials</i>
IEC 60212:1971	<i>Standard conditions for use prior to and during the testing solid electrical insulating materials</i>
IEC 60260:1968	<i>Test enclosures of non-injection type for constant relative humidity</i>
ISO 1853:1998	<i>Conducting and dissipative rubber vulcanized or thermoplastic — Measurement of resistivity</i>
ISO 2951:1974	<i>Vulcanized rubber — Determination of insulation resistance</i>
ISO 3915:1981	<i>Plastics — Measurement of resistivity of conductive plastics</i>

3 Definitions For the purpose of this Standard, the following definitions apply:

Information : The general static electricity terms are prescribed in TR C 0018 : 2000 (Type II) Glossary of Terms used in Electrostatic Discharge (ESD).

3.1 volume resistance (R_v) the ratio of a d.c. voltage (V) applied between two electrodes placed on two (opposite) surfaces of a specimen and the steady-state current (A) between the electrodes

3.2 volume resistivity (ρ_v) the ratio of a d.c. field strength (V/m) and the steady-state current density (A/m²) within the material. In practice, it is equivalent to the volume resistance of a cube with unit length, having the electrodes at two opposite surfaces

NOTE : Volume resistivity is not an appropriate characteristic for materials that are electrically inhomogeneous.

3.3 surface resistance (Ω) the ratio of a d.c. voltage (V) applied between two electrodes on a surface of a specimen and the current (A) between the electrodes

3.4 surface resistivity (Ω) the surface resistivity is equivalent to the surface resistance of a square area, having the electrodes at two opposite sides

NOTE : The SI unit of surface resistivity (Ω) is sometimes referred to as Ω/sq (ohms per square).

3.5 measuring electrode a conductor of defined shape, size and configuration being in contact with the specimen to be measured

4 Conditioning and test environment The electrostatic behaviour of materials is influenced by environmental conditions, such as relative humidity and temperature.

For this reason, measurements shall be performed under controlled conditions. The selection of the appropriate conditions for testing shall be decided according to the type of material (product specification) and the intended application, based on the most severe conditions (e.g. lowest humidity) expected to occur during usage. Specimens shall be conditioned and measured in the same climate, if not specified differently.

Preconditioning can be necessary in order to eliminate the effects of stress appearing after the moulding process of some plastic materials or as a drying treatment before the test procedure starts. The preconditioning shall normally be handled in a different environment.

Adequate devices are a desiccator in an oven or a climate chamber preferably equipped with forced circulation and interchange of air. Additional guidance may be taken from IEC 60212 and IEC 60260.

5 Selection of test method The following procedure shall be used to select the test method:

- a) if the range of electrical resistance of a material to be tested is known, then use the relevant clause where appropriate standards are listed or methods described;
- b) for a material of initially unknown resistivity, start the measurements by using methods for conductive materials according to clause 6.

If the measurement is not possible or the obtained result exceeds the given range for the application of the test method, it shall be regarded as being inadequate and the result shall not be taken into account. The measurement shall be repeated according to clause 8 for static-dissipative materials. If the situation described above occurs again, the measurement shall be repeated according to clause 7 for insulating materials.

6 Resistance measurements of solid conductive materials The resistance of solid conductive materials (non-metals) shall be measured in accordance with ISO 3915 for plastics or ISO 1853 for rubbers.