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Electrostatics –
Part 4-7: Standard test methods for specific applications – Ionization

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ELECTROSTATICS –

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FOREWORD

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International Standard IEC 61340-4-7 has been prepared by IEC technical committee 101: Electrostatics.

The text of this standard is based on ANSI/ESD STM3.1-2006. It was submitted to the National Committees for voting under the Fast Track Procedure.

The text of this standard is also based on the following documents:

FDIS	Report on voting
101/292/FDIS	101/299/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61340 series, under the general title *Electrostatics*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Grounding is the primary method used to limit static charge fwhen protecting electrostatic discharge-susceptible items in the work environment. However, grounding methods are not effective in removing static charges from the surfaces of non-conductive (insulative) or isolated conductive materials. Air ionization techniques may be employed to reduce these charges as the active parameters in charge neutralization are the conductivities of the air for each polarity. It would be appropriate to measure either the conductivities themselves or the ion concentrations for each polarity as this would determine the ability of the ionized air to neutralize a charge in a given location. Annex A provides information on performance of ionizers.

In practice, these measurements are difficult to make. A more feasible way of evaluating the ability of an ionizer to neutralize a static charge is to directly measure the rate of charge decay. Charges to be neutralized may be located on insulators as well as on isolated conductors. It is difficult to charge an insulator reliably and repeatably. Charge neutralization is more easily evaluated by measuring the rate of decay of the voltage of an isolated conductive plate. The measurement of this decay should not interfere with or change the nature of the actual decay. Four practical methods of air ionization are addressed in this standard test method:

a) radioactive emission;

b) high-voltage corona from a.c. electric fields;

c) high-voltage corona from d.c. electric fields;

d) soft X-ray emission.

This part of IEC 61340 provides test methods and procedures that can be used when evaluating ionization equipment. The objective of the test methods is to generate meaningful, reproducible data. The test methods are not meant to be a recommendation for any particular ionizer configuration. The wide variety of ionizers, and the environments within which they are used, will often require test methods different from those described in this part of IEC 61340. Users of this standard should be prepared to adapt the test methods as required to produce meaningful data in their own application of ionizers.

Similarly, the test conditions chosen in this part of IEC 61340 do not represent a recommendation for acceptable ionizer performance. There is a wide range of item sensitivities to static charge. There is also a wide range of environmental conditions affecting the operation of ionizers. Performance specifications should be agreed upon between the user and manufacturer of the ionizer in each application. Users of this standard test method should be prepared to establish reasonable performance requirements for their own application of ionizers.

Annex B has been provided in order to provide a method for measuring capacitance of the charged plate.

ELECTROSTATICS –

Part 4-7: Standard test methods for specific applications – Ionization

1 Scope

This part of IEC 61340 provides test methods and procedures for evaluating and selecting air ionization equipment and systems (ionizers).

This standard establishes measurement techniques, under specified conditions, to determine offset voltage (ion balance) and discharge (charge neutralization) time for ionizers.

This standard does not include measurements of electromagnetic interference (EMI), or uses of ionizers in connection with ordnance, flammables, explosive items or electrically initiated explosive devices.

As contained in this standard, the test methods and test conditions may be used by manufacturers of ionizers to provide performance data describing their products. Users of ionizers are urged to modify the test methods and test conditions for their specific application in order to qualify ionizers for use, or to make periodic verifications of ionizer performance (refer to ESD SP3.3). The user will need to decide the extent of the data required for each application.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ESD ADV1.0, *Glossary of terms*[1]

ESD SP3.3, *Standard practice for protection of electrostatic discharge susceptible items – Periodic verification of air ionizers*[1]

29 CFR 1910.1000, *Ozone, (OSHA) Air contaminants*[2]

29 CFR 1910.95, *(OSHA) Occupational noise exposure*[2]

29 CFR 1910.242 (b), *(OSHA) Compressed air used for cleaning*[2]

10 CFR 20, *(NRC) Standards for protection against radiation*[2]

21 CFR 1020, *(FDA) Performance standards for ionizing radiation emitting products*[2]

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1 ESD Association, 7900 Turin Road, Bldg. 3, Rome, NY 13440-2069, 315-339-6937, www.esda.org

2 CFR (Code of Federal Regulations) U.S. Government printing office, 732 N. Capitol Street NW, Washington, DC 20401, 866-512-1800, http://bookstore.gpo.gov

3 Terms and definitions

For the purposes of this document, the following terms and definitions, in addition to those specified in the ESD association glossary of terms, shall apply.

3.1
air conductivity
ability of air to conduct (pass) an electric current under the influence of an electric field

3.2
air Ions
molecular clusters of about ten molecules (water, impurities, etc.) bound by polarization forces to a singly charged oxygen or nitrogen molecule

3.3
charge decay
decrease and/or neutralization of a net electrostatic charge

3.4
charge induction
redistribution of charge in an isolated conductor when placed in an electric field (e.g. from a charged body)

NOTE Momentary grounding of such a conductor would result in its gaining a net charge.

3.5
charged plate monitor
CPM
instrument used to measure the charge neutralization properties of ionization equipment

3.6
compressed gas ionizer
ionization devices that can be used to neutralize charged surfaces and/or remove surface particles with pressurized gas

NOTE This type of ionizer may be used to ionize the gas within production equipment.

3.7
corona
production of positive and negative ions by a very localized high electric field

NOTE The field is normally established by applying a high voltage to a conductor in the shape of a sharp point or wire.

3.8
decay rate
decrease of charge or voltage per unit time

3.9
discharge time
time necessary for a voltage (due to an electrostatic charge) to decay from an initial value to some arbitrarily chosen final value

3.10
emitter
conducting sharp object, usually a needle or wire, which will cause a corona discharge when kept at a high potential

3.11
horizontal laminar flow
non-turbulent airflow in a horizontal direction

3.12
ion balance
(see offset voltage)

3.13
ionizer
device that is designed to generate positive and/or negative air ions

3.14
isolated conductor
non-grounded conductor

3.15
laminar flow hood ionization
these devices or systems provide local area ionization coverage in vertical or horizontal laminar flow hoods or benches

3.16
offset voltage
observed voltage on the isolated conductive plate of a charged plate monitor (CPM) that has been placed in an ionized environment

3.17
peak offset voltage
for pulsed ionizers, the maximum value of the offset voltage for each polarity, as the ionizer cycles between positive and negative ion outputs

3.18
room ionization
ionization systems that provide large area coverage with air ions

3.19
worksurface ionization (formerly **tabletop ionization**)
ionization devices or systems used to control static charges at a workstation

NOTE This type includes benchtop ionizers, overhead worksurface ionizers and laminar flow hood ionizers.

3.20
vertical laminar flow
non-turbulent airflow in a vertical direction

4 Safety requirements

In addition to the safety issues mentioned in this clause, there may be local, state, national and international safety standards or regulations that affect the operation of ionizers. Users of this standard test method should determine if such requirements will apply to their installation of ionizers.

4.1 Personnel safety

4.1.1 The procedures and equipment described in this part of IEC 61340 may expose personnel to hazardous electrical conditions. Users of this standard, therefore, are responsible for selecting equipment that complies with applicable laws, regulatory codes and

both external and internal policy. Users are also cautioned that this standard cannot replace or supersede any requirements for personnel safety.

Ground fault circuit interrupters (GFCI) and other safety protection should be considered wherever personnel may come into contact with electrical sources.

Electrical hazard reduction practices should be exercised and proper grounding instructions for the equipment must be followed.

4.2 Electrical

In the case of high-voltage ionizers with exposed emitters, the corona points or wires should be peak current limited to applicable safety requirements for the installation.

4.3 Ozone

The OSHA limit, as defined by 29 CFR 1910.1000, shall not be exceeded. If ozone-sensitive components are in the vicinity of an ionizer, the manufacturer should provide information and/or evaluation suggestions for the situation.

4.4 Radioactive

The manufacturer is required to obtain a license from the Nuclear Regulatory Commission (NRC) or the NRC agreement state in which the equipment is manufactured. The manufacturer and user shall meet all requirements of 10 CFR 20 and any other applicable government regulations.

4.5 X-ray

The manufacturer and user shall meet all requirements of 21 CFR 1020 and any other applicable government regulations. Typically, state and local government agencies will require the device to be registered at its use location. X-ray devices should be installed in such a way that prevents accidental exposure to personnel. Typically this will include some type of enclosure for the X-ray device and electrical interlocking to turn the X-ray device off when the enclosure is opened.

4.6 Installation

Installation should conform to applicable electrical, mechanical and safety codes, as well as individual facility standards. Some equipment, such as compressed gas guns and nozzles may have to meet other requirements such as 29 CFR 1910.95 for noise exposure and 29 CFR 1910.242 for personnel safety with compressed gas devices. Installation techniques should also be applicable to the particular environment in which the ionizer is to be installed (e.g., cleanrooms).

5 Test equipment

5.1 The instrument recommended in this standard to make performance measurements on air ionization equipment is the CPM (refer to Figure 1). The conductive plate shall be 15 cm by 15 cm (6“ by 6“) with a minimum capacitance of 15 pF when mounted in the test fixture without electrical hook-ups. The total capacitance of the test circuit, with plate, shall be 20 pF ± 2 pF (refer to Annex B). The instrument recommended by this standard test method may also be used for the periodic verification of air ionizers (refer to ESD SP3.3).

5.2 There shall be no objects, grounded or otherwise, closer than dimension "A" of the conductive plate except the supporting insulators or plate voltage contacts, as shown in Figure 2 (refer to Annex B).

5.3 The isolated conductive plate, when charged to the desired test voltage, shall not discharge more than 10 % of the test voltage within 5 min, in the absence of ionization.

5.4 The voltage on the plate shall be monitored in such a way that the system conforms to 5.1, 5.2 and 5.3. The response time of the monitoring device shall be sufficient to accurately measure changing plate voltages.

5.5 The voltage source used to charge the plate should be current limited so as to meet the requirements of 4.1.

6 Specific requirements for equipment categories

For the types of ionization equipment listed in 6.1, 6.2, 6.3 and 6.4, the following specific requirements apply:

a) **Discharge time test** – The conductive plate of the test fixture shall be charged to an initial test voltage and allowed to discharge to 10 % of the initial test voltage. The time required shall be monitored and recorded for both polarities of initial charge. This time is referred to as the discharge time (refer to 5.1 and Figure 1).

b) **Offset voltage test** – The conductive plate shall be momentarily grounded to remove any residual charges and to verify zero of the monitoring device. The plate is then monitored within the ionized environment, per the procedure described for each equipment category. The resulting observed voltage is referred to as the offset voltage.

c) **Locations** – The discharge time and offset voltage should be measured for each test location described in the test location figures (see Table 1).

d) **Same conditions** – Discharge time and offset voltage shall be measured under the same conditions without any equipment adjustments. If ionizers from different categories are to be compared, the same test voltages shall be used for all tests.

e) **Peak offset voltage** – In the case of pulsed ionizers, offset voltage should be measured and reported in peak values using the test equipment described in 5.1.

f) **Other parameters** – Application specific parameters such as humidity, temperature, air velocity, etc., should be recorded.

Table 1 – Test set-ups and test locations

Equipment category	Figure references	Number of test locations	Offset voltage measurement time interval	Charged plate initial voltage
Room ionization				
Grids, AC	3	2	(1 to 5) min	1 000
Bars, pulsed and DC	3	2	(1 to 5) min	1 000
Single polarity emitter	4	3	(1 to 5) min	1 000
Dual DC Line	5	3	(1 to 5) min	1 000
Pulsed DC emitter	6	2	(1 to 5) min	1 000
Laminar flow hood				
Vertical	7 and 8	8	(1 to 5) min	1 000
Horizontal	9 and 10	6	(1 to 5) min	1 000
Worksurface ionization				
Benchtop	11 and 12	12	(1 to 5) min	1 000
Overhead	13 and 14	12	(1 to 5) min	1 000
Compressed gas ionization				
Guns and nozzles	15	1	10 s to 1 min	1 000