## IDEMA STANDARD Contamination/ESD Control Committee Glossary of Terms Used in ESD Control Documents

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### 1.0 Purpose:

To define the terms and definitions as they relate to the standards developed by IDEMA for control of electrostatic charge and discharge in the hard disk drive industry.

#### 2.0 Scope:

This standard applies to all operations that involve packaging, transportation, handling and other activities intended to provide electrostatic protection to MR, GMR, TMR and related technologies in disk drive production.

The document will be considered a living document, as changes are needed the committee will incorporate them into the document.

#### **3.0 DEFINITIONS:**

#### Air ions\*

Molecular clusters of about 10 molecules (water, impurities, etc.) bound by polarization forces to a singly charged oxygen or nitrogen molecule.

#### Air ionizer\*

A source of charged air molecules (ions).

#### Charged device model (CDM) electrostatic discharge (ESD)\*

An ESD stress model that approximates the discharge event that occurs when a charged component is quickly discharged to another object at a lower electrostatic potential through a signal pin or terminal.

#### Charged device model (CDM) electrostatic discharge (ESD) tester\*

Equipment that simulates the component level CDM ESD event using the non-socketed test method.

#### Charged plate monitor (CPM)\*

An instrument used to measure the charge neutralization properties of ionization equipment.

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## Compressed gas ionizer\*

Ionization devices that can be used to neutralize charged surfaces and / or remove surface particles with pressurized gas. This type of ionizer may be used to ionize the gas within production equipment.

## **Conductive flooring material\***

A floor material that has a resistance to ground of less than  $1.0 \times 10^6$  ohms.

## Conductive material, resistance\*

A material that has a surface resistance of less than  $1 \ge 10^4$  ohms or a volume resistance of less than  $1 \ge 10^4$  ohms.

## Conductive material, resistivity\*

A material that has a surface resistivity less than  $1 \ge 10^5$  ohms/square or a volume resistivity less than  $1 \ge 10^4$  ohm-cm.

## Conductivity\*

- a. The ratio of the current per unit area (current density) to the electric field in a material. Conductivity is expressed in units of Siemens/Meter.
- b. In non-technical usage, the ability to conduct current.

### Corona\*

The production of positive and negative ions by a very localized high electric field. The field is normally established by applying a high voltage to a conductor in the shape of a sharp point or wire.

## **Contact voltage measurement**

A measurement technique using high input impedance circuitry used to monitor the voltage induced on a conductive plate where there is a direct connection from the circuitry to the conductive plate.

## **Coulomb meter**

Coulomb meter is a probe-type device that permits easy measurement of the amount of electrostatic discharge (ESD), which causes electrostatic damage to electronic devices in their manufacturing, inspection and assembly.

The charged device model (CDM) explains many cases of ESD that damage electronic devices. The CDM is a model of a phenomenon in which a high peak current flows at a high speed when the device itself is charged and its external electrode is grounded. The Coulomb meter performs high-precision measurement of the amount of ESD, which is the integral value of the current.

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### **Decay rate\***

The decrease of charge or voltage per unit time.

## **Decay time\***

The time required for an electrostatic potential to be reduced to a given percentage (usually 10%) of its initial value. (See static decay test.)

#### **Discharge current\***

A current produced by causing a stored charge to flow out of a component into a conductor from an ESD simulator.

#### **Discharge time\***

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

#### **Dissipative floor material\***

A floor material that has a resistance to ground of greater than  $1.0 \times 10^6$  ohms and less than or equal to  $1.0 \times 10^9$  ohms.

### **Dissipative materials\***

A material that has a surface resistance greater than or equal to  $1 \times 10^4$  ohms but less than

1 x  $10^{11}$  ohms or a volume resistance greater than or equal to 1 x  $10^4$  ohms but less than

1 x 10<sup>11</sup> ohms.

## **Electrical ionizer\***

A device that creates ions in gases by use of high voltage electrodes.

## Electrical overstress (EOS) \*

The exposure of an item to a current or voltage beyond its maximum ratings. This exposure may or may not result in a catastrophic failure.

#### Electrostatic discharge (ESD) \*

The rapid, spontaneous transfer of electrostatic charge induced by a high electrostatic field. Note:

Usually, the charge flows through a spark between two bodies at different electrostatic potentials as they approach one another. Details of such processes, such as the rate of the charge transfer, are described in specific electrostatic discharge models.

## Electrostatic discharge (ESD) control\*

See static control.

## Electrostatic discharge (ESD) protective\*

A property of materials capable of one or more of the following: reducing the generation of static electricity, dissipating electrostatic charges over its surface or volume, or providing shielding from ESD or electrostatic fields.

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## Electrostatic discharge (ESD) protective workstation\*

An area that is constructed and equipped with the necessary protective materials and equipment to limit damage to electrostatic discharge susceptible items handled therein.

### Electrostatic discharge (ESD) protective worksurface\*

A worksurface that dissipates electrostatic charge from materials placed on the surface or from the surface itself.

#### Electrostatic discharge sensitivity (ESDS) \*

The ESD level that causes component failure.

NOTE: See also electrostatic discharge susceptibility.

#### Electrostatic discharge (ESD) shield\*

A barrier or enclosure that limits the passage of current and attenuates an electromagnetic field resulting from an electrostatic discharge.

## Electrostatic discharge susceptibility (ESDS) \*

The propensity to be damaged by electrostatic discharge. (See also electrostatic discharge sensitivity).

#### **Electrostatic field\***

An attractive or repulsive force in space due to the presence of electric charge.

#### **Electrostatic potential\***

The voltage difference between a point and an agreed upon reference.

#### **Electrostatic shield\***

A barrier or enclosure that limits the penetration of an electrostatic field.

#### ESD\*

See electrostatic discharge.

#### ESD event\*

Occurrence of a single electrostatic discharge from any source. Examples of source include humans, ESD simulators and other charged objects.

## ESD failure\*

Non-recoverable failure (electrical or physical) of any circuit caused by its exposure to ESD event(s).

## ESD grounding / bonding reference point\*

The ESD grounding system selected for use in a facility or situation that best suits the application:

- a) AC equipment ground
- b) Auxiliary ground
- c) Equipotential bonding.

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## ESD protected area (EPA) \*

A defined location with the necessary materials, tools and equipment capable of controlling static electricity to a level that minimizes damage to ESD susceptible items.

## ESD protective packaging

Containers and other enclosures that have properties and functionality to limit electrostatic charge generation, dissipate electrostatic charge, or limit interior electrostatic fields

## Faraday cage\*

A conductive enclosure that attenuates a stationary electrostatic field.

## Field induced charging\*

A charging method using electrostatic induction.

#### **Garment system\***

Any electrically interconnected components of static control apparel.

#### Ground\*

- a. A conducting connection, whether intentional or accidental between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of earth.
- b. The position or portion of an electrical current at zero potential with respect to the earth.
- c. A conducting body, such as the earth or the hull of a steel ship used as a return path for electric currents and as an arbitrary zero reference point.

#### Grounded\*

Connected to earth or some other conducting body that serves in place of the earth.

#### Hard ground\*

A connection to ground through a wire or other conductor that has very little or nearly no resistance (impedance) to ground.

#### Human body model (HBM) ESD\*

An ESD event meeting the waveform criteria specified in ANSI/ESDA/JEDEC JS-001, approximating the discharge from the fingertip of a typical human being to a grounded component.

#### Human body model (HBM) ESD tester\*

Equipment that applies human body model electrostatic discharges to a component. Also referred to as an HBM simulator.

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## Human metal model (HMM) ESD tester\*

An ESD stress model that approximates the discharge from a human holding a metal object, such as a key or screw driver, touching one pin of a device with another pin grounded.

### **Insulated conductor\***

A conductor encased within material of composition and thickness that is recognized as electrical insulation.

#### Insulative materials\*

A material that has a surface resistance or a volume resistance equal to or greater than  $1 \ge 10^{11}$  ohms.

#### **Intimate packaging**

Materials that come into direct contact with ESD sensitive items

#### Ionization\*

The process by which a neutral atom or molecule acquires a positive or negative charge.

#### Ionizer\*

A device which is designed to generate positive and/or negative air ions.

#### Isolation\*

The electrical means of separating devices available in an IC process from unwanted interactions. Examples of isolation can be LOCOS, trench isolation, diffusions and insulating oxide layers.

#### Laminar flow hood ionization\*

These devices or systems provide local area ionization coverage in vertical or horizontal laminar flow hoods or benches.

## Latch-up\*

Latch-up refers to the activation of parasitic bipolar transistors (junctions) inherent to the CMOS process. These Transistors form a latch, which when activated, results in a large and sustained increase in the supply current. This state remains active until power is removed or the device self-destructs.

The device is generally non-functional when in their state. Latch-up is typically triggered by an over stress voltage or current on one or more pins.

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## Latent failure\*

A malfunction that occurs following a period of normal operation. NOTE: The failure may be attributable to an earlier electrostatic discharge event. The concept of latent failure is controversial and not totally accepted by all in the technical community.

#### Machine model (MM) ESD\*

An ESD stress model that approximates the discharge to a device pin due to contact of equipment or tools such as those found in the manufacturing line. This model assumes that one pin is contacting the equipment or tool that has an electrostatic charge and another pin is grounded.

#### Machine model (MM) ESD tester\*

Equipment that applies machine model electrostatic discharges to a component.

#### Neutralize\*

To eliminate an electrostatic field by recombining positive and negative charges, either by conducting the charge to ground or by introducing an equal opposite charge.

#### Non-contact voltage measurement\*

A measurement technique using an electrostatic field meter or voltmeter to monitor the voltage induced on an isolated conductive plate where there is no direct connection from the measurement sensor to the isolated conductive plate.

#### Nuclear ionizer\*

A device that creates ions usually by alpha emissions which strip electrons from gas molecules to form equal numbers of positive and negative ions in gases.

#### **Offset voltage\***

The observed voltage on the isolated conductive plate of a charged plate monitor that has been placed in an ionized environment.

#### **Passive ionizer\***

A device, usually a sharp grounded needle point, which discharges surfaces in the immediate vicinity by creating a conductive path of air ions.

#### 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.

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#### Personnel charge accumulation\*

Charge that accumulates on a person as a result of movement, such as walking across a floor.

#### **Point-to-point resistance\***

The resistance in ohms measured between two electrodes placed on any surface.

#### **Proximity packaging**

Materials or items that cover or surround intimate packaging materials

#### **Room ionization\***

Ionization systems that provide large area coverage with air ions.

#### Secondary packaging (physical protection)

Additional overwraps or containers that provide physical protection to proximity packaging **Socketed device model (SDM) electrostatic discharge (ESD)** \*

An ESD stress model that approximates the discharge event that occurs as the total charge stored in the test system, consisting of the IC component, socket and test simulator's parasitic elements, discharges to another object at a lower electrostatic potential (ground), through the test system relay matrix. (This model attempts to duplicate a CDM discharge for a charged component that is in a socket on a test fixture board of a relay matrix based tester.)

#### Socketed device model (SDM) electrostatic discharge (ESD) tester\*

Equipment that simulates the component level SDM ESD event in a socket.

#### Socketed discharge\*

An ESD event is initiated by a relay. The relay is connected to the component pin via a single pogo pin and a trace on the test fixture board while the component is placed in a socket.

#### Static control\*

- a. Adjective Electrostatic discharge protective.
- b. Noun Generic term for measures taken to diminish the effects of electrostatic discharge.

#### Static control floor material\*

A permanently installed floor material such as tile, carpet, polymer, epoxy, or sheet flooring that dissipates static charges by grounding personnel, equipment, or other objects contacting the floor material, or that controls the generation and accumulation of static charges associated with floor materials.

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#### Static control footwear (other devices) \*

Foot grounds, such as foot straps, toe grounders, booties, or other electro-mechanical connectors (excluding shoes), which are connected to human feet and are intended to control the generation and accumulation of static charge when used in conjunction with a static control floor, floor finish, or floor mat.

#### Static control footwear (shoes) \*

Coverings for the human foot that have properties to control the accumulation of static charge when used in conjunction with a static control floor, floor finish, or floor mat.

#### Static control garment\*

A garment that exhibits a specified electrical resistance from any point or panel on the garment, to another point or panel on the garment.

#### Static control seating\*

Chairs used in conjunction with a static control floor or static control floor mat that are intended to control the generation, accumulation and dissipation of electrostatic charge associated with the seating.

#### Static decay test\*

A procedure in which an item is first charged to a specified voltage, then allowed to dissipate to a specified voltage while measuring the duration of the discharge.

#### Static dissipative\*

A property of a material having a surface resistivity of at least  $1 \ge 10^5$  ohms/square or  $1 \ge 10^4$  ohm-cm volume resistivity but less than  $1 \ge 10^{12}$  ohms/square surface resistivity or  $1 \ge 10^{11}$  ohm-cm volume resistivity.

#### Surface resistance\*

The ratio of DC voltage to the current flowing between two electrodes of specified configuration that contact the same side of a material. This measurement is expressed in ohms.

#### Surface resistivity\*

For electric current flowing across a surface, the ratio of DC voltage drop per unit length to the surface current per unit width. In effect, the surface resistivity is the resistance between two opposite sides of a square and is independent of the size of the square or its dimensional units. Surface resistivity is expressed in ohms/square.

#### **Tabletop ionization\***

See worksurface ionization.

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#### Transmission line\*

A coaxial cable with controlled impedance for transferring a signal with minimum loss from one point of the system to another.

## Transmission line pulse (TLP) \*

A rectangular current pulse formed by discharging a charged transmission line cable.

#### Transmission line pulse test system\*

A test system that applies a transmission line pulse to a device under test and allows measurement of device electrical characteristics during a pulsed state. The system typically measures current and voltage across the device, and typically performs an evaluation measurement after TLP pulse application.

#### Triboelectric charging\*

The generation of electrostatic charges when two materials make contact or are rubbed together, then separated. *See also* triboelectric series.

#### **Triboelectric series\***

A list of materials arranged so that one can become positively charged when separated from one farther down the list, or negatively charged when separated from one farther up the list. NOTE: The series' main utility is to indicate likely resultant charge polarities after triboelectric generation.

However, this series is derived from specially prepared and cleaned materials tested in very controlled conditions. In everyday circumstances, materials reasonably close to one another in the series can produce charge polarities opposite to that expected. This series is only a guide.

#### Volume resistance\*

The ratio of the DC voltage to current passing between two electrodes, of a specified configuration, that contact opposite sides of the material or object under test. Volume resistance is reported in ohms.

#### Volume resistivity\*

The ratio of the DC voltage per unit thickness to the amount of current per unit area passing through a material. Volume resistivity is given in ohm-centimeters.

#### Worksurface ionization\*

Ionization devices or systems used to control static charges at a workstation. NOTE: This type includes bench top Ionizers, overhead worksurface Ionizers, and laminar flow hood ionizers.

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## Wristband\*

The portion of the wrist strap worn on the wrist. The wristband makes electrical contact with a person's skin.

## Wrist strap\*

An assembled device consisting of a wristband and ground cord that provides electrical connection of a person's skin to ground.

## Wrist strap system\*

A wrist strap when properly worn by a person, where the electrical path includes the person, the cuff, and the ground cord.

## Zap (colloquial term) \*

See electrostatic discharge.

## *Note:* \* *is source of reference from ESD Association standard document of* (ESD ADV1.0-2017)

## **Additional Information:**

Regarding HDD manufacturing process, 5 to 10V static charge control is popular. Therefore, we recommend below measurement conditions and specifications at ESD control.

- 1. Surface Resistance measurement: We recommend 10V applied voltage range and surface resistance meter have IEC 61340/RCJS/ESDA Standard conformity.
- 2. Device voltage measurement: We recommend electrostatic voltmeter.
- Ionizer performance measurement: We recommend below condition and Charged Plate monitor have IEC 61340/RCJS/ESDA Standard conformity. Decay mode: From +/- 1,000V to +/-10V Offset Voltage: +/- 5 to +/- 10V

This document is subject to change. To propose a new term or to prose an update to an existing term, please send proposed update and/or change to the IDEMA Standards Program Manager.