1.0 Purpose:

1.1
Packaging materials are required during various stages in the manufacturing of disk drives, including but not limited to: trays, wraps, bags, pouches, films, containers and other carriers that come into close proximity or contact to disk drives and components. This standard establishes the fundamental requirements for ESD protective packaging materials for use with Magnetoresistive (MR), Giant Magnetoresistive (GMR) and related new concepts in disk drive read-write head manufacturing and processing.

1.2
This standard specifies requirements to control electrostatic potential levels on packaging lower than what can cause damage to the most sensitive parts handled. For transportation outside of established ESD protected areas, packaging suitable for protection of components from electrostatic discharges and fields is required. Within an ESD protected area, low charging or electrostatic dissipative packaging materials are required.

2.0 Scope:

2.1
This standard applies to all operations that involve packaging, transportation, handling and other activities intended to provide electrostatic protection to MR, GMR, TMR, MAMR, HAMR and related technologies in disk drive and read-write head production.

3.0 Referenced and/or Related Documents:

Unless otherwise specified, the following document of the latest issue, revision or amendment, forms a part of this standard to the extent specified herein.

IDEMA – **Glossary of Terms Used in ESD Control Documents,** ESD Doc01
IDEMA – HDD Process General Practices for ESD Control (Tentative name), ESD Doc03
IDEMA – **Microcontamination Standards**
EOS/ESD ADV 1.0 EOS/ESD Association Glossary of Terms,
ESD TR20.20-2016:
Handbook For The Development Of An Electrostatic Discharge Control Program For The Protection Of Electronic Parts, Assemblies, And Equipment

ANSI/ESD S20.20-2014:
Protection Of Electrical And Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices)

ESD ADV11.2-1995:
ESD Association Advisory for the Protection of Electrostatic Discharge Susceptible Items – Triboelectric Charge Accumulation Testing

ANSI/ESD S11.4-2012:
ESD Association Standard for the Protection of Electrostatic Discharge Susceptible Items – Static Control Bags

ANSI/ESD STM11.11-2021:
ESD Association Standard Test Method for Protection of Electrostatic Discharge Susceptible Items – Surface Resistance Measurement of Planar Materials

ANSI/ESD STM11.12-2021:
ESD Association Standard Test Method for Protection of Electrostatic Discharge Susceptible Items – Volume Resistance Measurement of Planar Materials

ANSI/ESD STM11.13-2021:
ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items – Two-Point Resistance Measurement

ANSI/ESD STM11.31-2018:
ESD Association Standard Test Method for Evaluating the Performance of Electrostatic Discharge Shielding Materials – Bags

ANSI/ESD S541-2019:
Standard for Packaging ESD Susceptible Items

IEC 61340-5-1:2016 RLV: Redline version
Electrostatics - Part 5-1: Protection of electronic devices from electrostatic phenomena - General requirements

IEC TR 61340-5-2:2018:
Electrostatics - Part 5-2: Protection of electronic devices from electrostatic phenomena - User guide

ESD TR55.0-01-04:
ESD Association Technical Report – Electrostatic Guidelines and Considerations For Cleanrooms and Clean Manufacturing

ANSI/ESD S1.1-2021:
ESD Association Standard for the Protection of Electrostatic Discharge Susceptible Items – Wrist Straps

ANSI/ESD STM2.1-2018:

ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items – Garments – Resistive Characterization

ANSI/ESD STM3.1-2015:

ESD Association Standard Test Method For the Protection of Electrostatic Discharge Susceptible Items – Ionization

ANSI/ESD SP3.3-2016:

ESD Association Standard Practice For the Protection of Electrostatic Discharge Susceptible Items - Periodic Verification of Air Ionizers

ANSI/ESD SP3.4-2016:

ESD Association Standard Practice For the Protection of Electrostatic Discharge Susceptible Items - Periodic Verification of Air Ionizer Performance Using a Small Test Fixture

ANSI/ESD SP3.5-2020:

ESD Association Standard Practice for the Protection of Electrostatic Discharge Susceptible Items - Test Methods for Air Assist Bar Ionizers, Soft X-Ray (Photon) Ionizers, Room Ionization Alternatives, and Non-Airflow Alpha Ionizers

ANSI/ESD STM4.1-2017:

ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items – Worksurfaces – Resistance Measurements

ESD STM4.2 ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items - Worksurfaces – Charge Dissipation Characteristics

ANSI/ESD SP5.1.3-2017:

ANSI/ESD SP5.1.3 Human Body Model (HBM) Testing - Component Level - A Method for Randomly Selecting Pin Pairs

ESD SP5.2-2019:

ESD Association Standard Practice for Electrostatic Discharge Sensitivity Testing - Machine Model (MM) - Component Level

ANSI/ESD SP5.3.3:

ANSI/ESD SP5.3.3 - Charged Device Model (CDM) Testing – Component Level-Low-Impedance Contact CDM as an Alternative CDM Characterization Method

ANSI/ESD S6.1-2019:

ESD Association Standard Practice for the Protection of Electrostatic Discharge Susceptible Items – Grounding

ANSI/ESD STM7.1-2020:
ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items – Floor Systems – Resistive Characterization
ANSI/ESD STM9.1-2014:
ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items – Footwear – Resistive Characterization
ANSI/ESD STM12.1-2019:
ESD Association Standard Practice for the Protection of Electrostatic Discharge Susceptible Items – Seating – Resistance Measurement
ESD ADV53.1-1995:
ESD Association Advisory for Protection of Electrostatic Discharge Susceptible Items -ESD Protective Workstations
ANSI/ESD STM97.1-2015:
ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items – – Footwear/Flooring System – Resistance Measurement in Combination with a Person
ANSI/ESD STM97.2-2016:
ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items – Footwear/Flooring System – Voltage Measurement in Combination with a Person

ISO 14644 Cleanrooms and Associated Controlled Environments

4.0 ESD Protective Packaging Material Requirements

4.1
Materials that have direct contact with ESD susceptible items, including disk drive head components regardless of type, shall be either low charge generating or electrostatically dissipative or both. Conductive materials may be substituted in user-defined applications.

Note:
Low charge generation materials are those that allow the generation of less than user defined charge levels when contacted and separated from actual components in a process that simulates actual handling conditions.
Note:
A material's electrical resistance is not necessarily creatable to a material's propensity to generate charge upon contact and separation.

4.1.1

Electrostatically dissipative materials have a surface resistance between 1 x 10^4 Ω and < 1 x 10^{11}Ω when tested using ANSI/ESD STM 11.11 or 11.13 or equivalent, or a volume resistance of greater than 1 x 10^4 Ω but less than 1.0 x 10^{11}Ω when tested using ANSI/ESD S20.20, ANSI/ESD STM 11.12

Note:
Lower resistance value materials have faster discharge times in actual use.
Note:
In the event that sample geometry does not allow the use of ANSI/ESD S20.20, ANSI/EOS/ESD STM 11.11 or ANSI/ESD STM 11.12, other probe configurations may be used as long as a correlation in results has been made between the probes.

4.1.2

Electrostatically conductive materials have a surface resistance of < 1 x 10^4 Ω when tested according to ANSI/ESD S20.20, ANSI/ESD STM 11.11 or equivalent, or a volume resistance of < 1 x 10^4 Ω. when tested according to ANSI/ESD STM 11.12.

4.1.3

Packaging bags that are used for static discharge shielding protection should be evaluated using the test methods described in ANSI/ESD S20.20, ANSI/ESD STM 11.31. Approved shielding bags shall attenuate the static discharge to less than 25 nJ.

4.2

Materials used to contain, cover or physically protect ESD susceptible items (including disk drive head components, regardless of type), during transportation outside of an ESD protected area must be electrostatic discharge shielding (4.1.3) and have low charging or static dissipative direct contact surfaces. Conductive materials may be substituted in user-defined applications.

5.0 Cleanliness Requirements

5.1

Cleanliness is not an absolute. It is a relative condition denoting the degree to which a product can be isolated from or cleaned of contaminants. The level of required cleanliness must first be established for the end product before the level of cleanliness for packaging or containers can be determined.

The cleanliness requirements should be based on individual company manufacturing specifications. This Packaging Standard references the IDEMA Standards, and ASTM Test Methods for Microcontamination, which document minimum guidelines to be used.

5.1.1

Particulate--No Industry Standards

ASTM F311

ASTM F312

5.1.2

Non-Volatile Residue

NVR Testing: The filtered solvent from particle testing is heated and analyzed for total non-volatile residue.

IDEMA Standard M7-98 Organic Contamination as Non-Volatile Residue

5.1.3

Outgassing

The analysis of volatile chemicals typically uses gas chromatography / mass spectroscopy. The packaging material sample is heated in a closed container, driving off volatile components. The collected sample is then analyzed by weight. This outgassing is caused by a combination of vacuum and/or high temperatures in the test environment that may be well beyond what can be expected in real handling and shipping situations.

IDEMA Standard M11-99 General Outgas Test Procedure by Dynamic Headspace Analysis

IDEMA Standard M14-00 Guide to Outgassing by Dynamic Headspace Cry focusing GC-MS

5.1.4 Ionic Contamination

Ionic contamination is defined as chemical species that are not electrically neutral, but are either charged positively or negatively. Ionic contaminants are anions (e.g. fluorine, chlorine, bromides, nitrates, nitrites, phosphates, and sulfates) and cations (e.g. lithium, sodium, ammonium, potassium, magnesium, and calcium). The presence of ionic contamination may cause corrosion. Ionic contaminants are determined by ion chromatography. The user must define the level of ionic contamination based on product requirements.

IDEMA Standard M10-98 Special Cation Analysis

IDEMA Standard M12-99 Measurement of Extractable /Leachable Cation Contamination Levels on Drive Components by Ion Chromatography (IC)

IDEMA Standard M13-99 Measurement of Extractable/Leachable Anion Contamination Levels on DRIVE Components by Ion Chromatography (IC)

6.0 Moisture Barrier Properties (If Required)

6.1 Film or Sheet materials must meet ANSI/ESD S20.20, ANSI/ESD S541, EIA541, or surpass EIA 583 Class 1 (Type-1) / equivalent requirements for Water Vapor Transmission Rate (WVTR).

6.2 Bag or Pouch – Factory heat seal seams should meet ANSI/ESD S20.20, ANSI/ESD S541, EIA 541, EIA 583 Class 1 (Type-1) or equivalent requirements for WVTR.

7.0 Physical Properties

All physical properties must meet or exceed user-defined requirements based on application requirements.