ESD Association Standard

ANSI/ESD S541-2019

ANSI/ESD S541-2019
Limited revision of ANSI/ESD S541-2018

For the Protection of Electrostatic Discharge Susceptible Items

Packaging Materials

Electrostatic Discharge Association
7900 Turin Road, Bldg. 3
Rome, NY 13440-2069

An American National Standard
Approved December 19, 2019

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

Packaging Materials

EOS/ESD Association, Inc.
Approved June 19, 2019

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FOREWORD

Packaging is necessary to protect electronic items from physical and environmental damage during manufacturing, transportation, and storage. While most packaging (not for static sensitive items) provides physical and environmental protection, some forms of packaging also may harm static sensitive electronic items by allowing the accumulation or the discharge of static electricity. (See Annex B for device damage information.)

Packaging for ESD susceptible (ESDS) items are commonly derived by modifying existing packaging to prevent the packaging itself from causing static damage. The packaging generally retains its physical and environmental protective qualities. Some forms of ESD protective packaging have been modified further to prevent other sources of static electricity from damaging a packaged item.

This can be illustrated by considering bags. Polyethylene bags are useful packages for containing items and providing protection from physical and environmental damage. However, polyethylene bags may accumulate potentially damaging amounts of static electricity. Chemicals (antistats) may be added to polyethylene film to render it low charging. The result is a low charging polyethylene film that is less likely to charge static sensitive items by contact and separation (triboelectric interaction). Static sensitive items that attain an electrostatic charge may be damaged when they are grounded or contact other items at a different electrical potential. By adding a conductive layer to the low charging polyethylene bag, an ESD shielding bag is created. This static discharge shielding bag is low charging, shields packaged items from exterior discharges, and limits external electric fields generated by other items. For additional information, see ANSI/ESD S11.4 Static Control Bags.

Other normal packaging, including corrugated paper, plastic boxes, trays, clamshells, etc., may be treated similarly to films, resulting in packaging forms that have static control properties. A complete ESD control program, such as defined by ANSI/ESD S20.20, requires the use of ESD protective packaging as part of the system needed to manufacture, transport, and store ESDS devices properly. This standard provides the requirements for ESD protective packaging that is used inside and outside an ESD protected area (EPA).

Because most physical and environmental considerations can be left to traditional packaging design and testing methodologies, only the material properties that provide reduction or prevention of damage from static electricity need be addressed in this standard.

This standard[1] describes the packaging material properties needed to protect ESDS electronic items and references the testing methods for evaluating ESD protective packaging and packaging materials for those properties. Where possible, required limits are provided. Guidance for selecting ESD protective packaging with protective properties appropriate for specific applications is also provided. Other considerations for ESD protective packaging are also provided.

This document is a substantial refinement of the discontinued Electronic Industries Association standard EIA-541-1988 (canceled by ANSI in 1999). Updates include the adoption of surface resistance (ohms) in place of surface resistivity (ohms/square), volume resistance (ohms) in place of volume resistivity (ohm-cm), a shielding test that allows penetrating energy (nJ) to be calculated in place of a differential voltage measurement (volts) and limits the use of static decay testing. Resistance is no longer the only property that is used to classify ESD protective packaging. Low charging, electric field shielding, and direct discharge shielding have been added.

[1] **ESD Association Standards (S):** A precise statement of a set of requirements to be satisfied by a material, product, system or process that also specifies the procedures for determining whether each of the requirements is satisfied.

This standard was originally designated ANSI/ESD S541-2003 and was approved on February 9, 2003. ANSI/ESD S541-2008 was a reaffirmation of ANSI/ESD S541-2003 and was approved on June 8, 2008. ANSI/ESD S541-2018 was a revision of ANSI/ESD S541-2008 and was approved on April 15, 2018. ANSI/ESD S541-2019 is a limited cycle revision of ANSI/ESD S541-2018 and was approved on June 19, 2019.

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1.0 PURPOSE

This standard defines the packaging properties needed to protect electrostatic discharge susceptible (ESDS) electronic items through all phases of production, transport, and storage. Packaging requirements are defined to support the ESD control program requirements stated in ANSI/ESD S20.20. Test methods are referenced for the evaluation of ESD protective packaging and packaging materials. Required limits are provided.

2.0 SCOPE

This document applies to packaging used to store, transport, and protect ESDS electronic items during all phases of production and distribution. This document does not address protection from EMI/RFI/EMP or protection of volatile materials.

3.0 REFERENCED PUBLICATIONS

Unless otherwise specified, the following documents of the latest issue, revision, or amendment form a part of this standard to the extent specified herein:

ESD ADV1.0, Glossary[2]

ESD TR20.20, ESD Control Program Handbook[2]

ANSI/ESD S8.1, Symbols, ESD Awareness[2]

ANSI/ESD STM11.11, Surface Resistance Measurement of Static Dissipative Planar Materials[2]

ANSI/ESD STM11.12, Volume Resistance Measurement of Static Dissipative Planar Materials[2]

ANSI/ESD STM11.13, Two-Point Resistance Measurement of Static Dissipative Materials[2]

ANSI/ESD STM11.31, Bags[2]

4.0 DEFINITION OF TERMS

The following definition shall apply for the purposes of this standard in addition to those specified in the ESD Association Glossary of Terms, available for complimentary download at www.esda.org:

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.

unprotected area (UPA). Areas not designated as an EPA.

NOTE: Refer to ANSI/ESD S20.20 for a discussion of safeguards and ESD TR20.20 for additional guidance on setting up and maintaining an EPA.

[2] EOS/ESD Association, Inc., 7900 Turin Road, Bldg. 3, Rome, NY 13440; 315-339-6937; www.esda.org