



R&R LOTION

2025 ESD Control Program Guide

Understanding and Preventing
Electrostatic Discharge



Introduction

In the modern electronics landscape, where microchips and advanced circuitry are at the heart of innovation, even a single invisible spark can lead to catastrophic failures. Electrostatic Discharge (ESD), a silent and often underestimated threat, poses significant risks to manufacturing, quality control, and product reliability. This white paper, *ESD Control Program Guide: Understanding and Preventing Electrostatic Discharge*, serves as a comprehensive resource for professionals seeking to mitigate ESD risks and safeguard sensitive electronic components.

The guide provides a foundational understanding of ESD, detailing its causes, effects, and the challenges it presents in high-tech environments. More importantly, it outlines actionable strategies to establish static-safe workplaces, implement effective grounding techniques, and select essential tools for ESD control. From preventing costly damage and latent failures to ensuring compliance with industry standards, this guide equips organizations with the knowledge needed to maintain operational excellence and enhance customer satisfaction.

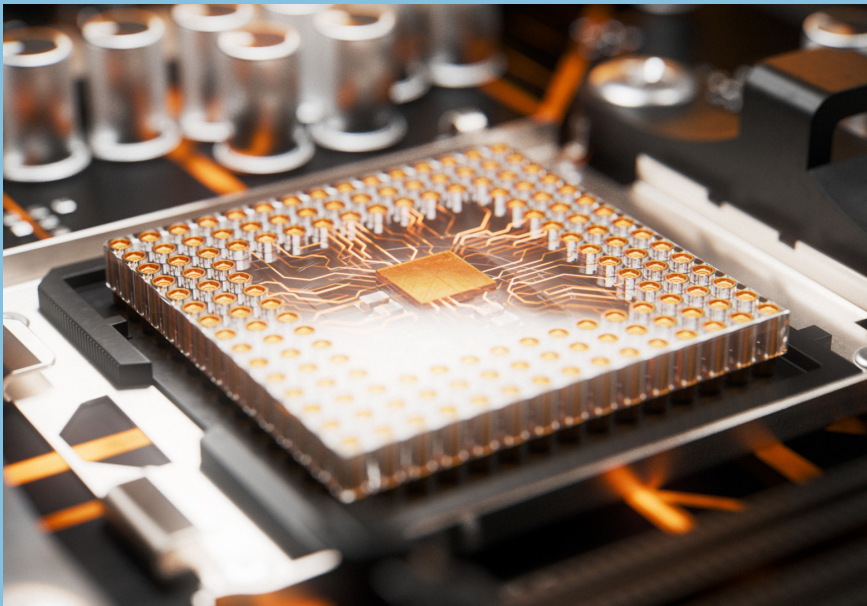


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What is ESD?

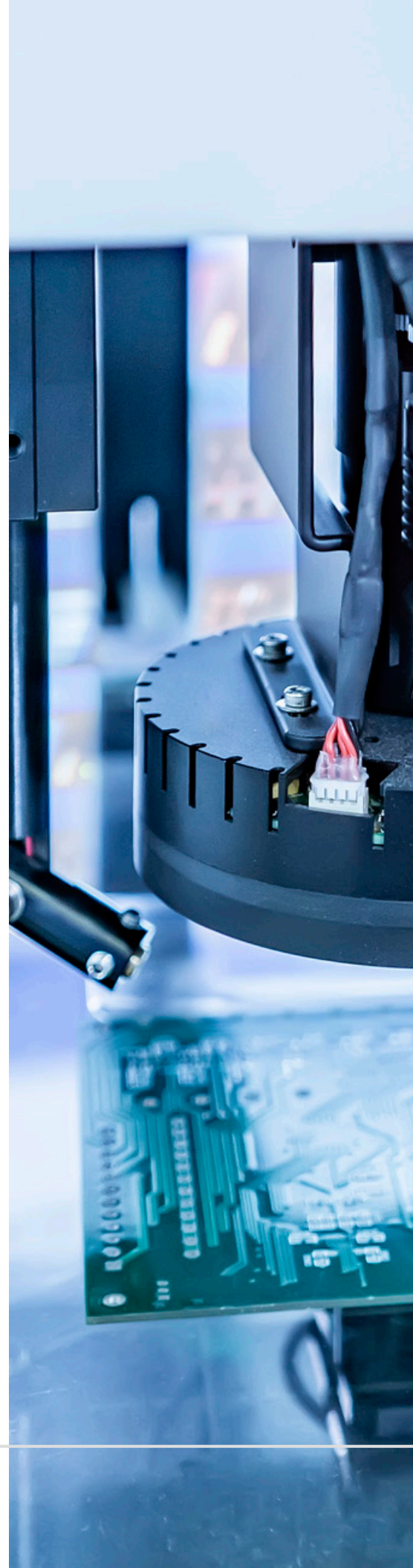
Electrostatic Discharge (ESD) is the sudden transfer of electricity from one object to another. Commonly referred to as “static electricity,” ESD is something we encounter in everyday life:

- The shock you feel after walking across a carpet and touching a doorknob.
- The crackling sound and sparks when pulling clothes out of the dryer.
- The dramatic flash of lightning during a storm, which is nature’s version of ESD on a massive scale.

While these events may seem harmless, ESD is one of the most serious threats to modern electronics. Even a tiny spark—one you can’t feel or see—can damage sensitive components, leading to costly repairs, lower product quality, and frustrated customers.

Why is ESD a Problem for Electronics?

- **Higher Costs:** Components damaged by ESD may need immediate replacement or rework, increasing production costs.
- **Intermittent Failures:** These “walking wounded” devices may pass initial tests but fail unpredictably in the field, resulting in additional service calls and warranty claims.
- **Customer Dissatisfaction:** Product malfunctions, especially at critical moments, damage brand reputation and erode trust.



Major Problems Associated with Static Discharge:

Dust and Lint Attraction

Static charges attract dust and debris, contaminating sensitive work areas

Material Handling Issues

Static can disrupt automated handling processes and cause jams or misfeeds

Product Damage and Malfunction

Direct and indirect ESD damage can render products inoperable or unreliable

Fire and Explosion Hazards

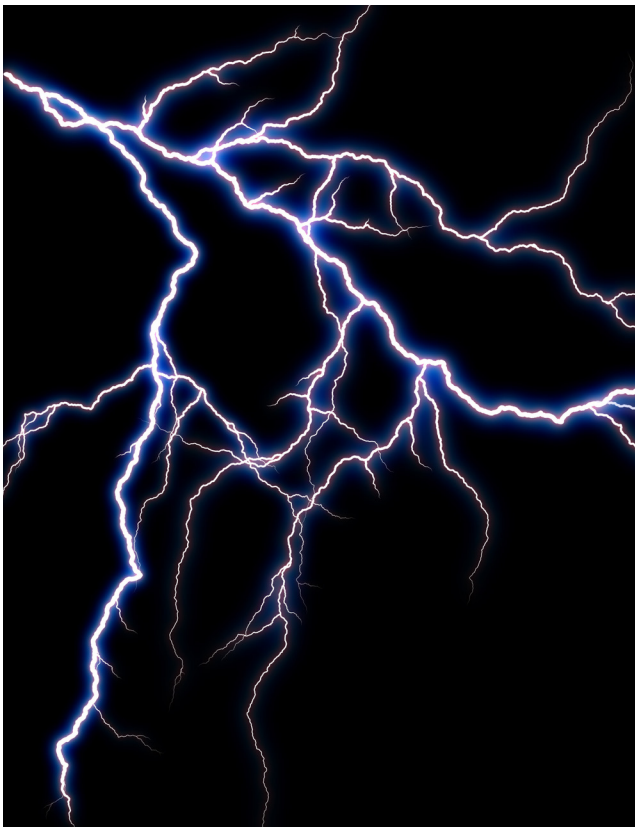
Static discharges in environments with flammable materials can cause catastrophic events

How Does ESD Happen?

ESD occurs when two objects with different electrical charges come into contact, rub together, or are separated. Even objects that don't touch can cause ESD if they are close enough for their electric fields to interact.

Every object possesses an electrical charge, which can be classified as positive, negative, or neutral. A positive charge occurs when there are more protons than electrons, while a negative charge results from having more electrons than protons. A neutral charge exists when the number of protons and electrons is

equal. When these charges become imbalanced, static electricity is generated. For instance, walking across a carpet can cause your body to accumulate static electricity. If you then touch a sensitive electronic component, the charge flows, potentially leading to damage.

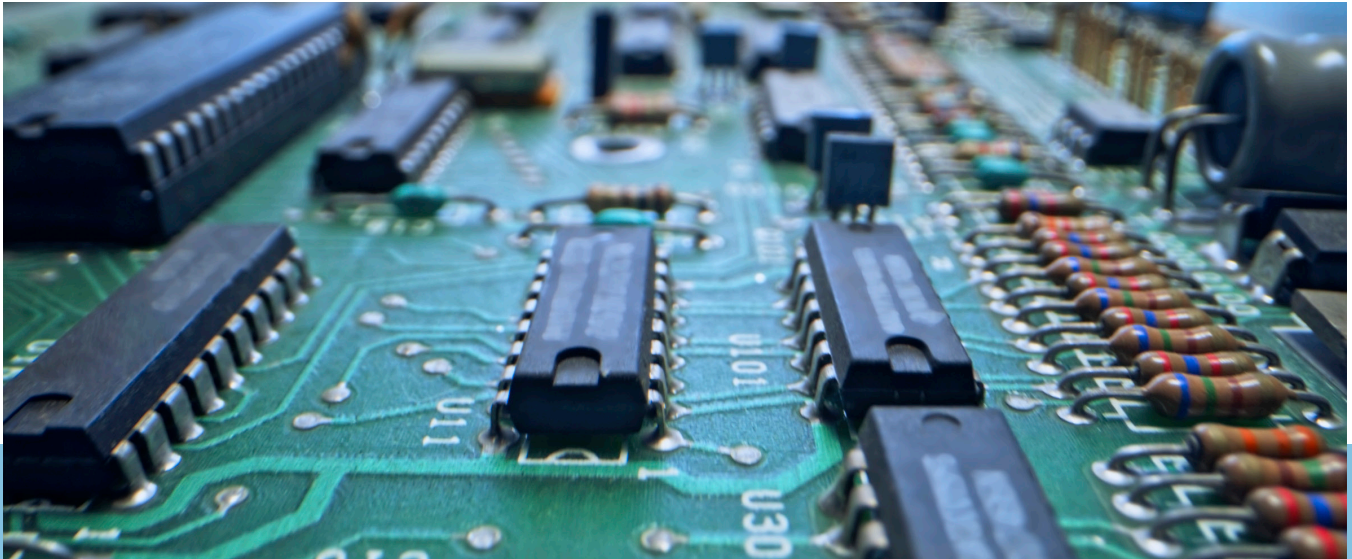


Materials and Their Static Charge Tendencies

- **Positive Charge Producers:** Asbestos, glass, mica, human hair, wool, nylon, aluminum, silk, paper
- **Negative Charge Producers:** Steel, wood, hard rubber, brass, sulfur, polyester, Teflon, PVC, polyethylene

Factors that Increase ESD

- **Low Humidity:** Dry air makes it easier for static to build up
- **Activity Type:** Walking, rolling a chair, or even brushing your hair can create static
- **Materials:** Synthetics, plastics, and other insulators are prone to static buildup



How Does ESD Damage Electronics?

ESD damage can be surprisingly severe, even though the discharge itself is often invisible and silent. The damage occurs when a sudden flow of electricity, caused by static discharge, interferes with the delicate internal structures of an electronic component. This interference can cause:

Immediate Failure:

This type of damage is apparent right away. The static discharge destroys the component outright, rendering it non-functional. For instance, a microchip may no longer process data, or a circuit board might completely shut down. Immediate failures are easier to detect during quality control checks but can still result in production delays and increased costs.

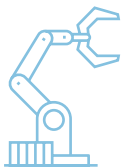
Latent Failure:

Latent damage is far more insidious. The static discharge weakens the component, but the defect doesn't manifest until later—during testing, use, or repair. The product might work fine initially, only to fail unpredictably in the field. This leads to expensive returns, warranty claims, and frustrated customers. Latent failures are particularly concerning because they can harm a company's reputation and erode customer trust.

EOS (Electrical Overstress):

Electrical Overstress (EOS) is a type of failure caused by excessive voltage or current, often resulting from an ESD event, that permanently damages internal circuits. EOS is the leading cause of semiconductor failures, accounting for approximately 59% of all electronic defects. This far exceeds other common causes, such as wire bond issues (15%) and die fractures (4%), making it a critical concern in electronics manufacturing and handling processes.

When Can ESD Damage Happen?

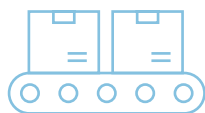


During Production

Manufacturing processes often involve sensitive components being handled, moved, and assembled. Without proper ESD controls, workers and tools can introduce static that damages these components

During Testing or Inspection

Quality control processes that involve direct interaction with the product can also create opportunities for ESD if testing stations and personnel aren't properly grounded

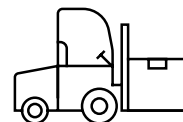


During Assembly or Packaging

Packaging materials, particularly plastics, are often insulators that can generate and hold static charges. If ESD-safe packaging isn't used, static can discharge directly into the product during the packing process or while items are being transported

During Shipping and Storage

Transportation exposes products to various risks, including environmental conditions like low humidity, which increase the likelihood of static buildup. Items stored without adequate shielding may also be exposed to charges from nearby materials.



During Service and Repair

Repairs often involve opening a product and directly handling its internal components. Without proper grounding and static control measures, technicians can inadvertently damage parts during servicing.

How to Prevent ESD: Creating a Static-Safe Workplace

Preventing ESD is critical to ensuring the integrity and reliability of sensitive electronic components. Implementing a comprehensive ESD control program doesn't just reduce product failures—it also saves time, money, and the reputation of your products and organization. Here's how to establish a static-safe workplace that protects components at every stage of handling and production.



Treat All Components as ESD-Sensitive

Adopt a precautionary approach, treating every component as susceptible to static damage to ensure consistent protection. Classify sensitivity levels (e.g., Class 0 to Class 3) and conduct regular training to reinforce awareness. Organize periodic audits and use monitoring data to improve ESD control programs



Ground Everything and Manage Static Risks

Personnel and Tools: Use and test wrist straps, heel straps, or conductive footwear daily. Ground all tools and equipment or use static-dissipative alternatives.

Workstations and Equipment: Install ESD mats and ensure proper grounding for chairs, carts, and other items. Control insulative materials by removing unnecessary items, using static-dissipative alternatives



Use Protective Storage and Maintain Clean Work Areas

Protective Storage: Store and transport components in static-shielding containers, inspecting them regularly. Use moisture vapor barrier bags (MVBs) for items sensitive to moisture and static.

Clean Work Areas: Keep workspaces clutter-free and clean with ESD-safe cleaners. Organize tools and equipment properly, replacing worn or damaged grounding equipment to maintain effective static control



Grounding: The Foundation of ESD Control

Grounding is a critical component of any ESD control program. Proper grounding provides a safe and efficient pathway for static electricity to dissipate, protecting sensitive electronics from damage. However, understanding the principles, methods, and testing of grounding can be complex. This section will break down the essential concepts and best practices to ensure effective static control.

What is Grounding?

Grounding creates a conductive path for electrical charges to flow safely into the earth or a designated point, preventing harmful static discharges. In ESD control, it dissipates static electricity from personnel, tools, and equipment.

Types of Grounding:

Earth Ground: Physical connection to the earth, like a ground rod or water pipe

ESD Ground: Specific grounding point for ESD control equipment

Common Ground: Shared system connecting all conductive surfaces to the same potential

Third Wire Ground: Standard electrical outlet ground for safety and equipment protection

01 Key Grounding Concepts



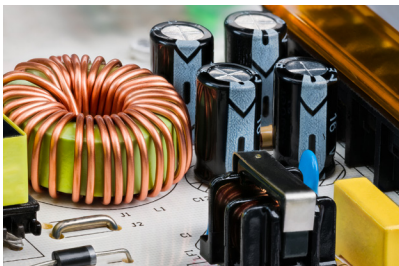
- **Resistivity:** Surface Resistivity: Measures how materials dissipate static across surfaces, key for ESD-safe mats. Volume Resistivity: Assesses charge dissipation through a material's bulk, crucial for insulators.
- **Equipotential Bonding:** Connects all conductive items in an ESD-protected area to a common ground, ensuring uniform electrical potential and preventing ESD events.
- **Ionization:** Neutralizes static on non-conductive materials by emitting balanced ions, ideal for insulators like plastics and glass

02 How to Ground and Test Resistance



- **Wrist Straps:** Safely dissipate charges by connecting personnel to a ground point. Resistance should be 1–10 megohms (ANSI/ESD S1.1).
- **Worksurfaces and Mats:** Connect to a ground point and maintain resistance between 10^6 – 10^9 ohms. Test point-to-point and to the ground (ANSI/ESD S4.1).
- **Footwear and Flooring:** Ground mobile personnel by ensuring resistance from footwear through flooring meets safety standards (ANSI/ESD STM97.1).
- **Testing Ground Points:** Verify ground integrity using a multimeter; resistance to earth ground should be below 1 ohm (ANSI/ESD S6.1)

03 Why Improper Grounding is a Problem



- **Loose Connections:** Faulty connections between ground points and equipment can introduce resistance or fail to dissipate charges.
- **Corrosion:** Over time, grounding systems can degrade, reducing their effectiveness.
- **Electrical Noise (EMI):** Poor grounding can result in electromagnetic interference (EMI), disrupting sensitive electronics.

01 | How to Test and Maintain Grounding Systems



- Test outlets for correct wiring and proper grounding.
- Inspect ground points for secure, corrosion-free connections.
- Regularly measure resistances with a multimeter.
- Verify all equipment is bonded to a common ground using a continuity tester.

02 | When Bonding and Grounding are Critical



- **Bonding:** Necessary when multiple conductive surfaces or equipment pieces need to share the same electrical potential to prevent charge imbalances. Examples include connecting metal shelves, racks, and workstations to a single ground.
- **Common Ground Bonding:** Connects all ESD control elements—such as mats, tools, and personnel grounding devices—to a centralized ground point.

Essential Tools for ESD Control

A successful ESD control program relies on a combination of tools and equipment designed to prevent, neutralize, or safely dissipate static electricity. These tools are vital for creating a static-safe environment and ensuring that sensitive electronic components remain protected. Below is an expanded list of essential products and their roles in ESD control:

Testing static flooring ensures it performs effectively within the ESD control system. Regular testing identifies issues like degradation, wear, or environmental factors that could impact its performance.

Resistance Testing

Resistance testing measures the flooring's ability to dissipate static charges. Using an ohmmeter or specialized resistance meter, measure the resistance from the flooring to the ground. Recommended ranges include:

- Conductive Flooring: Less than 1×10^6 ohms.
- Static-Dissipative Flooring: Between 1×10^6 and 1×10^9 ohms

System Walking Test

This test evaluates the performance of the flooring in conjunction with ESD footwear. Personnel wearing conductive footwear walk across the flooring while instruments measure how static charges are dissipated. This test ensures the system works under real-world conditions.

Subfloor Moisture Testing

Before installation, test the subfloor for moisture content. Excess moisture can interfere with the adhesive or bonding process, leading to performance issues or delamination.

Wrist Straps

Wrist straps are one of the most reliable tools for grounding personnel in static-sensitive environments. By providing a direct connection between the worker and a designated ground point, wrist straps ensure that static charges generated by the human body are safely dissipated, preventing electrostatic discharge (ESD) from damaging sensitive electronics.



How Wrist Straps Work

A wrist strap consists of two main components:

1. **Conductive Band:** The band is made from materials such as stainless steel or conductive fibers and is worn snugly against the worker's skin. This ensures a direct pathway for static electricity to flow.
2. **Cord with Resistor:** The wrist strap is connected to a ground point via a cord that includes a built-in resistor (usually 1 megohm). The resistor limits current flow to prevent electrical shock, ensuring worker safety.

When properly worn, the wrist strap neutralizes any static charge on the body by allowing it to dissipate safely to the ground. This protects ESD-sensitive components during handling and assembly. Wrist straps ground personnel in static-sensitive environments, varying by material (metal or fabric) and connection (corded or cordless). Metal straps are durable and conductive, while fabric straps are comfortable and flexible. Corded straps ensure reliable grounding for stationary tasks, while cordless straps offer mobility but are less effective in high-static settings.



Boost Wrist Strap Performance with I.C. ESD Safe Lotion

Dry skin and hair can insulate and hinder wrist strap performance. I.C. ESD Safe Lotion addresses this by:

- Hydrating skin** to reduce resistance and improve conductivity.

- Supporting your ANSI/ESD S20.20 program** by helping keep the skin-to-strap contact conductive.

- Minimizing interference from hair** by creating a better contact surface.

Used with your ESD program, this lotion helps keep wrist strap grounding reliable and reduce ESD-related risks.

Heel Straps

Heel straps are an essential component of ESD control programs, designed to ground personnel who are frequently mobile in static-sensitive environments. By providing a continuous path to ground when used with conductive flooring, heel straps prevent static charges from accumulating on the body, reducing the risk of electrostatic discharge (ESD) damaging sensitive electronics.



How Heel Straps Work

A heel strap consists of two main components:

1. **Conductive Strap or Cup:** The conductive material wraps around the heel or sole of the worker's shoe. It creates a connection between the worker's footwear and the conductive flooring, enabling static charges to flow to the ground.
2. **Static-Dissipative Tab:** A conductive tab is inserted into the shoe, making contact with the worker's skin or sock. This ensures that static charges generated by the body are transferred to the heel strap for dissipation.

When used with ESD-safe flooring, heel straps provide effective grounding for personnel who need to move around the workspace. Proper contact with the floor and consistent wear are critical to their functionality.

Types of Heel Straps

Heel straps and conductive footwear offer grounding solutions tailored to various needs.

Heel Grounders: Elastic straps around the heel; cost-effective and easy to wear but may lose floor contact during movement.

Toe Grounders: Fit the shoe's front; ideal for incompatible footwear but less reliable for grounding.

Sole Grounders: Cover the entire sole, offering excellent grounding but are costlier and harder to secure.

Conductive Footwear: Permanent grounding with integrated conductive materials; reliable but expensive & requires maintenance.

Testing Heel Straps

Regular testing ensures heel straps maintain effective grounding within an ESD program.

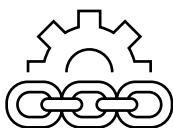
Resistance Tester: Measures resistance, ensuring it stays below 3.5×10^7 ohms (ANSI/ESD STM97.1).

Walking Tests: Assesses strap-floor performance during movement; voltage must stay under 100 volts (ANSI/ESD STM97.2).

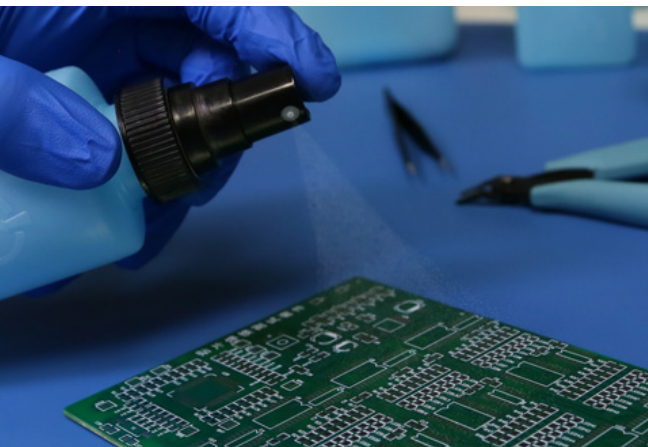
Frequency: Test daily at shift start, inspect regularly, and replace damaged straps promptly.

ESD Worksurface Mats

ESD worksurface mats provide a static-dissipative surface to protect sensitive electronics during assembly or repair. Unlike floor mats, they focus on grounding workstations to safely dissipate static charges and prevent equipment damage. Proper cleaning, such as with I.C. Workstation Cleaner, ensures their reliability and compliance with ESD standards.



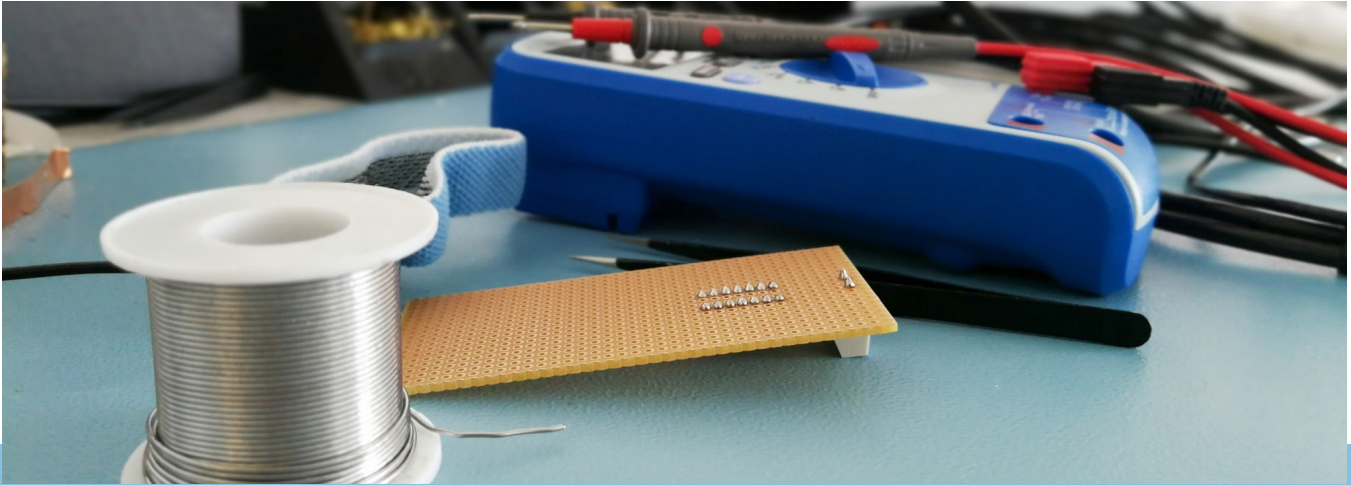
How ESD Worksurface Mats Work



Worksurface mats are made from static-dissipative or conductive materials that direct static electricity away from the work area to a designated ground point. When connected to a reliable grounding system, these mats prevent electrostatic discharge (ESD) events that can damage sensitive electronic devices.

- **Static Dissipation:** Charges are dispersed across the mat's surface and safely routed to ground.
- **Grounding Integration:** Mats typically include grounding cords that connect to common ground points, ensuring a complete ESD-safe system.
- **Maintenance of Resistivity:** Cleaning mats with specialized cleaners, such as I.C. Workstation Cleaner, ensures that the mat's resistive properties remain intact and effective over time.

Type	Material	Key Features	Applications
Vinyl Mats	Static-dissipative vinyl	Cost-effective, chemical-resistant, easy to clean	Ideal for light to medium-duty work environments
Rubber Mats	Conductive or dissipative rubber	Durable, heat-resistant, resistant to solder and flux	Suitable for environments involving heat or chemicals
Laminated Mats	Multi-layer vinyl or rubber	Enhanced durability, long-lasting performance	Best for high-traffic or heavy-duty workstations
Hard Laminate Surfaces	ESD-safe laminate sheets	Smooth, rigid surface, ideal for precision work	Cleanrooms, labs, or assembly lines requiring stability
Foam Mats	Static-dissipative foam	Lightweight, flexible, ergonomic	Portable workstations or areas needing easy transport
Combination Mats	Vinyl or rubber with foam backing	Combines ESD protection with anti-fatigue properties	Ergonomic benefits for workers standing for long periods



Why ESD Mats are Essential

ESD worksurface mats are vital for safeguarding sensitive electronics and ensuring reliable operations in static-sensitive environments. Their ability to provide a grounded, static-safe workspace reduces the risk of ESD damage, protecting equipment and ensuring compliance with industry standards. By selecting the right mat, integrating it into a comprehensive ESD control program, and conducting regular testing, facilities can create a safe, efficient, and ESD-free work environment.

Choosing the Right ESD Worksurface Mat

- **Material:** Vinyl mats are budget-friendly for light-duty use; rubber mats are durable and heat-resistant for demanding tasks.
- **Conductivity:** Static-dissipative mats prevent sudden charges, while conductive mats rapidly dissipate static for sensitive electronics.
- **Durability:** Laminated mats handle high traffic; foam mats are flexible but less durable.
- **Ergonomics:** Anti-fatigue mats support prolonged standing.
- **Environment:** Choose chemical-resistant mats for solvents or heat-resistant mats for soldering.

Cleaning and Maintenance

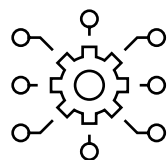
Regular cleaning preserves mat functionality, preventing dust and oils from degrading static-dissipative properties. Use products like **I.C. Workstation Cleaner** to remove contaminants without harming the mat's conductivity.

Testing ESD Mats

- Point-to-Point Resistance: 10^6 to 10^9 ohms (ANSI/ESD S4.1).
- Resistance to Ground: 10^6 to 10^9 ohms.
- Test quarterly and clean regularly to ensure performance

Ionizers: Neutralizing Static in ESD Control

Ionizers are a vital tool for managing electrostatic discharge (ESD) in environments where grounding alone cannot eliminate static. They work by neutralizing charges on insulative materials or objects that cannot be grounded, such as plastics, glass, or certain packaging materials. By balancing positive and negative ions in the air, ionizers provide a reliable method for static control, especially in cleanrooms, electronics manufacturing, and assembly environments.



What are they and how do they work?

Ionizers produce a balanced stream of positive and negative ions that neutralize static charges on nearby surfaces or objects. They work by emitting these ions into the surrounding air, where they interact with charged surfaces, neutralizing excess positive or negative charges.

1. **Basic Mechanism:**

- Ionizers use a high-voltage source to generate ions by breaking apart molecules in the air.
- The emitted ions are carried to the target surface by airflow, neutralizing static charges.

2. **Application in ESD Control:**

- Ideal for handling materials that are inherently insulative and cannot be grounded, such as plastic packaging or tools.
- Used to reduce static buildup in cleanrooms, workstations, and production lines

Type	How it Works	Applications	Advantage/ Disadvantage
Benchtop Ionizers	Emit ions directly onto a worksurface or localized area.	Small workstations, soldering areas.	Compact, localized control. Limited range, may not cover larger areas.
Overhead Ionizers	Mounted above workstations to cover larger areas.	Assembly lines, cleanrooms.	Broad coverage, hands-free operation. Requires proper alignment and airflow maintenance.
Portable Ionizers	Small, movable units for targeted applications.	Temporary setups, repair areas.	Flexible, can be moved as needed. Lower output compared to fixed systems.
Ionizing Blowers	High-powered fans that distribute ions over large spaces.	Warehouse storage, large assembly areas.	Covers wide areas effectively. Noisy, requires regular maintenance.
Ionizing Bars	Static-neutralizing bars placed near production lines.	Conveyor belts, automated processes.	Integrates well into production equipment. Fixed installation, limited to specific setups.

Why Ionizers Are Essential

Ionizers are a critical component of ESD control in environments where grounding is insufficient or impractical. By neutralizing static charges on insulative materials, they provide a versatile and effective solution for reducing ESD risks. While they require regular maintenance and testing to ensure consistent performance, their ability to handle unique challenges makes them indispensable in industries like electronics manufacturing, cleanrooms, and assembly lines. Properly selected, installed, and maintained ionizers help facilities achieve a comprehensive and reliable ESD control program.

Ionizers: Pros and Cons

Advantages:

- Neutralize charges on insulative materials like plastics and glass.
- Cover large areas with flexible overhead or blower options.
- Require no physical connection, ideal for delicate or moving parts.

Disadvantages:

- Regular cleaning and calibration needed for optimal performance.
- Proper placement and airflow are critical.
- Higher upfront costs compared to simpler grounding methods.

Testing and Monitoring Ionizers

Ion Balance Test: Measures voltage offset (± 50 volts acceptable per ANSI/ESD SP3.3).

Decay Time Test: Checks charge neutralization speed (ANSI/ESD STM3.1 standards).

Frequency: Test monthly or more in critical areas; clean emitters regularly.

Monitoring: Some ionizers have sensors for real-time performance alerts.

ESD Garments

ESD garments are specialized clothing designed to protect sensitive electronics from electrostatic discharge (ESD) by neutralizing static charges generated by the wearer. Commonly used in industries such as electronics manufacturing, cleanrooms, aerospace, and medical device production, these garments help create a controlled environment for handling static-sensitive components.



How do ESD Garments Work

ESD garments are made from fabrics that incorporate conductive or static-dissipative fibers, which prevent the buildup of static electricity. These fibers create a network within the fabric that allows static charges to flow safely to ground when the garment is connected to an ESD control system.

- 1. Static Shielding:** ESD garments act as a barrier, shielding components from charges generated by the wearer's clothing or body.
- 2. Charge Dissipation:** Conductive fibers dissipate static electricity through grounding systems, such as wrist straps, heel straps, or conductive flooring.
- 3. Full Coverage:** By covering areas prone to static generation (e.g., torso, arms), ESD garments minimize the risk of ESD events during handling or assembly.



ESD Garment Fiber Types

Conductive Fibers: Woven with materials like carbon or stainless steel for excellent conductivity and durability but can be less comfortable.

Static-Dissipative Fibers: Polyester or nylon with conductive threads, offering flexibility and comfort but wearing out faster.

Blended Fabrics: Combines natural and conductive fibers, balancing comfort and ESD control but with lower durability than pure conductive fibers.

Testing & Monitoring ESD Garments

Regular testing ensures ESD garments maintain effective static control by identifying wear or conductivity issues.

Testing Methods:

Surface Resistance Testing: Measures fabric resistance (acceptable range: 10^5 to 10^{12} ohms, ANSI/ESD STM2.1).

Charge Decay Testing: Assesses charge dissipation speed for performance.

Visual Inspection:

Checks seams, cuffs, and fibers for wear.

Frequency:

Test quarterly or after each cleaning cycle using resistance meters or charge plate monitors.

Static-Shielding Bags and Containers

Static-shielding bags and containers are essential tools in ESD control programs, designed to protect sensitive electronic components during storage, handling, and transportation. These specialized packaging materials provide a barrier against electrostatic discharge (ESD), reducing the risk of damage to components caused by static buildup or exposure to electric fields.



What are ESD Bags?

Static-shielding bags and containers work by creating a conductive or static-dissipative barrier around sensitive components, neutralizing or blocking external static charges. They are made from materials designed to dissipate charges and shield the contents from electrostatic fields.

- 1. Static Shielding:** Bags and containers use multiple layers, typically including a conductive or metalized layer, to shield the contents from external electric fields.
- 2. Low-Charging Materials:** Packaging materials often incorporate low-charging properties to reduce static buildup during contact and separation.
- 3. Types of Packaging:**
 - **Bags:** Include transparent static-shielding bags, moisture barrier bags, and cushioned shielding bags.
 - **Containers:** Include conductive totes, boxes, and plastic films designed to provide robust and reusable protection.

Using & Testing Static-Shielding Packaging

Selecting the Right Size and Type:

- Ensure the bag is slightly larger than the component for secure sealing without bending or folding.
- Use conductive totes or boxes for heavy or bulky items.

Proper Sealing of Bags:

- Seal with a heat sealer for moisture and static-shielding bags; avoid staples or conductors that may puncture.
- Inspect for gaps or damage that may compromise shielding.

Testing Packaging Materials:

- **Resistance Testing:** Measure resistance (10^5 – 10^{12} ohms) with an ohmmeter per ANSI/ESD standards.
- **Shielding Effectiveness:** Check for leaks using a charge plate monitor or field meter.
- **Durability Testing:** Inspect for tears or wear that may affect performance.

I.C. ESD-Safe Bottles

I.C. ESD-Safe Bottles add an advanced layer of protection and functionality for storing and dispensing solvents, flux, or cleaning solutions in static-sensitive environments. With a surface resistivity of 10^9 to 10^{10} ohms per square and a static decay time of less than 0.5 seconds, these bottles are ideal for maintaining ESD-safe conditions.

Unique Features of I.C. ESD-Safe Bottles:

- **Material Integrity:** Designed to resist reactivity with solvents like alcohol and TCE, ensuring compatibility with cleanroom solutions.
- **Enhanced Safety:** Manufactured without surfactant-laden materials, which can degrade the contents or introduce contaminants.
- **Versatile Use Cases:** Available as solvent dispensers, wash bottles, and flux dispensers, tailored to a variety of cleanroom and static-sensitive applications.
- **Anti-Contamination Design:** The press-and-dispense mechanism prevents drained liquid from re-entering the reservoir, minimizing cross-contamination.

ANSI Standards for ESD Packaging:

Several ANSI and EOS standards define the requirements for ESD-safe packaging, ensuring consistent performance and protection:

- **ANSI/ESD S11.11 and S11.12:** Define resistance and shielding effectiveness for packaging materials.
- **ANSI/ESD S11.31:** Focuses on static shielding bag requirements.
- **ANSI/ESD ADV11.2:** Provides guidance on the selection and use of ESD packaging materials.
- **ANSI/ESD S8.1:** Addresses the requirements for desiccants, humidity indicator cards, and sealing methods for moisture barrier bags.



ESD Monitoring Equipment

ESD monitoring equipment ensures effective static control by checking grounding, detecting static buildup, and maintaining compliance with ESD standards. It provides real-time feedback to prevent costly ESD events, making it essential for high-risk environments like electronics manufacturing, cleanrooms, and testing facilities.



What does ESD Monitoring Equipment Do?

1. **Grounding Assurance:** Verifies that grounding systems, such as wrist straps, heel straps, or mats, are functioning correctly to dissipate static electricity.
2. **Static Detection:** Monitors the presence of static charges on personnel, tools, or work surfaces, ensuring they remain within safe limits.
3. **Real-Time Feedback:** Alerts users immediately when an ESD control measure fails, allowing for quick corrective actions.
4. **System Integration:** Often integrates with facility-wide ESD control systems to provide a comprehensive monitoring solution.

Types of Equipment

Continuous Monitors

Function: Provide real-time feedback on grounding integrity for wrist straps, heel straps, or mats.

Applications: Electronics assembly and testing.

Importance: Critical for uninterrupted ESD protection, preventing unnoticed grounding failures.

Charge Plate Monitors

Function: Measure electrostatic charge levels and decay times to evaluate ionizer performance.

Applications: Ionizer testing in cleanrooms or high-sensitivity manufacturing.

Importance: Ensure ionizer compliance and effectiveness, mitigating static risks on insulators.

Static Field Meters

Function: Handheld devices for detecting static fields on tools, personnel, or surfaces.

Applications: Troubleshooting static buildup in manufacturing or assembly.

Importance: Identify and resolve static problems to prevent ESD events.

Resistance Testers

Function: Measure the resistance of ESD components like mats, wrist straps, and footwear.

Applications: Routine maintenance and compliance verification with ESD standards.

Importance: Ensure the integrity of ESD control materials.



Supporting ESD Tools

R&R Lotion provides a range of essential tools to help manage electrostatic discharge (ESD) in static-sensitive environments. These tools are designed to support ESD control programs and comply with industry standards, ensuring a safer and more effective workspace.

These tools play a critical role in minimizing ESD risks, maintaining compliance with ESD standards, and protecting sensitive electronics across industries. By incorporating these items into your ESD control program, you can create a safer and more efficient workspace.

01 Static-Safe Bottles



- R&R Lotion's I.C. ESD Safe Bottles are made from static-dissipative materials to prevent charge buildup.
- These bottles safely store and dispense liquids such as cleaning agents or solvents without introducing static into ESD-sensitive areas.
- They are critical for maintaining static control in cleanrooms, electronics manufacturing, and other static-sensitive environments.

02 Topical Anti-Static Solution



- The I.C. Topical Anti-Stat neutralizes static charges on insulative surfaces like tote boxes, carriers, and workbenches.
- By helping dissipate static charge on insulative surfaces, this solution helps reduce the risk of ESD damage to sensitive electronic components during handling, storage, and assembly.
- Its versatility allows it to be applied using sprays or wipes, making it a flexible tool in static control.

03 Workstation Cleaner



- The I.C. Workstation Cleaner removes dust, dirt, and static-causing contaminants from work surfaces.
- It is safe for use on ESD mats, benches, and other static-sensitive equipment, ensuring surfaces remain clean without compromising static control measures.
- Regular use of a workstation cleaner helps maintain the integrity of your ESD control program.
- By reducing static potential on surfaces, this cleaner helps prevent accidental electrostatic discharge and ensures the consistent performance of ESD control measures.

04 ESD Safe Lotion



- The I.C. ESD Safe Lotion conditions and hydrates the skin, reducing resistance and improving the connection between the user's skin and ESD wrist straps.
- Dry skin can act as an insulator, interfering with proper grounding. This lotion helps support an ANSI/ESD S20.20 program by reducing skin resistance at the wrist strap.
- Its non-greasy, skin-safe formula is suitable for frequent use in industrial environments.

Standards and Compliance in ESD Control

Adhering to ESD standards is critical for ensuring the reliability, safety, and quality of electronic components throughout their lifecycle. One of the most universally adopted standards is ANSI/ESD S20.20, developed by the ESD Association. This standard provides detailed guidelines for establishing, implementing, and maintaining an effective ESD control program. It applies to all stages of handling sensitive electronic components, including assembly, testing, packaging, storage, and repair.

Key Elements of ANSI/ESD S20.20:

- 1. ESD Protected Areas (EPAs):** Requires the creation of designated zones where ESD-sensitive items are handled, ensuring they are protected by appropriate controls.
- 2. Grounding Systems:** Mandates the use of wrist straps, heel straps, mats, and other grounding systems to dissipate static charges.
- 3. Auditing and Compliance:** Establishes requirements for regular auditing of ESD control measures, ensuring they are effective and meet industry standards.
- 4. Training:** Emphasizes the need for consistent employee training to foster awareness and compliance.

By following ANSI/ESD S20.20, organizations reduce product defects, minimize repair costs, and enhance customer satisfaction, solidifying their reputation in a competitive market. Compliance also demonstrates a commitment to quality and safety, essential for maintaining relationships with partners and clients.



Steps to Create a Static-Safe Work Area

Set Up ESD Mats and Grounding Points: Install ESD-safe mats on workbenches and floors, connecting them to grounding points tested regularly (10^6 – 10^9 ohms, per ANSI/ESD S4.1).

Employee Training: Train staff on ESD risks, equipment use, and maintaining proper habits, with regular refreshers.

Label ESD-Sensitive Items: Use clear warning signs, static-dissipative labels, and restricted zones for sensitive components.

Daily Equipment Testing: Test wrist straps, heel straps, mats, and ionizers daily; address issues immediately.

Documentation and Auditing: Maintain training logs, test records, and conduct audits to track program effectiveness and ensure compliance.

Benefits of Controlling ESD

An effective ESD control program provides numerous advantages for organizations, employees, and clients:

Improved Product Quality

Controlling ESD ensures that sensitive components are not damaged during handling or production. Fewer defects mean higher-quality products, leading to increased customer satisfaction and reduced warranty claims.

Reduced Costs

Preventing ESD damage reduces the need for costly repairs, rework, or component replacements. Additionally, it minimizes downtime associated with troubleshooting ESD-related issues, improving operational efficiency.

Increased Product Reliability

Electronics protected from ESD during production have a longer lifespan and perform more reliably in the field. This boosts customer confidence and strengthens brand reputation.

How to Build an ESD Control Program

To develop a comprehensive ESD control program, follow these steps:

1. Assess Needs and Risks

Evaluate your environment to identify where static-sensitive components are handled and determine the specific ESD risks. Consider insulative materials, humidity levels, and worker movement.

2. Create an ESD Policy

Develop a policy outlining the goals and requirements of the program. Include details on EPA setup, employee training, and monitoring protocols.

3. Implement ESD Measures

Install mats, grounding systems, and ionizers in static-sensitive areas. Use approved static-shielding packaging for sensitive items and create designated EPAs.

4. Train and Engage Employees

Conduct initial and ongoing training to ensure employees understand their role in ESD prevention. Engage them in maintaining compliance by emphasizing the importance of ESD control.

5. Monitor and Improve

Use ESD monitoring equipment to continuously assess the effectiveness of the program. Regularly review documentation and audit findings to identify areas for improvement.

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