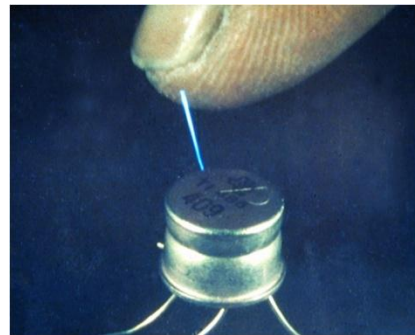
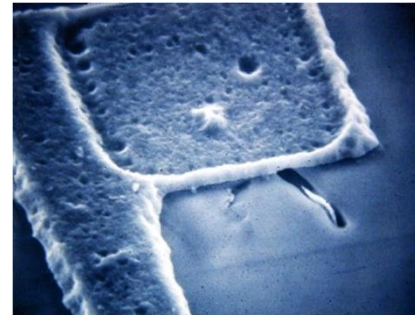




# Electrostatic Discharge



# ESD Basics and Protection

# ***About Transforming Technologies***

**Transforming Technologies is a leading solution provider for static control in the electronics industry. We offer over 10 years experience in providing electrostatic solutions to manufacturing facilities; protecting products and processes from the many serious problems associated with static electricity.**

**Headquartered in Toledo, OH, USA, [Transforming Technologies](#) we offer a wide range of unique and exceptional ESD products to prevent, eliminate and monitor electrostatic charges.**

**We provide comprehensive knowledge of electrostatic issues, and above all outstanding, friendly service. We call it Static Care™.**

# *What is ESD?*

- ESD definition
- Common causes of ESD
- Sources of ESD
- Types of ESD damage

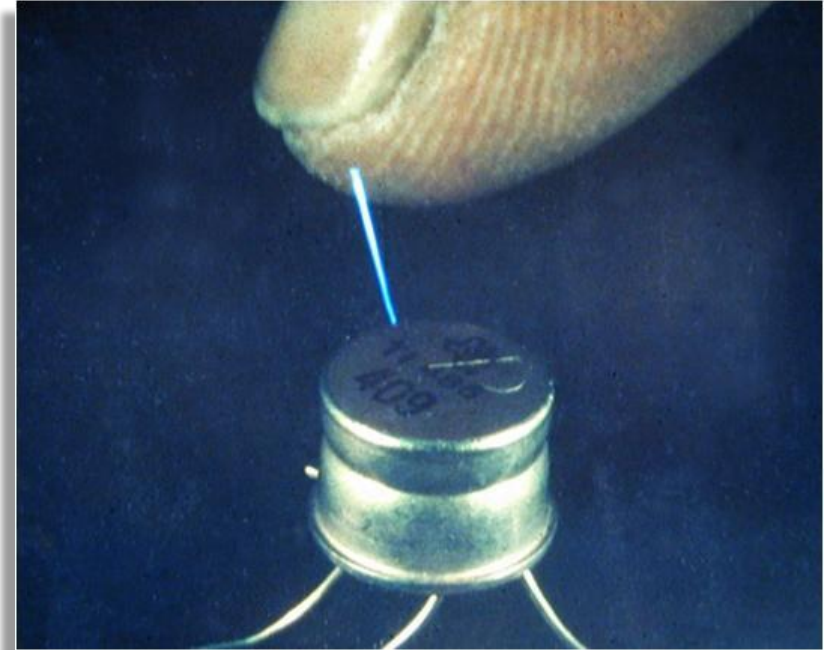
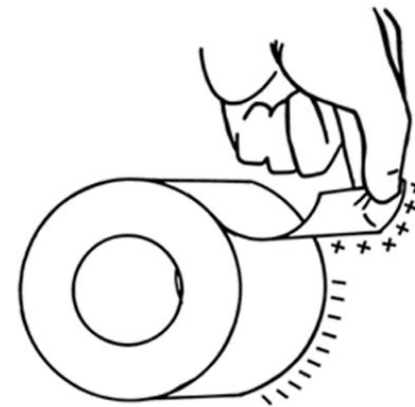
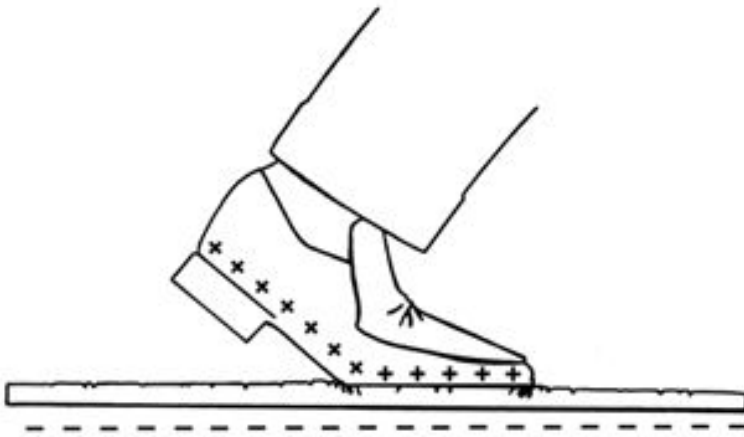


Photo of ESD arcing from finger to component

# ESD Definition

**ESD – Electrostatic Discharge:** The transfer of an electrostatic charge between bodies at different electrical potentials.

- Also referred to as static electricity
- **Electrostatic charge is most commonly created by the contact and separation of two materials which results in Tribocharging**



# ***ESD Is the Hidden Enemy***

There are innumerable ESD events occurring all the time that we cannot see or feel.

**People Feel ESD** at **2000 Volts!!!!**

**Component damage** - can occur with as little as **15 – 30 Volts!!!!**

| <b>Examples of Static Generation<br/>Typical Voltage Levels</b> |                  |                  |
|-----------------------------------------------------------------|------------------|------------------|
| <b>Means of Generation</b>                                      | <b>10-25% RH</b> | <b>65-90% RH</b> |
| Walking across carpet                                           | 35,000V          | 1,500V           |
| Walking across vinyl tile                                       | 12,000V          | 250V             |
| Worker at bench                                                 | 6,000V           | 100V             |
| Poly bag picked up from bench                                   | 20,000V          | 1,200V           |
| Chair with urethane foam                                        | 18,000V          | 1,500V           |

# *Typed of Materials that Charge*

## **Conductors**

- Materials that easily transfer electric charge
- **Can be used to transfer charge to earths ground**
- **Examples**
  - Metals
  - Water
  - Carbon
  - People

## **Insulators**

- Materials that hold an electric charge and can not easily transfer the charge
- **Can not be grounded to earth by common means**
- **Examples**
  - Plastics
  - Glass
  - Dry Air



# Sources of ESD

The following items are examples of materials that generate and hold electrostatic charge.

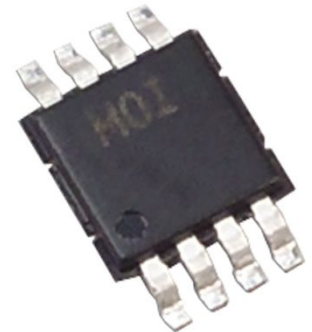
- Vinyl binders
- Equipment covers
- Plastic document holders/sheet protectors
- Post-It™ notes
- Plastic pens
- Bubble wrap
- Plastic housings on equipment
- Paper, schematics, etc.
- Plastic work travelers
- Plastic spray bottles
- Personal items
  - Purses
  - Sweaters/jackets
  - Insulated lunch totes
  - Combs/brushes
  - Lotion bottles

# What type of Materials are ESD Sensitive?

## ESDS – Electrostatic Discharge Sensitive

Integrated Circuits (DIPs, QFP, BGA, SOT, etc.)

- Crystals and oscillators
- Printed Circuit Board Assemblies
- When in doubt, treat it as ESDS!





# Common Causes of ESD

- Opening a common plastic bag
- Removing adhesive tape from a roll or container
- Walking across a floor and grabbing the door knob
- Transporting computer boards or components around in their trays on non-ESD carts
- Sliding circuit boards on a work bench



# Types of ESD Damage

## CATASTROPHIC FAILURE

- A device is exposed to ESD and it no longer works
- The device circuitry is permanently damaged
- Such failures may be caught when tested, before shipment

## LATENT FAILURE

- A device is exposed to ESD and is partially damaged, yet it continues to work
- The product may have a failure after the user places it in service

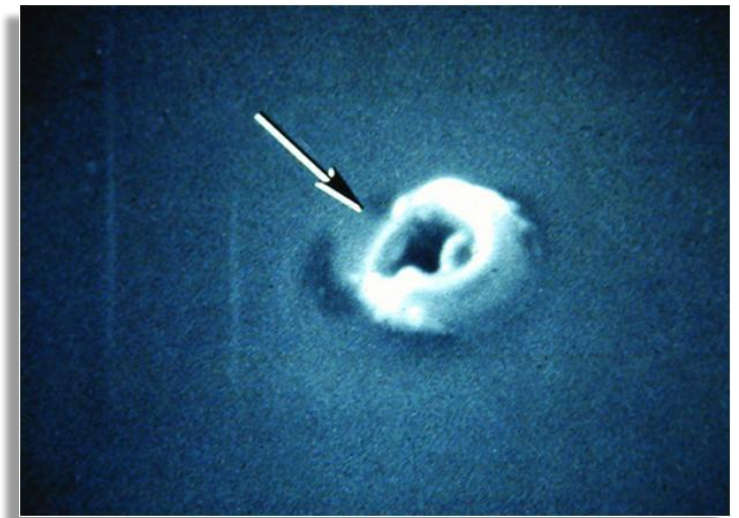
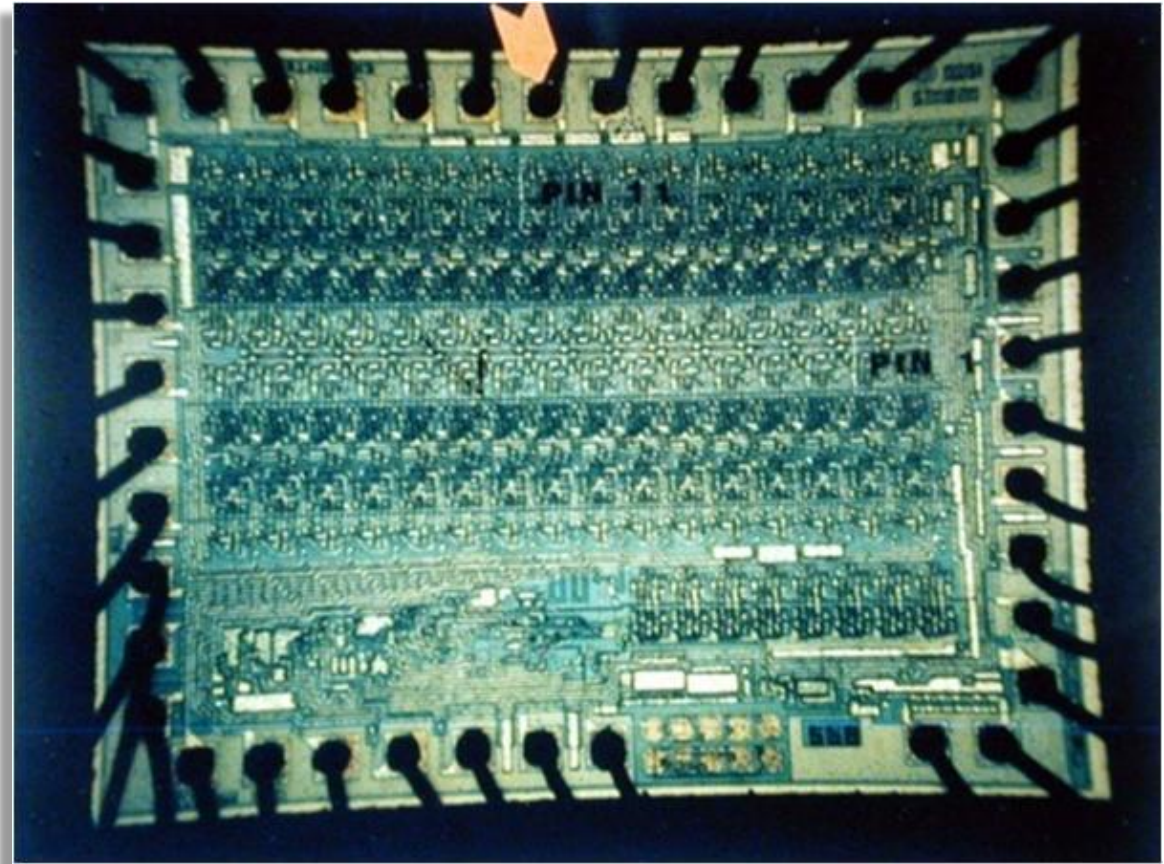


Image of the ESD damage after removal of the capacitor metallization.  
Magnification is 10,500 times

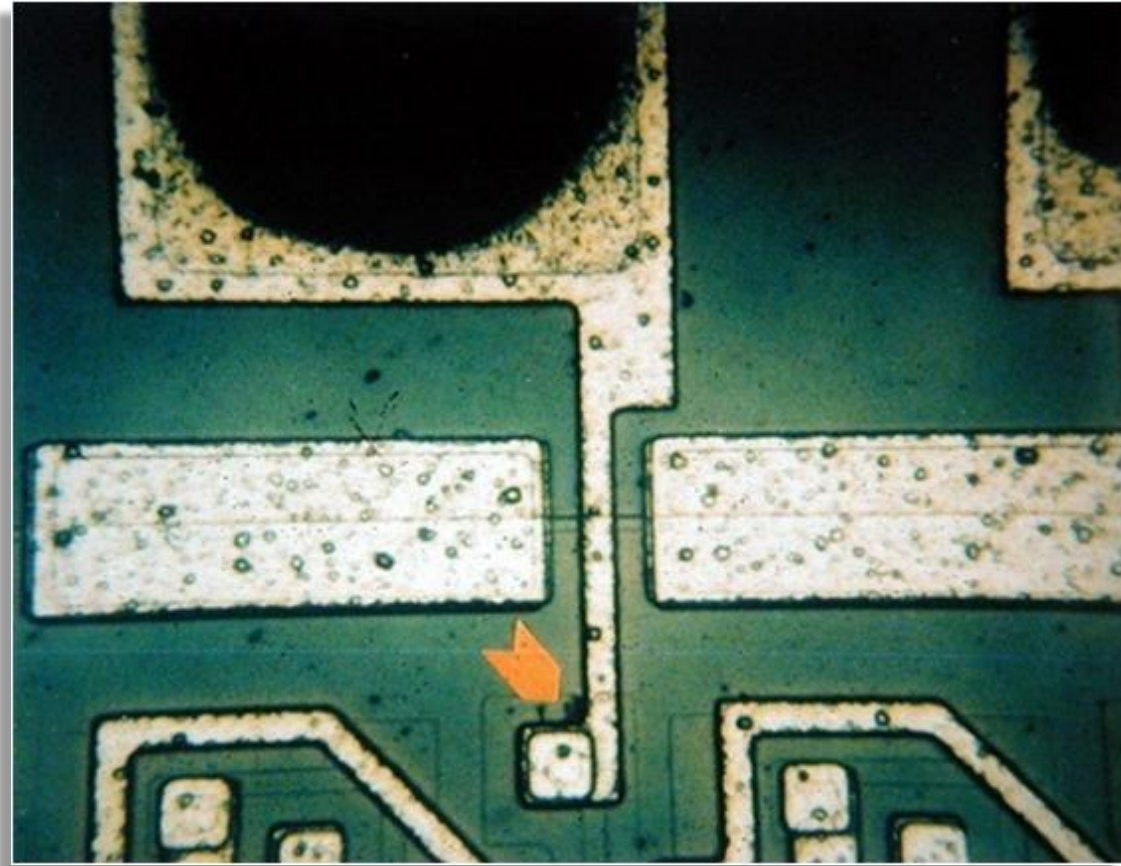
# *Example of ESD Damage*

- Optical photo of a large Integrated Circuit which has experienced ESD damage to the pin noted by the arrow.



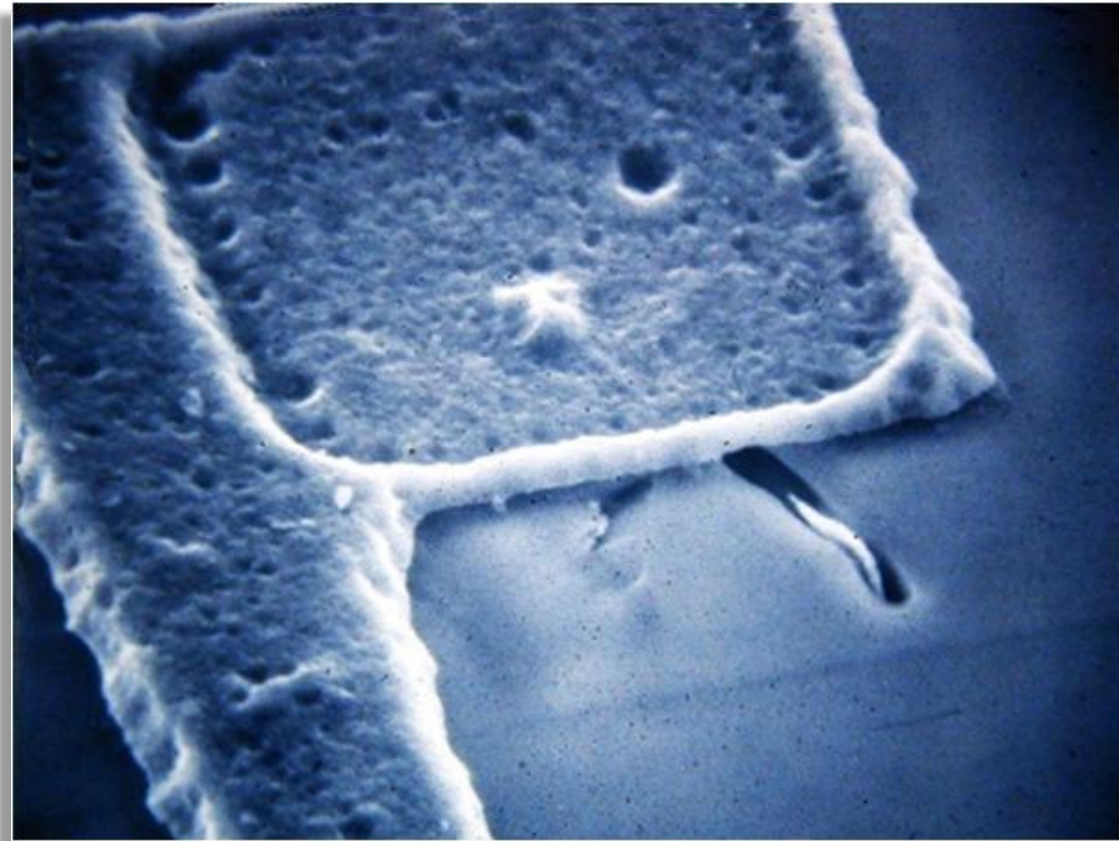
# *Example of ESD Damage*

- Higher magnification photo of pin noted by the arrow in the prior slide This taken at 400 times magnification on a 4" X 5" photo. The damage is noted as the "fuzz" at the end of the arrow.



# *Example of ESD Damage*

- **Overlying glassivation has been removed and the surface decorated to show the ESD damage at 5,000 times magnification in this scanning electron micrograph.**



# Why is ESD Important?

**Electrostatic Discharge (ESD) can damage sensitive electronic devices, resulting in:**

- Higher manufacturing costs
  - Rework
  - Repair
  - Scrap
- Lower production yields
- Unhappy customers
  - Shorter product life
  - Reduce product reliability

**Estimates of actual cost of ESD damage to the electronics industry = \$\$\$ Billions annually**



# *How to control ESD?*

## *ESD Control Program*

- ESD Training
- ESD Control Areas
- Ground Conductors
- Ionization
- ESDS Component Handling and Storage



# ***ESD Control Program***

**The first step in ESD control is to train all personnel who may come in contact with static sensitive materials**



- Proper use of personal grounding equipment such as heel grounders or wrist straps
- Personnel should understand ESD equipment test methods and documentation
- Understanding of other ESD control methods such as ionization



# ***ESD Control Program***

**Any area where unprotected ESD sensitive parts and assemblies may be handled shall be designated an ESD Control Area, and must meet the following requirements;**

- The area is free from non-essential static generators, and the risk from process-essential static generators is minimized
- All personnel must be grounded and all equipment must be tested daily
- All movable carts, racks, etc. are grounded
- The area is labeled as an ESD control area, and the boundaries are clearly marked



# *Create an ESD Control Area*

- Any area where unprotected ESDS parts and assemblies may be handled
- **ESD areas must be labeled with posted signs and their boundaries marked**



# ESD Control Program Cont.

## All Conductors within the EPA must be grounded

- Personal Grounding: All personnel, including visitors
- Work surfaces and flooring
- All equipment in EPA



# Personal Grounding

## Wrist Straps and Coil Cords

- Wrist Straps ground personnel at workstations



## Heel Grounders

- Ground mobile personnel in areas where there are ESD floors



## Smocks

- Smock sleeves should be in contact with the skin, clothing underneath should not show

# Personal Grounding

## All Personal Grounding Equipment Should be Tested or Monitored Daily

- Wrist Strap and Footwear Testing Stations
- ESD ground monitoring
- **Constant**
- **Impedance**



OHM Metrics and Monroe Electronics  
Test and Measurement Products

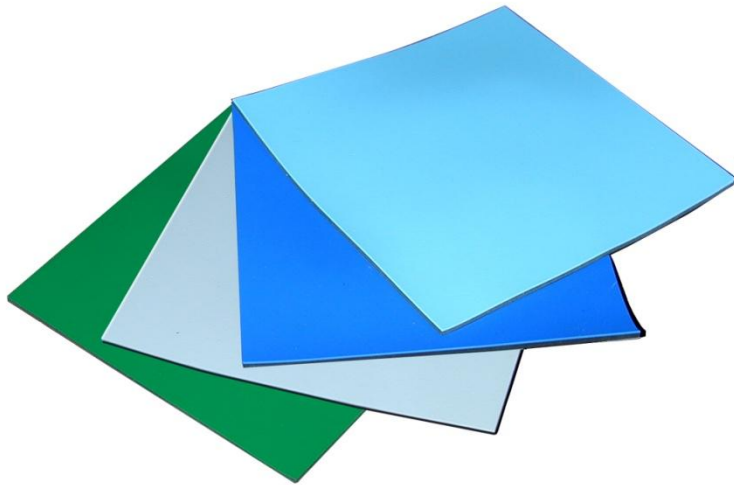


CM Series  
ESD Workstation Monitors

# Equipment Grounding

## Work Stations and Tables

- Must have static dissipative surfaces connected to the building ground source.
- Must have wrist strap ground connections (2 recommended), preferably banana jack receptacles, connected in parallel to the bldg ground source
- Should be cleaned daily with an antistatic cleaner



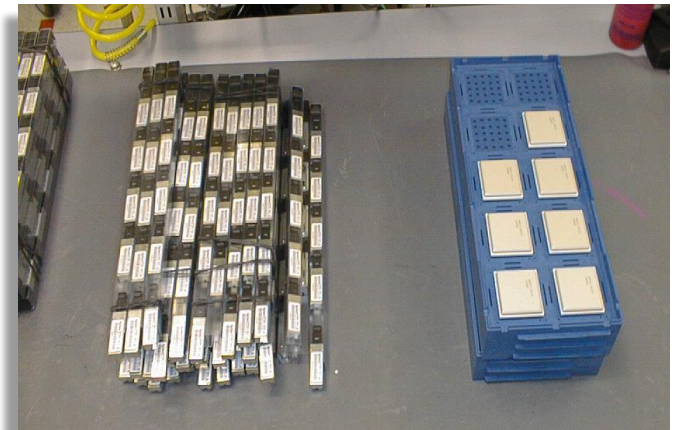
# Equipment Grounding

## Shelving and Cabinets

- Must provide a grounded surface unless the parts remain fully enclosed within shielding-type packaging

## Storage Bins

- All parts bins and containers must be static dissipative or antistatic
- Whenever practical, sensitive parts should remain in the original container until assembled



# ***Ionization***

Many times, equipment or objects (insulators) are unable to be grounded in which case air ionizers should be used.

## **What is Ionization?**

Air Ionizers use a process called "neutralization" to remove static charge from insulators that cannot be grounded.

- Ionizers produce positively and negatively charged ions and floods ESD area with Ions.
- Ions are charged particles that are present in the air, and as opposites attract, charges will be neutralized over time.





# Types of Air Ionizers



- Bench Top
- Ionizing Nozzles
- Air Guns
- Overhead Ionizers



# ESDS Component Handling and Storage

To move ESDS parts or assemblies inside an ESD control area, use one of the following;

- Static dissipative containers
- Static shielding containers
- Conductive containers or board carriers
- Ground movable racks



Surface Mount Devices  
SMD Boxes

# ***ESD Basics Review***

## **Things to remember about an ESD protection plan.**

- Only allow trained or escorted people in EPA
- Ground all conductors including people at ESD workstation
- Test wrist straps at least daily, or use continuous monitors
- Test ESD footwear at least daily, if used
- Visually check all grounding cords
- Keep wristband snug, foot grounder grounding tab in shoe, and ESD smocks buttoned
- Ionizers are maintained and air flow directed at ESDS items
- Use shielded packaging for shipping or storing ESD sensitive items outside the ESD Protected Area
- Handle unpacked ESDS items only when grounded



# About Transforming Technologies

Transforming Technologies is a leader in static protection, offering a wide range of unique and exceptional ESD products to prevent, eliminate and monitor electrostatic charges.

- Constant Monitors
- ESD Apparel: ESD Hot Glove, ESD Jackets
- Ionization: Alpha, Bench Top, Overhead, Gun, Nozzles
- Personal Grounding: Coil Cords, Wrist Straps, Footwear, Grounding Cords
- SMD Boxes
- Surface Protection: Rubber, Vinyl, PVC
- Test and Measurement Equipment

