

ESD BASICS



BASIC CONCEPTS IN ELECTROSTATIC DISCHARGE (ESD)



Introduction

ESD Control Training



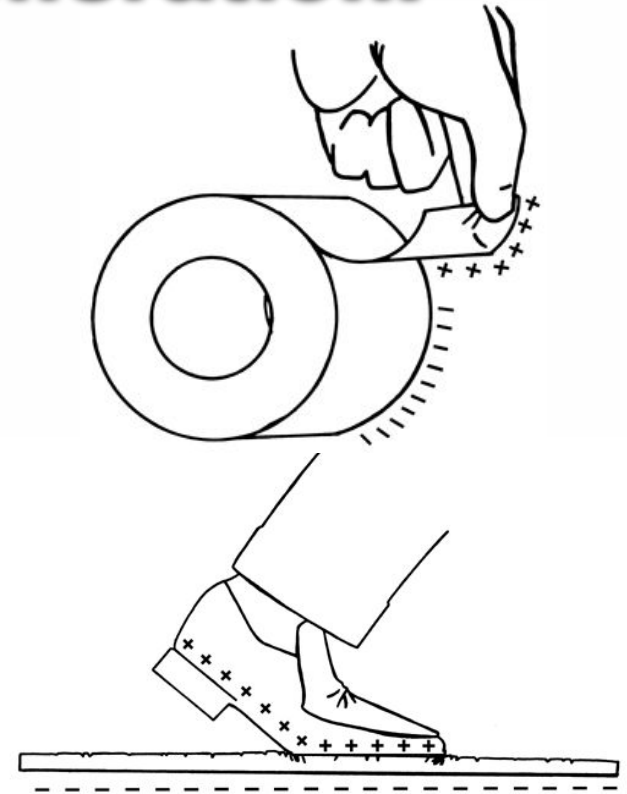
All Materials Tribocharge



ElectroStatic Charge Generation:

- When 2 Surfaces in Contact then Separate
- Some Atom Electrons Move Causing Imbalance

One Surface Has Positive Charge & One Surface Has Negative Charge



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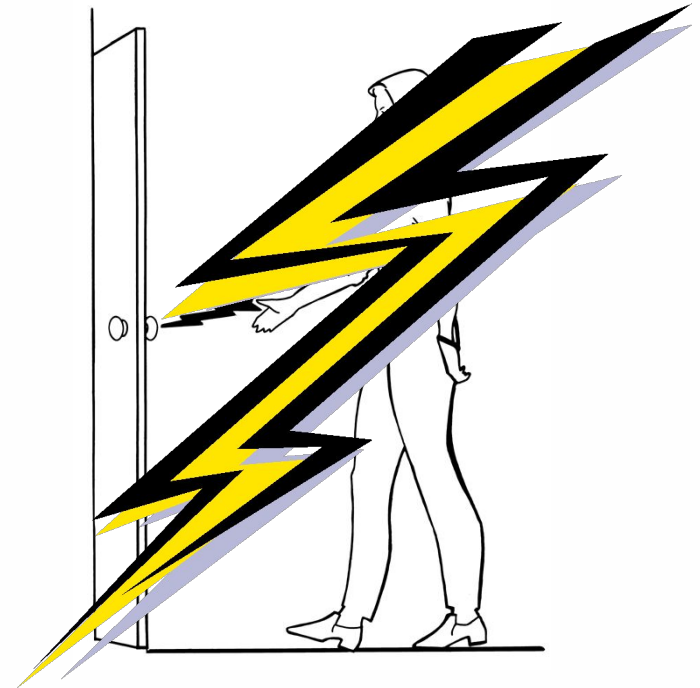
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Examples Of Electrostatic Discharge or ESD



- **Lightning**



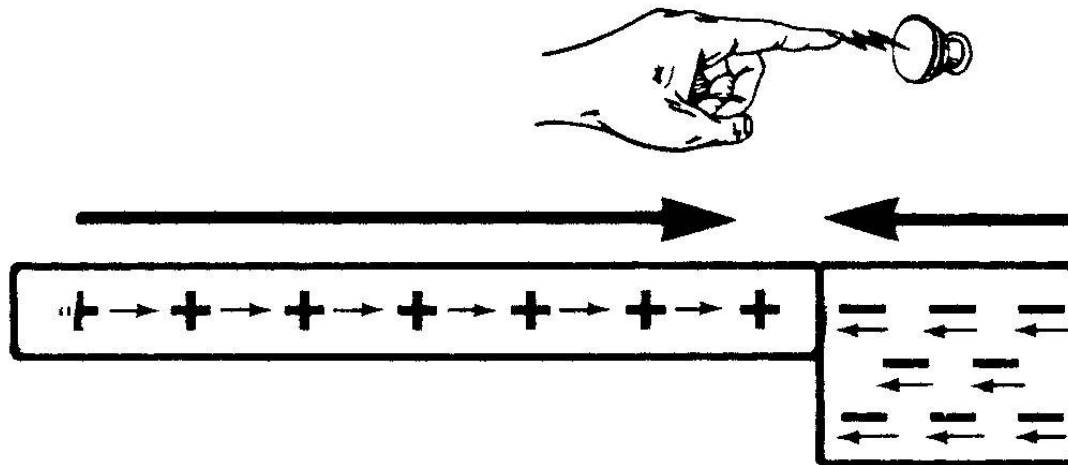
- **Zap from a door**



ESD or ElectroStatic Discharge

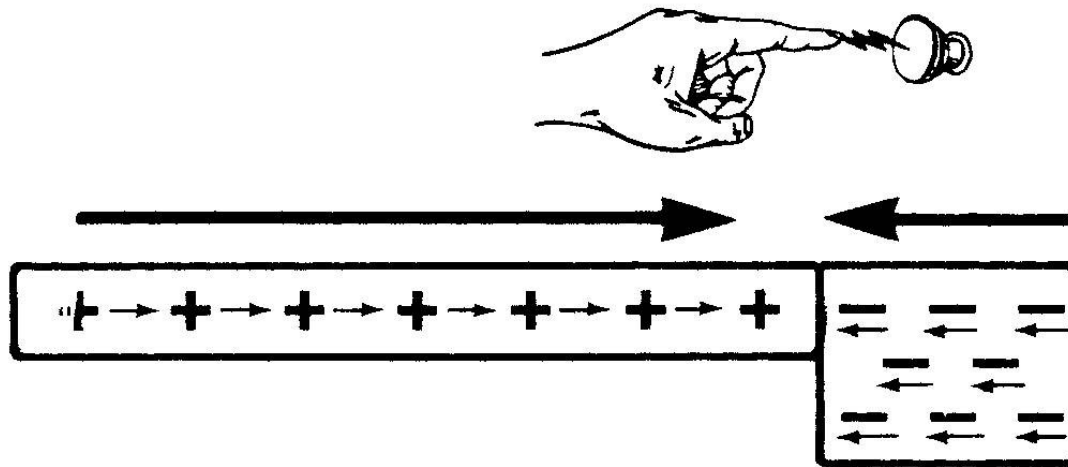


- Charges Seek Balance
- Discharge is Rapid
- Creating Heat



Two Types of Materials Conductors

- Electrical Current Flows Easily
- Can be Grounded
- Can Discharge
- Examples: Metals and People



Two Types of Materials Insulators



- Electrical Current Does Not Flow Easily
- Cannot be Grounded
- Example: **Plastics**

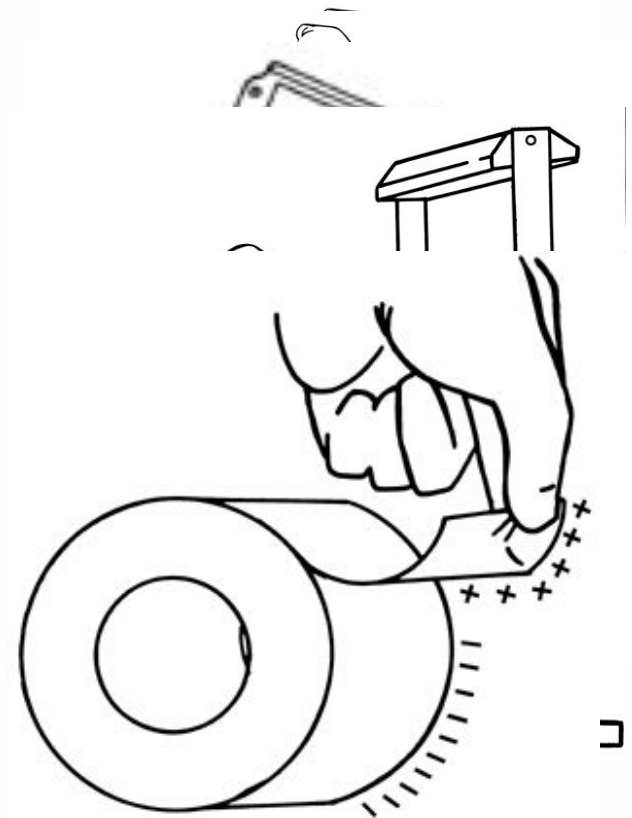
Typically very high charging



Large Charges Generated All The Time



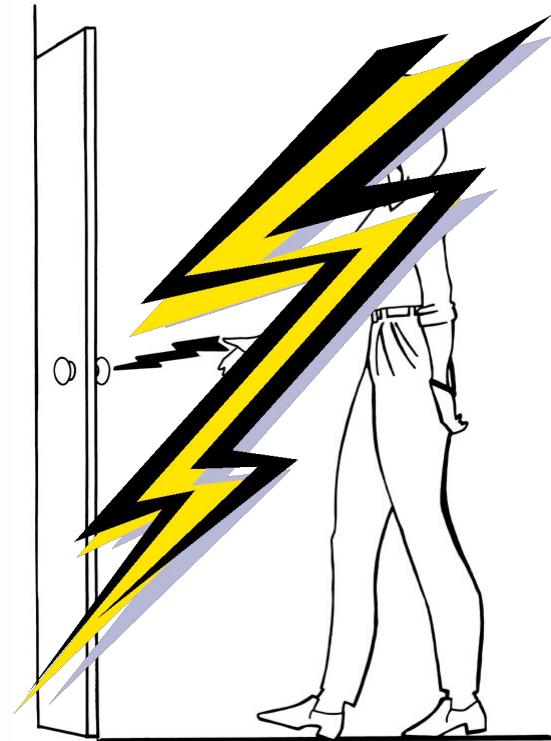
- Walking across a carpet:
1,500 - 35,000 volts
- Walking over untreated vinyl floor:
250 - 12,000 volts
- Vinyl envelope used for work instructions: **600 - 7,000 volts**
- Worker at a bench:
700 - 6,000 volts
- Unwinding regular tape:
9,000 - 15,000 volts



People Discharge Frequently



**But To feel a
Discharge it
must be
about
3,000 volts**



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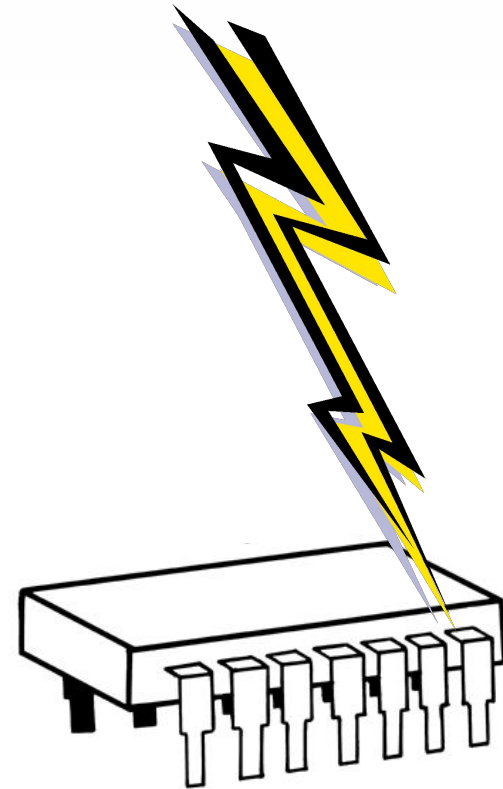
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ESD That A Person Can't Feel Can Easily Damage Electronic Components



**100 volts or
less can
damage
components!**



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Electronic Component ESD Sensitivity (ESDS)

Human Body Model (HBM) per ANSI/ESD STM5.1



- **ESD Class 0:** **Damage you can't feel:** **< 250 Volts**
Device Names: SAW, JFETS, CCDs, Precision voltage regulator diodes,
OP AMP, Thin film resistors, Integrated circuits, Hybrids utilizing class 1 parts, VHSI, CSCRs
- **ESD Class 1:** **Damage you can't feel:** **250 to 1,999 Volts**
Device Names: SAW, JFETS, CCDs, Precision voltage regulator diodes,
OP AMP, Thin film resistors, Integrated circuits, Hybrids utilizing class 1 parts, VHSI, CSCRs
- **ESD Class 2:** **Damage you might feel:** **2,000 to 3,999 Volts**
Device Names: JFETs, Ics, VHSIC, Precision resistor networks (type RZ), Hybrids utilizing class 2 parts,
Low power bipolar transistors
- **ESD Class 3A:** **Damage you can probably**
 detect as spark with your own body: **4,000 to 7,999 Volts**
Device Names: JFETs, OP AMPS, Ics, VHSIC, All other microcircuits not included in class 1 or class 2,
Small signal diodes, General purpose silicon rectifiers, Opto-electronic devices (LEDs, phototransformers,
opto couplers), Resistor chips, Piezo electric crystals, Hybrids using Class 3 parts

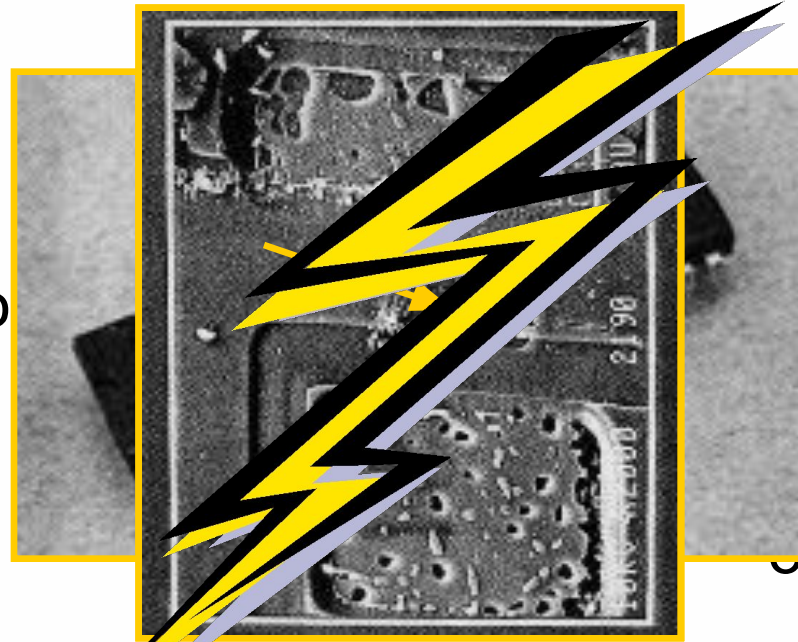


Tiny Conductive Paths Can Easily Be Damaged



Smaller components mean greater sensitivity to ESD. Damage to these components can not be detected by the naked eye.

- At this magnification we see that 1/2 of the width of the material has been destroyed



At higher magnification, the damage in the area between the base and emitter becomes more obvious

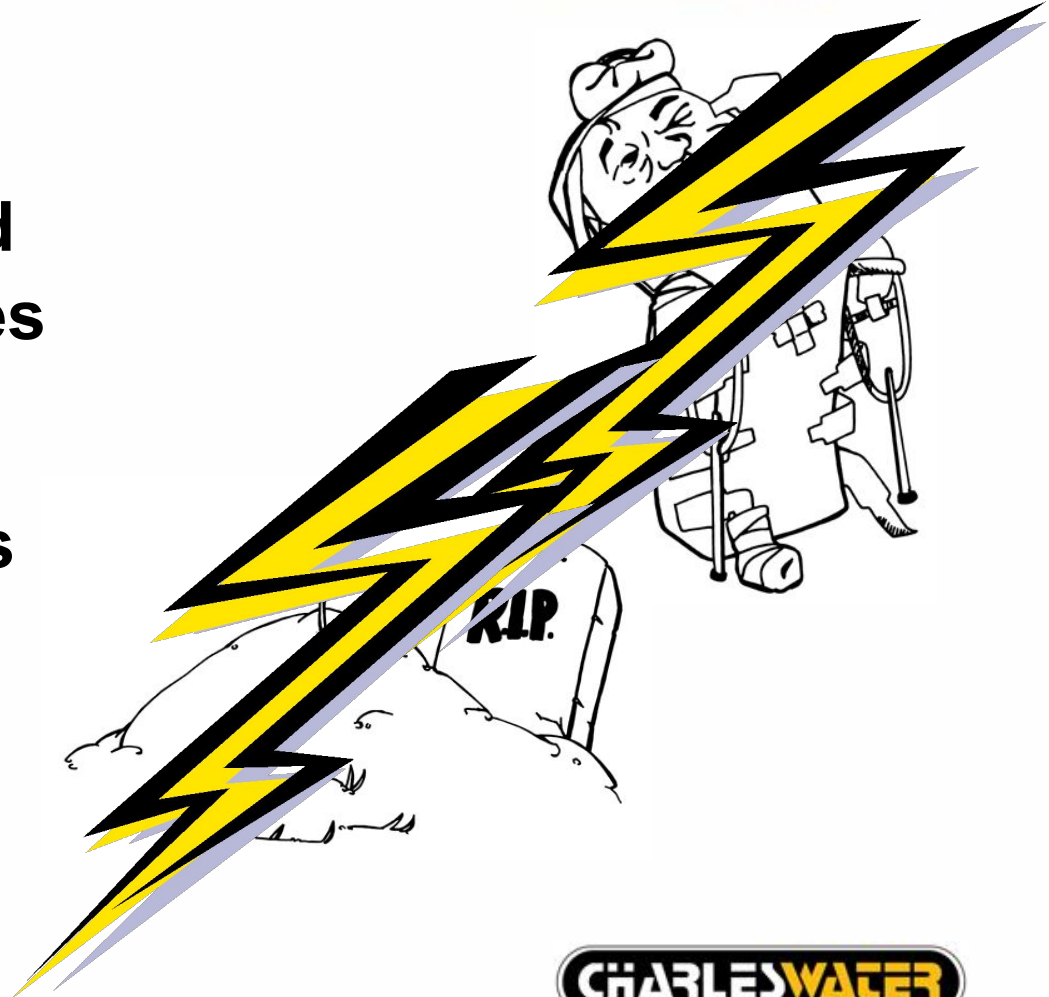
• Integrated Circuit



Types Of ESD Device Damage



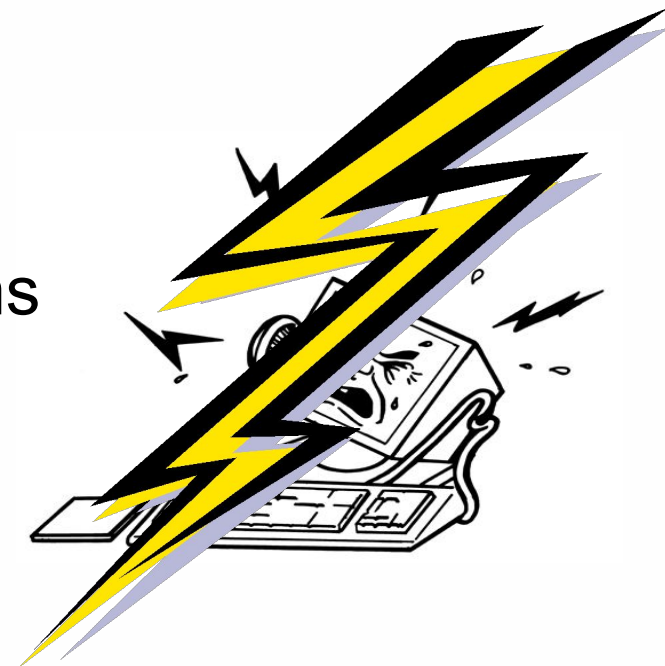
- **Latent Defect**
Component wounded
But Inspection Passes
- **Catastrophic Failures**
Inspection
Able to detect



Latent Defects More Costly



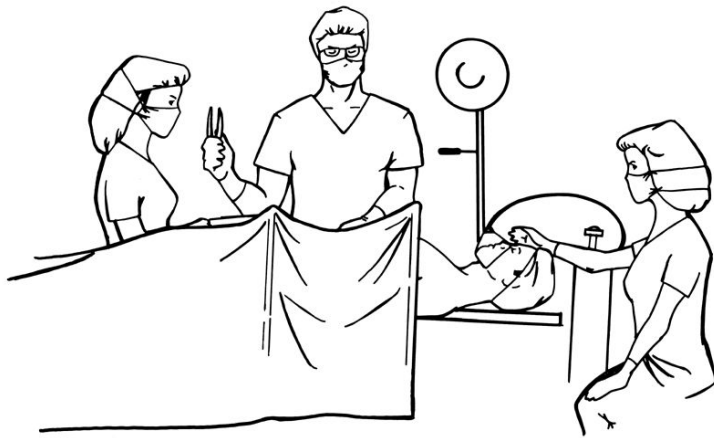
- Sub Assembly passes inspection
- Assembly passes inspection
- Product passes inspection
- Works a while for customer
- Then Upsets & Mysterious Problems
- More Returns
- More Warranty Costs
- Lower Customer Satisfaction



Like Germs, ESD Is The Hidden Enemy

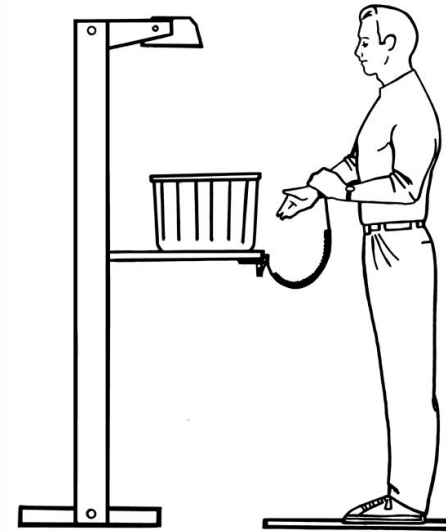


Control Germs



**We are aware of
sterilization in medicine**

Control ESD

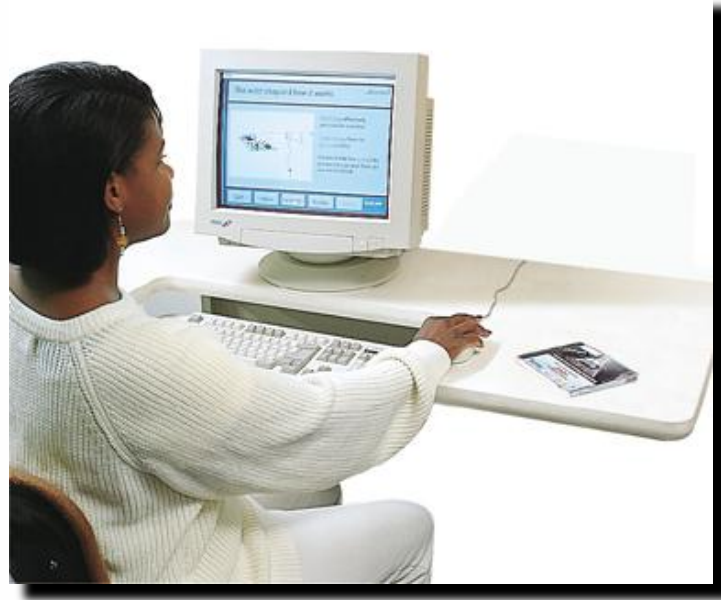


**We should develop the
same attitude about ESD**



The Prerequisites of ESD Control

- Identify ESD Area
- Identify ESD sensitive items
- Provide ESD control training



The Basics Of ESD Control



- Ground Conductors
- Neutralise insulators with ionisers
- Shield ESDS
When store
or transport
outside EPA

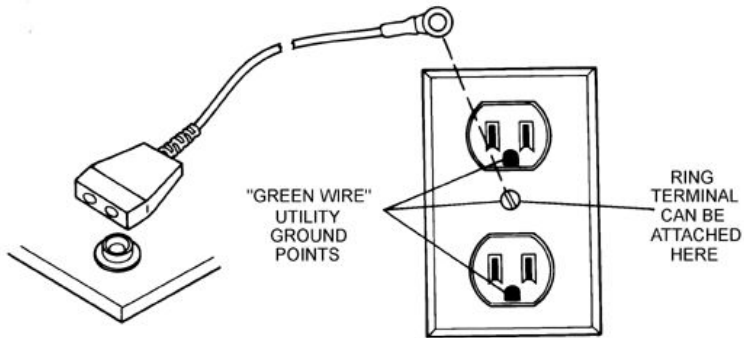


Ground Conductors Including People

- Wrist Straps
- Must work, so test wrist strap daily
- Foot Grounders
- Must work, so test foot grounder daily



Ground All Conductors in ESD Protected Area

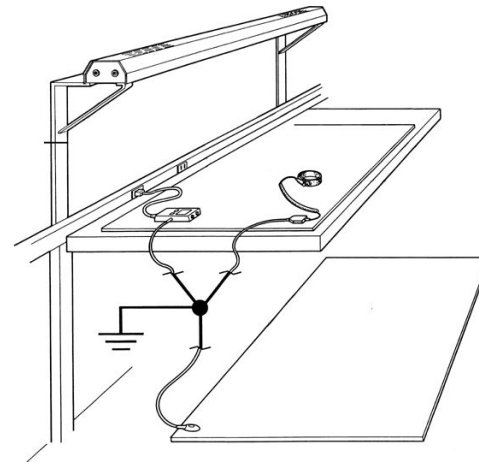


- **Dissipative WorkSurfaces**

- Ground ESD worksurface via ground cord to common point ground to equipment ground

- **Conductive Floor Mats**

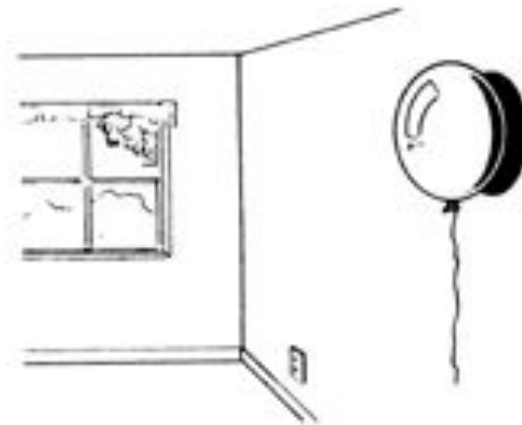
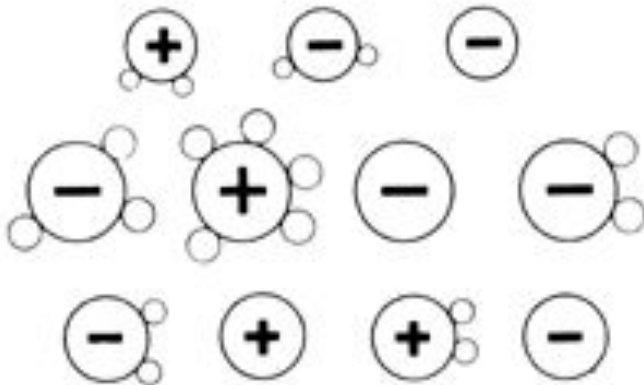
- Ground ESD floor mats via ground cord to equipment ground



Neutralise Insulators Via Ionisers



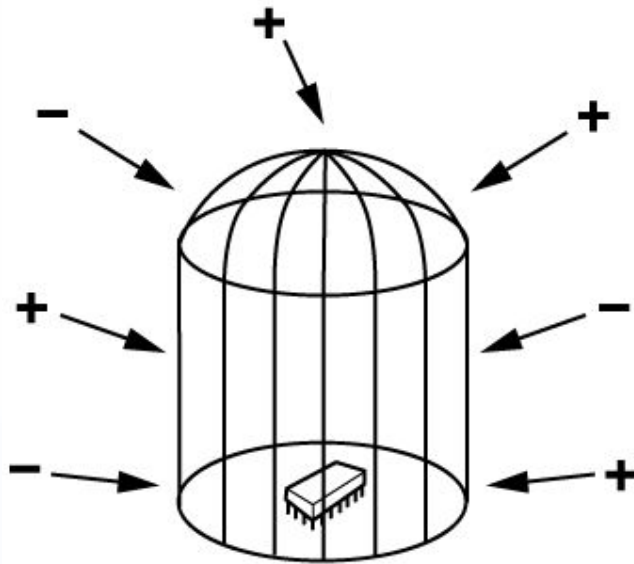
- Charged Insulators Cannot be grounded
- Ioniser air flow floods area with Ions
 - Neutralising Charge



Shield ESD Sensitive Items Outside Protected Area

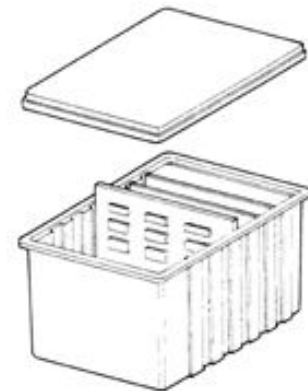


Faraday Cage



Charges Kept on Outside of Package:

- Closed Metallised Shielding Bag
- Covered conductive tote box



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ESD Protected Products

Regular Versions changed to be Low Charging and/or Groundable



Remove Insulator or Change to ESD Version

- ESD Smocks and Gloves
- Conductive Foam & Shunt Bars
- Antistatic or Low Charging Tape
- Dissipative Binders & Document Protectors
- Dissipative Floor Finishes
- Conductive & Dissipative Flooring



You Are On The Front Lines Fighting The Hidden Enemy



- Test Wrist Straps & ESD Footwear daily
- Keep wrist band snug, foot grounder grounding tab in shoe, & ESD Smocks buttoned up
- Only trained or escorted people allowed in ESD Protected Area



You Are On The Front Lines Fighting The Hidden Enemy



- Keep work area clean & clear of insulators
- Handle un-packaged ESD sensitive items only when grounded
- Visually check all grounding cords to make sure they are connected



You Are On The Front Lines Fighting The Hidden Enemy



- Make sure Ionisers are maintained and air flow is not blocked
- Use shielded packaging for shipping or storing ESD sensitive items outside the ESD Protected Area



The Basics Of ESD Control

- Ground Conductors including people
- Neutralise insulators with ionisers
- Shield ESDS when store or transport outside EPA



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BASIC CONCEPTS IN ELECTROSTATIC DISCHARGE (ESD)

