



ElectroStaticDischarge

Student Handout

What is ESD?

How Static Electricity Works

Electrostatic discharge damage is the result of static electric discharge. In order to understand ESD let's review how static electricity works.

Everything we see is made of tiny little parts called atoms. The atoms are made of even smaller parts. These are called protons, electrons and neutrons. They are very different from each other. One way they are different is their charge. Protons have a positive charge. Electrons have a negative charge. Neutrons have no charge.

Usually atoms have the same number of electrons and protons. In this case the atom has no charge, and is neutral. But if you rub things together electrons can move from one atom, to another. Some atoms get extra electrons. They have a negative charge. Other atoms lose electrons and so they have a positive charge. When charges are separated like this it is called static electricity.

If two things have different charges they attract or pull towards each other. If two things have the same charge they repel or push away from each other.

So, why does your hair stand up after you take your hat off? When you pull your hat off it rubs against your hair. Electrons move from your hair to the hat. Now each of the hairs has the same positive charge. Things with the same charge repel each other. So the hairs try to move away from each other. The farthest they can get is to stand up and away from all the other hairs.

We experience occurrences of static electricity everyday. If you walk across a carpet electrons move from the rug to you. Now you have extra electrons. Touch a door knob and ZAP! The electrons move from you to the knob. You get a shock.

While this sudden discharge of static electricity does not result in any harm to the human body, it can be very damaging to electronic devices which are sensitive to electrostatic discharge.



Typical ESD Situations

Means of Static Generation	RH 10 - 20%	RH 65 - 90%
Walking across carpet	35,000 volts	1,500 volts
Walking on a vinyl floor	12,000 volts	250 volts
Remove bubble wrap	26,000 volts	1,500 volts
Vinyl envelopes for paper work	7,000 volts	600 volts

Typical ESD situations occur in everyday situations.

Relative humidity has a significant role on the static charge.

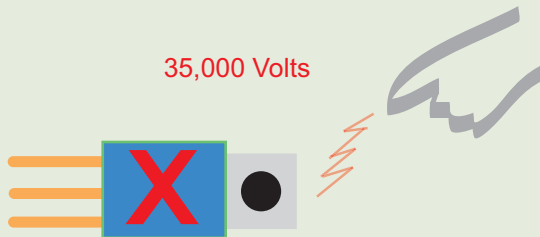
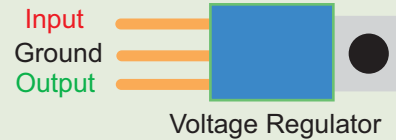
The optimal range for RH is 40 - 60% .

FACTS

- * It is possible for electronic devices to be damaged by ESD that is imperceptible to the human body.
- * In addition to component failures, industry experts have estimated average product losses due to ESD to range from 8 to 33 percent.

How does ESD damage occur?

In order for electrons to flow, you need a circuit, just like in a classic discussion of electricity.



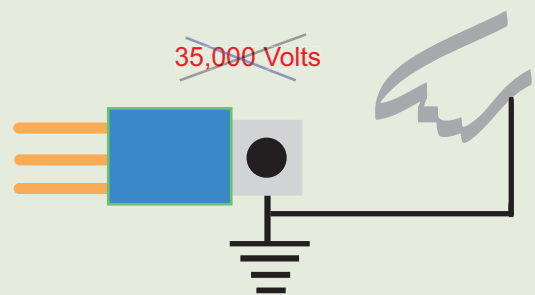
With ESD, the voltages are larger, so resistances that are so large as to be “near open-circuits” in classic electronics become viable current paths with ESD.

The air gap between the hand and the component functions as a large resistor.

The component is not grounded, the static electricity must go somewhere, so it surges through the component resulting in damage.

The focus of much of ESD protection is to give the static electricity a path to ground that does not go through the electronics.

With the component and worker virtually grounded (soft ground) via an ESD Static Safe Work Station they share the same electrical potential and static electricity is eliminated. (Soft ground = resistive path to ground.)



When a statically-charged person or object touches an electrostatic discharge sensitive (ESDS) device, there is a possibility that the electrostatic charge could be drained through sensitive circuitry in the device. If the electrostatic discharge possesses sufficient energy, damage could occur in the device due to localized overheating. Generally, devices with finer geometries are more susceptible to damage from ESD.

Two types of ESD damage

Catastrophic Damage

Catastrophic damage is immediate and detectable.

Catastrophic damage may happen anywhere in the process of manufacturing, repairing, inspection, shipping and receiving.

Latent Damage

Small voltages of ESD can weaken a component causing “hidden” or latent damage. The results of this type of damage may not emerge until a device is installed into its host system. Latent damage partially degrades a device and is often undetectable in routine quality control tests. This type of damage may result in intermittent operation, or even premature failure of an electronic component.

Strategies for ESD Prevention



Since humans are the primary source of static electricity, the single most important ESD protective material is the personnel grounding device. Normal body motions, clothing, and footwear constantly create and discharge static electricity. The most common, effective, and easy-to-use grounding device for preventing uncontrolled discharge is the wrist strap. The wrist strap makes contact with your skin and has a cord with an alligator clip or banana plug at the end. This allows it to be connected to soft ground, such as an ESD mat or a table plug. Charges can then be safely and rapidly dissipated. The wrist strap will also equalize your personal static level to the level on the surface where you are working.

For wrist straps to be effective, they must be tested each day prior to use to ensure they are working properly. Anything from dry skin to worn wires can cause a wrist strap to become ineffective. In a good ESD control program, a log is kept to record daily testing of wrist straps.

Three Rules for the Wrist Strap

- 1 WEAR IT
- 2 GROUND IT
- 3 TEST IT

WARNING

1. Always ensure system power is off while wearing a grounded wrist strap.
2. While installing or removing a component from a system, always power off the equipment and wear a grounded wrist strap.

WORK STATIONS



Static-free workstation Includes:

1. Static Control Surface
2. Floor Mat
3. Wrist Strap and/or Continuous Monitor System
4. Ionized Air (if needed)

TIP When large amounts of charge are detected, or an item cannot be grounded, an anti-static spray may be used to temporarily reduce the charge. Re-check often and apply spray as needed.

ESD BAGS

One of the most important and effective materials used to control ESD is protective packaging. All ESD sensitive parts are required to be enclosed in protective packaging sleeves at all times, except during actual repair and installation.

These sleeves serve several purposes:

- * they prevent static charging
- * they allow bleed off of charges
- * they control the rate that static charges are dissipated

TIP Before removing any ESD sensitive device from its packaging, your body must be grounded.



ESD SITUATIONAL AWARENESS

Recognition of the Prime Sources of Static Charge

Object or Process	Material or Activity
Work Surfaces	Waxed, painted or varnished surfaces, common vinyl tile or plastics.
Floors	Sealed concrete, waxed finished wood, common vinyl tile or sheeting.
Clothes	Clean room smocks, common synthetic garments, and non-conductive shoes.
Chairs	Finished wood, vinyl, fiberglass.
Packaging	Common plastic bags, wraps, envelopes, common bubble pack, foam, common plastic trays, plastic tote boxes, vials, parts bins.
Assembly Area	Spray cleaners, soldering tools, brushes, heat guns and blowers. Cleaning or drying by fluid or evaporation, sand blasting and soldering.

BEWARE OF THE COMMON ITEMS AROUND YOUR WORK AREA, LIKE STYROFOAM CUPS, PAPERS, PENS, PLASTIC BOTTLES, TOOLS.

Beware of the role you play in the chain of events and take precaution.

Almost all employees are involved at some level with ESD. Consider your role in the prevention of ESD damage. Here are a few tips. A more detailed list of procedures, checklists and requirements may be found in your company's ESD policy handbook or quality procedures.

Technicians

Recognition of ESD type components and packaging requirements. Use ESD safe test equipment, and ESD Work Station.

Inspectors

Evaluate ESD packaging. Understanding of ESD handling procedures, vendor & regulatory requirements. Safe handling and testing procedures.

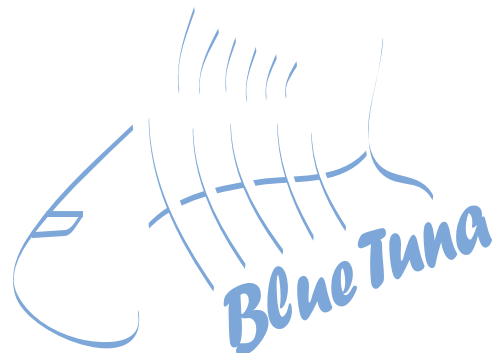
Receiving & Shipping

Recognition of good / bad ESD packaging. Understanding of procedures for handling ESD components. Maintain and use an ESD Work Station.

Purchasing

Recognition of ESD components and necessary controls. Understanding of Vendor and Regulatory requirements.

ESD
TRAINING



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