

How Static Affects Product Quality

Static electricity is a well known but little understood phenomenon that affects many industries and diverse environments. It can be something of a phantom - impossible to see, touch, or smell. However, the results of static charge buildup are quite noticeable. These results include potentially dangerous electrical shocks which can cause decreases in productivity, machinery jams, fires, and explosions. Static charges can also cause severe damage to sensitive electronic components, requiring costly rework and/or field service repair.

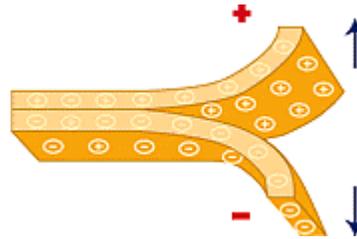


Figure 1: Triboelectric charging (a transfer of electrons) occurs when two materials are in contact and are then separated. One material acquires an excess of negative ions and the other an excess of positive ions.

Static charge buildup is caused by one of two processes: either by friction between two surfaces (called triboelectrification) or by proximity to an electrostatic field (called induction charging).

When substances become charged by triboelectrification, electrons migrate from the surface of one material to the surface of the other (see [Figures 1](#) and [2](#)). Upon separation of the two surfaces, one surface loses electrons and becomes positively charged. The other surface gains electrons and becomes negatively charged.

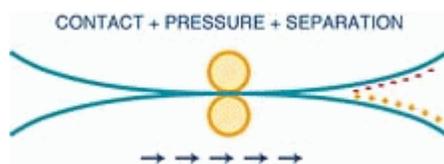


Figure 2: Friction, pressure, and separation are the major causes of industrial static electricity.

As the pressure or speed of contact and separation (friction) increases, the amount of the static charge buildup (voltage level) increases. Rapidly moving materials - such as plastic trim in a pneumatic conveyor or a converted film web - can quickly develop charges of more than 25,000 volts.

The second means by which an object or material may be charged is by induction. A

highly charged object is surrounded by a static charge field. If an isolated or ungrounded conductive object enters into this static field, it too will become charged. This creates the possibility of electrostatic discharge to some other conductive object, which could result in an arc of sufficient energy to ignite combustibles or destroy sensitive electronic components.

Conductors and Insulators

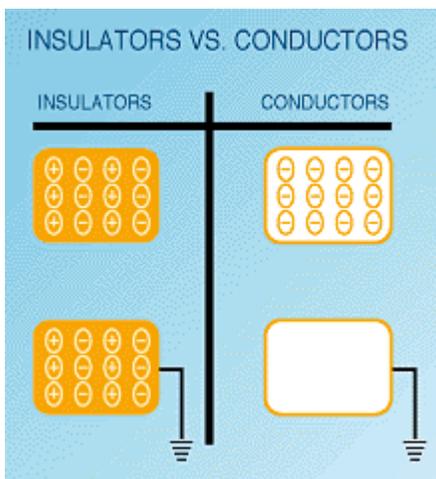
Materials are divided into two basic groups: conductors and insulators. Within a conductor, electrons move freely throughout the entire substance. Therefore, when an ungrounded conductor becomes charged, the entire volume of the conductive body assumes a charge of the same voltage and polarity. A charged conductor can be neutralized by connecting it to earth ground.

A charged insulator can remain charged for many hours. Opposite polarity charges can exist on an insulator at the same time.

Charges will not migrate on insulators.

Grounding insulators neither removes nor prevents surface charges.

Charge of one polarity can remain on a conductor as long as it is isolated from ground.



A Charged conductor will discharge completely when grounded.

Figure 3: Insulators and conductors have different surface charge and grounding capabilities.

An insulator reacts much differently to static electricity and cannot be neutralized by simple grounding techniques (see Figure 3). Within an insulator, the flow of electrons is very limited. Because of this, an insulator may retain several static charges of different polarities and potentials at various areas on its surface. This accounts for why certain areas of a material may stick together and others may repel each other. Connecting the insulator to ground will not result in an exchange of electrons as is the case with conductive substances; therefore, other means must be used for neutralizing static on insulators. The Triboelectric Series chart (see Figure 4) shows the relative positive or negative charge of various materials.

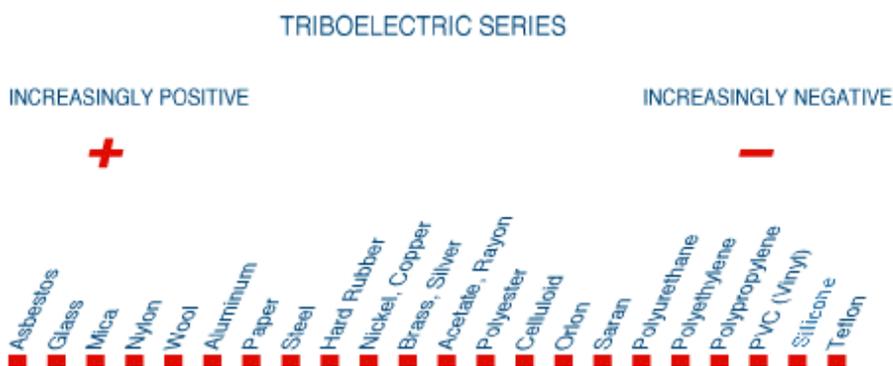


Figure 4: The Triboelectric Series chart shows the relative positive or negative charge of various materials.

Ionization

Static charge neutralization on insulators is most effectively achieved through ionization, a localized electrical breakdown of air molecules into positive and negative ions. An ionizer emits quantities of negative and positive ions in the vicinity of static charged material. The charged material then attracts a sufficient number of negative or positive ions, depending on which is required for neutralization.

Ionizers are available in many forms but all are based on one of three basic sources of ionization: electrical, induction, and nuclear.

SIMCO's electrically powered ionizers consist of one or more metal emitter points to which high voltage is applied in close proximity to a ground reference. Ionization of the air takes place as a high voltage field develops between the metal point and the ground reference as the high voltage "reaches" for ground. When a charged material passes through this field, it attracts ions until the charge on the material becomes neutral. Static charges are rapidly reduced to safe levels - even on fast-moving materials.

Induction type units are usually in a straight bar configuration with a series of ionizing

points or tufts of wire connected to a grounded metal bar. Induction type units cannot reliably achieve sufficient neutralization to solve many static charge related problems. They rely on high static charges to cause ionization, and therefore some residual charges may remain. Nuclear powered ionizers use elements such as Polonium 210. Nuclear devices are leased and must be replaced on a yearly basis because they lose effectiveness.

How Static Charges Hinder Manufacturing Processes

- *Converting*: static charge buildup results in dust and dirt attraction to web. Material is rejected.
- *Packaging*: static charge buildup attracts contaminants so that clear labels do not stick. Production decreases.
- *Plastics*: injection molded parts attract contaminants and shock personnel during processing due to static charges. Efficiency declines.
- *Textiles*: static charges cause threads to bind and break in creels and warpers. Machine downtime.
- *Nonwovens*: trim collection systems clog due to increasing static charge buildup on materials in pneumatic conveyors. Increased maintenance.
- *Printing*: sheet-fed press feed and delivery is troublesome due to static. Untimely delivery.
- *Graphic Arts*: static charge buildup while processing film results in costly retouching or remakes. Dissatisfied customers.
- *Medical Device Manufacturing*: static charges attract contaminants to small plastic parts prior to packaging. Decreased quality.
- *Electronics*: destructive electrostatic discharge (ESD) causes latent damage to board assembly. Field failure.

How SIMCO Static Control Equipment Enhances Manufacturing Processes

- *Converting*: neutralized material remains free of dust and dirt during rewind. Decreased rejects.
- *Packaging*: elimination of static charges on labels and/or bottles allows for successful application of product labels. Increased production.
- *Plastics*: following neutralization, injection molded parts do not stick together while being conveyed. Line efficiency increases.
- *Textiles*: threads run smoothly through creels and warpers run at optimum speeds without undue maintenance. No unnecessary downtime.
- *NonWovens*: trim collection system runs without interruption due to static elimination of charges prior to entering cyclone. Increased production.
- *Printing*: sheet-fed delivery is clean and stacked accurately-ready for bindery without adjustment. On time delivery.
- *Graphic Arts*: processed film remains dust free, eliminating the need for remakes. Satisfied customers.
- *Medical Device Manufacturing*: contaminant free packaging of small plastic parts due to elimination of static charges on parts and packaging materials. Increased quality.
- *Electronics and Semiconductor*: protection from ESD during assembly work ensures achievement of quality assurance standards. Reduced product failure.

SIMCO, the world's largest manufacturer of static control products, has been providing solutions to electrostatic problems in a wide range of industries since 1936. As we complete our sixtieth year, we're proud that SIMCO has achieved ISO 9001 certification. This signifies our commitment to quality products and service excellence.

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