WE CREATE BETTER ENVIRONMENTS
BY KEEPING THEM **UNDER CONTROL**

ESD essentials

WHY IS BEING FAMILIAR WITH THE **ESD ESSENTIALS** IMPORTANT?

What most people don't realize about electrostatic discharge (ESD) is that it can create damage without being noted. This invisible phenomenon can for example damage electronic devices or components, what can have crucial consequences. It can also cause danger for employees, patients and other people. So it is important to understand what ESD is and to know how ESD occurs, in order to be able to prevent or control it.

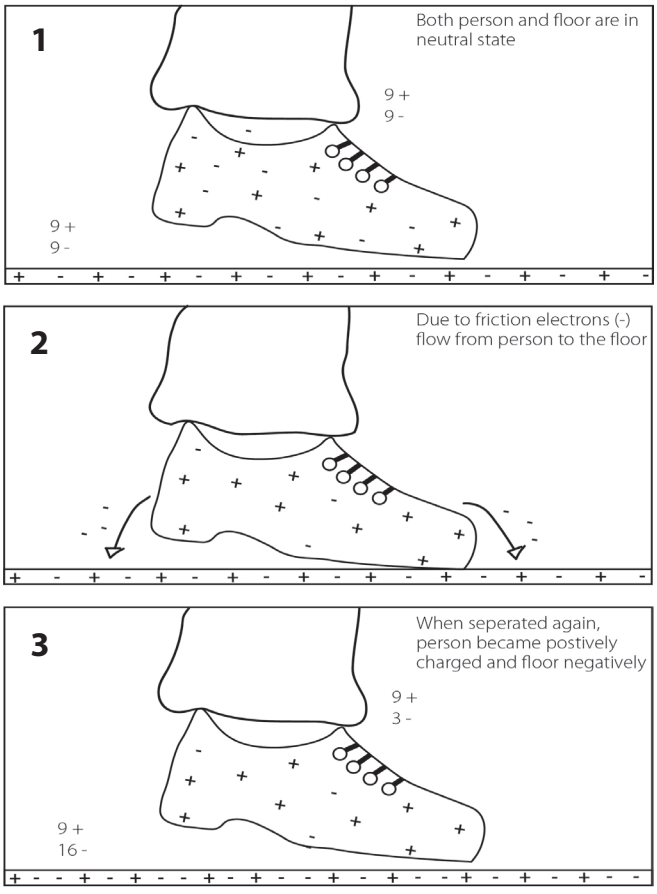
ESD: WHAT IS IT?

ESD is the abbreviation for Electro Static Discharge. It can be described as the sudden flow of electrons from one surface or human being to another surface or human being. This takes place when the materials return to their neutral or uncharged state. It can be seen as a miniature spark which passes from one electrostatically charged surface to another surface.

Discharges of electrically charged objects is a natural, physical phenomenon. The imbalance of positively and negatively charged objects will be restored by electrostatic discharges. Electro Static Discharge (ESD) events can be very large and noticeable, annoying or small and invisible. The power of a discharge can be expressed in Volts.

Volts of the discharge	The consequence of the discharge
100.000.000 V	The strength of a lightning bolt
10.000 V	The snap of a spark from static discharge can be heard
5.000 V	A visible spark will occur
3.000 V	Most people can feel a static discharge
2000 V	Most people cannot feel static discharge (limit value for antistatic flooring in EN14041
100 V (or less)	Some electronic components can be damaged (limit value for ESD areas)
50 V (or less)	Sufficient voltage to trigger an explosion
20 V (or less)	Sensitive electronic components, i.e. a magnetic reader strip, can be damaged

HOW DOES **ESD OCCUR**?



The cause of ESD is static electricity. Static electricity can be generated through various phenomena. Electrostatic charge is the buildup of charge between two surfaces and is most commonly created by the contact and separation of two surfaces. This is known as tribo-electric charging. It arises when two surfaces rub together. This example is visualized in the infographic on the right. Neutral surfaces have as many negative as positive electrons, as you can see in step one. During contact, charged electrons (-) flow from one surface to the other. This is step two in the infographic, where the electrons flow from the person to the floor. When the surfaces are being separated, as visualized in step three, electrons will be extracted from one surface and remain on the other surface. The surfaces now have a potential difference: an opposite electrostatic charge. It depends on the place in the tribo-electric range which material or surface becomes positively charged and which becomes negatively charged.

When two surfaces with potential difference come near each other, they can transfer charge to get back to their neutral state. This transfer of charge is also known as electrostatic discharge. Charged materials will by nature look for an electrostatic discharge to return to their neutral state, with an even amount of electrons (-) and protrons (+).

Another cause of electrostatic charge is induction. In this case an electrically charged surface is placed near a conductive surface, which is isolated from the ground. The presence of the charged surface creates an electrostatic field. This electrostatic field causes electrical charges on the conductive surface. Even though the electrostatic charge of this conductive surface has not changed, areas with excessive positive (+) and negative (-) charges have arisen.

So a charged source influences the electrons in another object without physical contact. The object becomes electrically charged. An ESD event may occur when this surface comes in contact with an object which is a conductor (i.e. metal). A daily life example is wireless charging of a mobile phone, where the charger influences the receiver, the battery, in the phone without physical contact. This is possible due to the alternating electromagnetic field created by the charger.

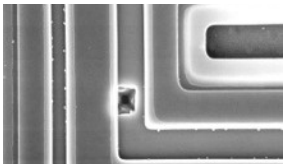
THE **RISKS** OF ESD

Even though a discharge might be imperceptible, it can cause large scale damage. In the world of ESD, there are three risk areas defined:

Degradation of sensitive electronic componenets

The discharge can damage the electrical path in for example a chip. When a microscopically small wire is broken, the chip will not function anymore. For a manufacturer it means that production yields reduce. This damage by discharge is also known as a catastrophic failure. The signal cannot flow from one point to the other anymore because the wire is damaged. This blocks the signal. It does not always lead to noticeable damage immediately: a discharge can also cause a latent defect. In this case, the chip still functions normally, but a weak spot is created. If the chip is already used inside an electrical device, the failure cost increases dramatically. There is a risk of malfunctioning equipment, overheating and electrical short circuit. In some cases, this can be life threatening. Examples of frequently occurring failures are data loss on magnetic data carriers and memory errors.

Catastrophic failure



Latent defect

Detoration of production or working conditions

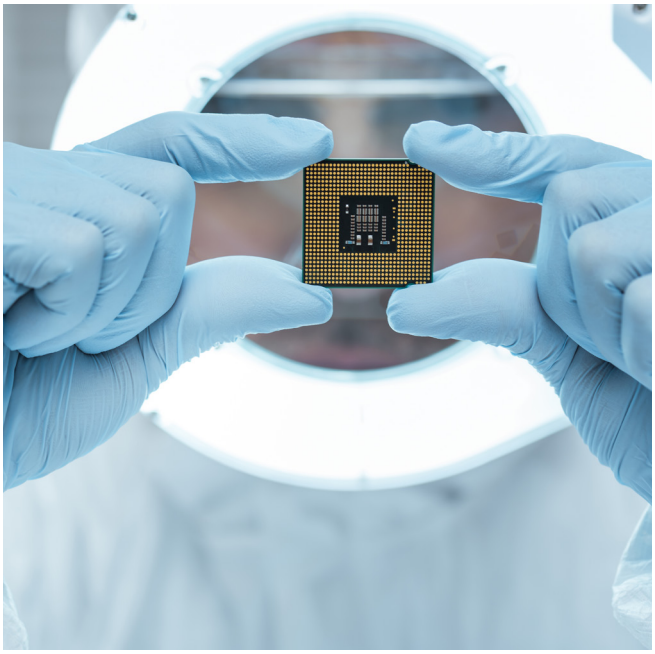
Electrostatic charges can also cause problems in production processes and working environments by upsetting the normal operation of an electronic system, causing equipment malfunction or failure. Static electricity is also attracting dust, powder and other contaminants and makes it harder to remove the particles; which is not desired in areas where very small components need to be soldered very precisely. This is because electrostatic forces are attractive or repulsive forces between particles that are caused by their electric charges. . In healthcare this phenomenon can have a negative effect on well-being of patients and spreading of microorganism. In other industries, production processes can be disturbed by ESD, for example in the Pharma industry where a production line gets jammed by small pills which are clinging to static plastic tubes in which they get transported. Electrical failures and flipping switches caused by ESD can be life threatening; for example an emergency stop which is not working properly.

Small pills clinging to static plastic tubes

Dust explosion

Trigger for explosions

In areas with inflammable gasses, ammunition or high concentrations of dust, ESD can be a trigger for an explosion. This is because an electrostatic discharge is accompanied by a miniature spark, which can trigger an explosion. Dust explosions are a real concern in pharmaceutical, chemical and other manufacturing industries. The powdered and granulated ingredients are naturally prone to creating dust, which can become airborne.



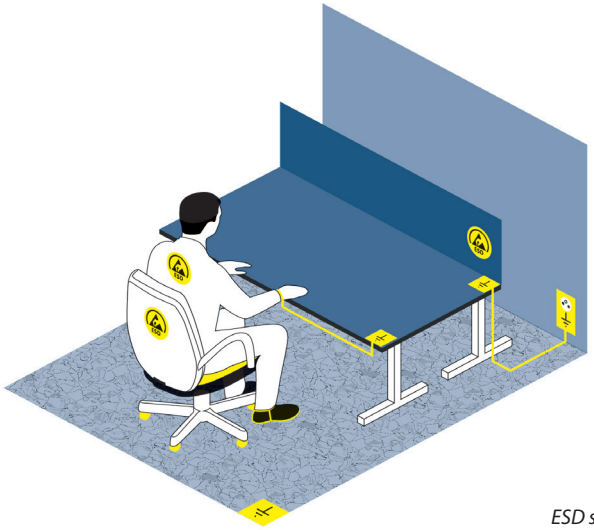
CONTROLLING ESD

Unwanted ESD events can be prevented by restoring the balance of negative (-) and positive (+) ions in a controlled way. One of the methods to return the charged surface to neutral state, is by using ESD protective equipment.

Specific ESD flooring limits the electrostatic charging of e.g. materials and people. They also ensure that when materials get charged, the charge is discharged and grounded from the people through the conductive shoes to the floor in a controlled way. Alternatively while seated a conductive arm wrist band which is connected to a grounding point is possible.

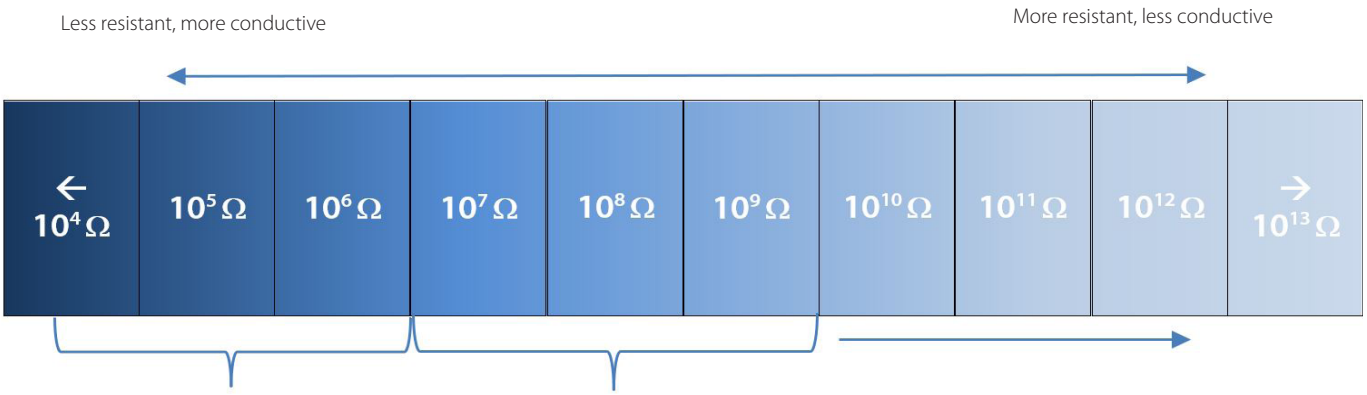
An ESD floor will only function properly if it is part of an ESD system! The charges must be able to flow from the place where they are created to a grounding point. The ability of a floor to lead away charges and restore the balance of negative and positive ions can be measured. There are several ESD related standards which describe how a floor should be tested. More information about testing and standards can be found in the whitepaper about ESD standards.

An ESD floor has conductive or dissipative properties, to ensure a low resistance and let the charges flow through the floor to earth. The need for dissipative (SD) or conductive (EC) flooring is depending on the electrical sensitivity of the customers product and/or process in the application area. Conductive flooring is not by definition better than dissipative flooring. The difference between conductive and dissipative flooring is in the degree of electrical resistance.



ESD system

The resistance value, expressed in Ohms (Ω), determines how easily electrostatic charges can flow via surface of the floor to earth. Conductivity is the opposite of resistance and predicts how effectively or efficiently a floor will ground electrostatic charges. If the resistance is low, the floor is more conductive and electrostatic charges will flow very easily. If the resistance is becomes higher, charges will be hindered more in their flow and the floor will be categorized as a dissipative, anti-static or even insulating floor. When it comes to controlling ESD, electrostatic conductive (EC) and static dissipative (SD) flooring are most relevant. These types of flooring have, due to their properties, a relatively low resistance (EC even more than SD) and are qualified to prevent charging or ground charges. The decision maker (e.g. a contractor or ESD specialist) knows if SD or EC flooring is required.



Conductive (EC)
The charges can flow efficiently and easily through the surface of the floor. Conductive floors of Forbo are.: Colorex EC, Colorex plus EC, Colorex signal Glow and Sphera EC.

Dissipative (SD)
Charges can still flow efficiently through the surface of the floor, but less easy than in a conductive floor. Forbo dissipative floors are: Colorex SD, Sphera SD and Marmoleum Ohmex.

Regular
Other 'regular' flooring systems of Forbo have a resistance >10^9 Ω
Examples of Forbo regular floors are: Allura, Marmoleum Marbled, Sphera Element, Flotex and Eternal

THE RELATION TO THE FORBO **UNDER CONTROL PORTFOLIO**

Forbo's Under Control portfolio contains several types of flooring for controlled environments, including flooring with Electrostatic Conductive (EC) and Static Dissipative (SD) properties, which can help preventing ESD problems for customers by reducing the charging of materials and grounding charges in time.

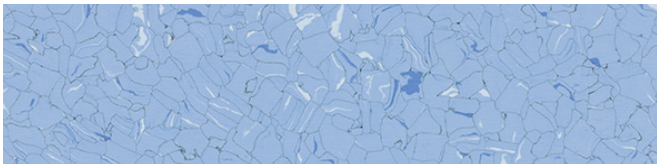
Forbo flooring systems with ESD properties are:

- **Colorex SD, Colorex EC and Colorex plus EC**
  Homogeneous vinyl tile collection with permanent dissipative or conductive properties, in standard tile format produced in Giubiasco (Switzerland) or as a system with interconnecting hidden dovetails (plus system), engineered in Giubiasco and produced in Germany.

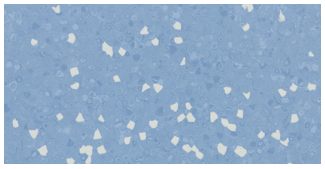
- **Sphera SD and Sphera EC**
  Homogeneous vinyl collection in sheet format, with permanent dissipative or conductive properties, produced in Coevorden (Netherlands).

- **Marmoleum Ohmex**
  Linoleum flooring in sheet format with dissipative properties, produced in Assendelft (Netherlands)

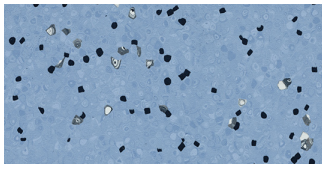
If you like to know more about the solutions for controlled environments that Forbo offers, you can read about it on the Under Control SharePoint and Forbo website.



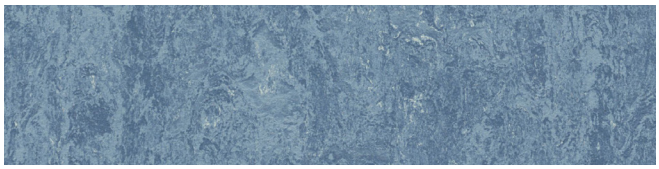
Colorex SD 150222 | niagara



Sphera SD | 550037 China blue



Sphera EC 450037 | China blue



Marmoleum Ohmex 3055 | fresco

Colorex **SD 150222** | niagara **SD 150265** | blue ridge