ECOTILE SALES TRAINING MANUAL

ESD

Benefits of ESD Flooring

Ecotile ESD floor tiles are a static dissipative or conductive flooring system designed for use in areas where components or individuals need to be protected from the risk of electrostatic damage. This includes electronic sub-assembly areas or facilities where combustible/explosive materials are handled, typically in an industrial or manufacturing environment.

Ecotile ESD is guaranteed to meet BS EN 61340-5-1 and to be IEC 61340 compliant. The resistance to ground falls between 2.9 x 10^4 ohm/m2 and 5.7 x 10^6 ohm.

The conductive properties of Ecotile ESD floors will last for the lifetime of the tile and if grounded in accordance with our instructions and maintained properly, the tiles will create a safe conductive floor surface that can be used as your primary ground.

Performance & Test Results

- Surface resistivity: 2.2 x $10^4\Omega$ to 3 x 10^6 Ω
- Resistance to Ground: 2.9 x $10^4\Omega$ to 5.7 to 10^5 Ω
- Electrostatic Propensity: < 10 Volts / <2.0 kV
- Static Decay at 15% Humidity: 0.01sec

The test results guarantee that Ecotile E500/ESD complies with British Standard BS EN 61340-5-1:2016 and IEC 61340

ESD Logo Tile

Smooth Texture

Benefits

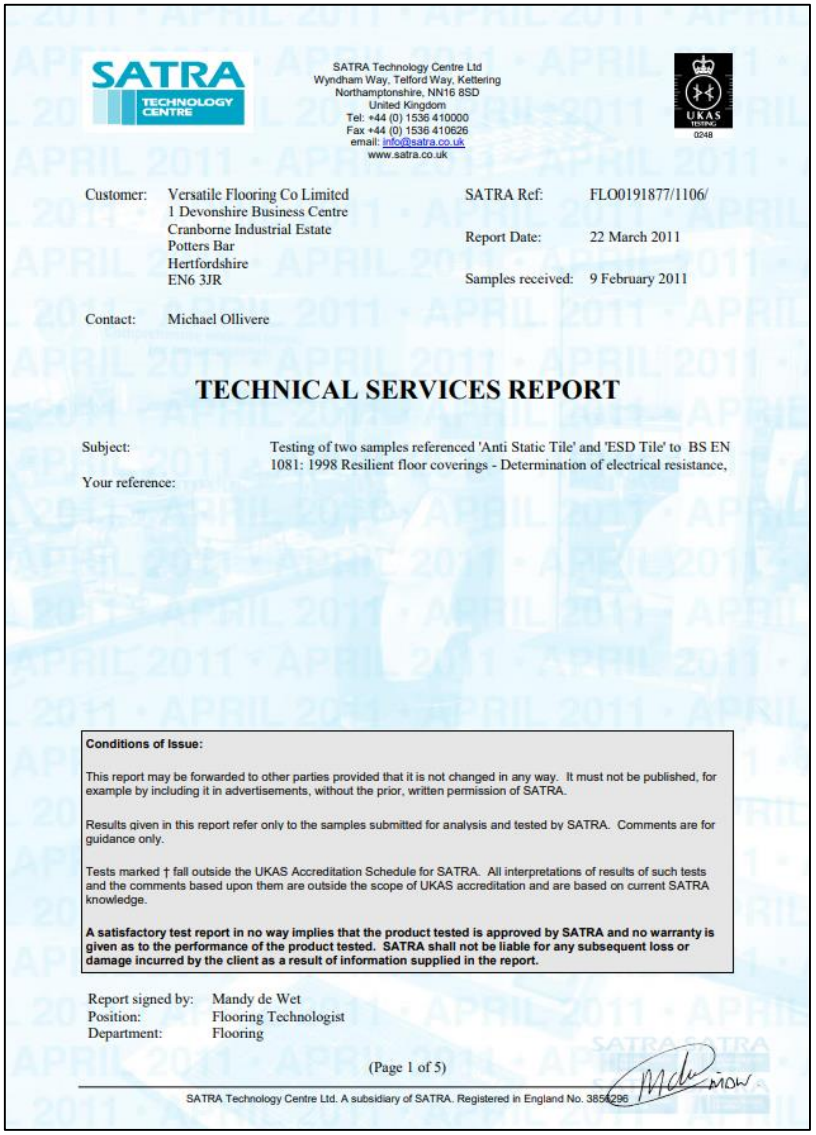
- Suitable for trucks, HGVs and heavy-duty applications
- Installed without any downtime
- 10 year warranty
- Withstands tight turning circles
- Ideal for uneven or damp floors
- Good chemical resistance
- Expected lifespan of 20 + years
- Exceptionally durable
- Quick & simple to install
- Noise reduction of up to 46db
- No damp proof membrane, screed or adhesives required
- Fire retardant – EN 13501-1 Class Bfl S1
- Easy to maintain & clean
- Excellent slip-resistance (R10)
- Reduces worker fatigue
- Warm – Insulates the floor from the cold
- No additional toxic chemicals - 100% recyclable

ESD Test Certificate

Ecotile ESD is guaranteed to meet BS EN 61340-5-1 and to be IEC 61340 compliant. The resistance to ground falls between 2.9 x 10^4 ohm/m2 and 5.7 x 10^6 ohm.

Here is the ESD Test Certificate:

- ESD Test Certificate



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UKAS TESTING 0248

Customer: Versatile Flooring Co Limited
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Cranborne Industrial Estate
Potters Bar
Hertfordshire
EN6 3JR

SATRA Ref: FLO0191877/1106/

Report Date: 22 March 2011

Samples received: 9 February 2011

Contact: Michael Ollivere

TECHNICAL SERVICES REPORT

Subject: Testing of two samples referenced 'Anti Static Tile' and 'ESD Tile' to BS EN 1081: 1998 Resilient floor coverings - Determination of electrical resistance,

Your reference:

Conditions of Issue:

This report may be forwarded to other parties provided that it is not changed in any way. It must not be published, for example by including it in advertisements, without the prior, written permission of SATRA.

Results given in this report refer only to the samples submitted for analysis and tested by SATRA. Comments are for guidance only.

Tests marked † fall outside the UKAS Accreditation Schedule for SATRA. All interpretations of results of such tests and the comments based upon them are outside the scope of UKAS accreditation and are based on current SATRA knowledge.

A satisfactory test report in no way implies that the product tested is approved by SATRA and no warranty is given as to the performance of the product tested. SATRA shall not be liable for any subsequent loss or damage incurred by the client as a result of information supplied in the report.

Report signed by: Mandy de Wet
Position: Flooring Technologist
Department: Flooring

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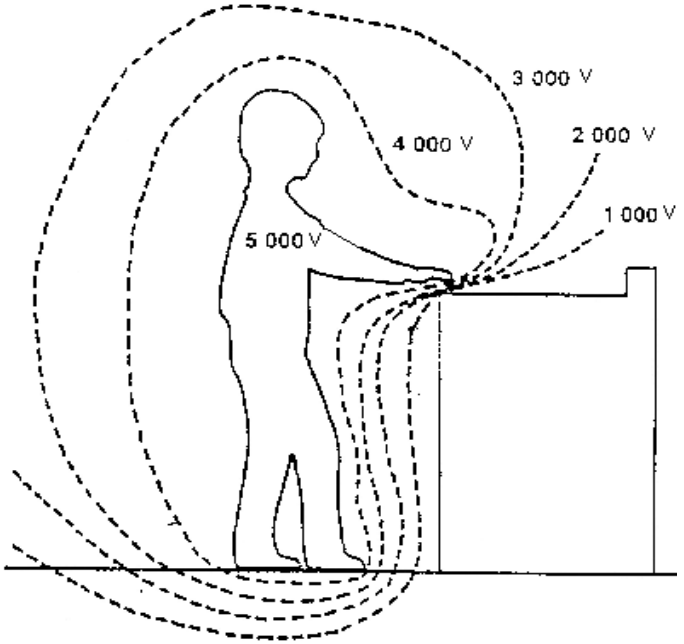
What is Electrostatic Discharge (ESD)

Electrostatic discharge is the sudden flow of electricity between two electrically charged objects caused by contact, an electrical short, or insulator breakdown. The ESD occurs when differently-charged objects are brought close together or when the insulator between them breaks down.

ESD can cause a range of harmful effects of importance in industry, including gas, fuel vapour and coal dust explosions, as well as failure of electronics components such as integrated circuits. These can suffer permanent damage when subjected to high voltages. Electronics manufacturers therefore establish Electrostatic Protected Areas (EPA) free of static, using measures to prevent charging, and measures to remove static such as grounding human workers, providing antistatic devices, and controlling humidity.

What Causes Static Electricity?
Static Electricity is caused by friction between and separation of two materials. This phenomenon is also called **Triboelectric Charging**



What Are The Main Generators Of Static?

The primary cause of static is people;

- Walking across floor surfaces
- Moving their chairs which creates friction
- Handling packaging materials
- Contact with containers, tools, machinery

How Can Static Discharge Damage Components?

- By direct contact, handling, assembling or moving static sensitive components
- By Electrostatic Induction between an individual and a component

Why Should I Be Concerned about ESD/Static Charge?

ESD will always cause some damage to a product even though it won't be visible most of the time. ESD damage cannot be detected without removing the silicon from the package and inspecting it, or, in cases where the damage is hidden in-between layers, by slicing the silicon into very thin sheets where the damage is likely to have occurred.

In most cases, most uses of a given part won't be measurably altered by the change. However over time repeated use of the component or subsequent discharges will potentially change the part enough that it will behave slightly out of spec. If you are lucky the product will fail during testing prior to shipping or installing the component. If the failure happens once your customer has used it in their product the cost of repair or replacement could increase significantly and you also risk reputational damage.

Taking appropriate ESD precautions will:

- Save you money by reducing your failure rates / Warranty Claims etc.
- Show that you are an Ethical & Responsible Manufacturer
- Win you Orders & Help Retain Customers

Problems That Can Be Caused By Static Electricity:

- Machinery breakdown
- Explosions & fires
- Staff discomfort / irritation from static shocks
- Contamination of products - contamination occurs because electrostatically charged products attract dust and micro-organisms
- Damage to electrostatic sensitive devices

Why Should I Be Concerned about ESD/Static Charge?

Damage That Can Be Caused By ESD:

- CATASTROPHIC DEFECT – Product / component failure at point of manufacture - not all catastrophic defects can be detected prior to shipping
- LATENT DEFECT - Latent defects such as reduced operational lifespan, product failure etc. Latent defects can occur arbitrarily at any time, in many cases latent defects are not identified as ESD damage: for example the device is damaged by ESD during manufacture but works when tested but the life span of the product is reduced dramatically.

How Can You Prevent ESD Damage:

- Minimise the generation of static electricity in areas where sensitive devices are handled - For example: do not establish an ESD Protected Area (EPA) close to a conveyer belt or other electrostatic generating activities.
- If charge generation can not be avoided, ensure a defined path to ground is in place allowing electrostatic charge to be drained in a controlled manner.
- Make sure that materials which acquire charges are not placed close to sensitive devices - Stay away from a monitor screen and do not move your devices close to a keyboard.

How do you Prevent Your People from Creating A Static Risk:

- Primary grounding via a suitable **CONDUCTIVE** floor surface combined with heel straps / ESD footwear and ESD protective garments

  Or

- Secondary grounding via a dissipative floor surface **AND** heel straps / ESD footwear, ESD protective garments, wrist straps and bench top matting connected to a suitable ground point.

Setting up an ESD Control System

- The level of ESD protection depends on the most sensitive parts used in the production process. Check the sensitivity of the components from the parts' lists and define the maximum electrical charge allowed to be generated in the EPA
- Define the boundaries of the ESD protected Area (EPA= ESD Protected Area)
- Develop an ESD Control programme
- Carry out ESD audits regularly
- Prevent contamination from plastic cups, rubbish sacks, packing tape etc. in the EPA

What are the Key Components of an ESD Control System

- Flooring (ESD protective flooring)
- Workbenches (frames and table tops)
- Chairs
- Shelves and trolleys
- EPA - boundary tape, signs
- Desk accessories (document holders/bins, ring binders, waste bins, etc.)
- Ionisation equipment

IEC / BS EN 61340-5-1:2007

THE STANDARD

IEC / BS EN 61340-5-1:2007 applies to activities that involve manufacture, processing, assembly, installation, packaging, labelling, servicing, testing, inspection, transport or any handling of electrical or electronic parts, assemblies and equipment susceptible to damage by electrostatic discharges greater than or equal to 100 V human body model (HBM).

IEC / BS EN 61340-5-1 provides the requirements for an ESD control program. The user should refer to IEC 61340-5-2 for guidance on the implementation of this standard. This standard does not apply to electrically initiated explosive devices, flammable liquids, gases and powders. The purpose of BS EN 61340-5-1 is to provide the administrative and technical requirements for establishing, implementing and maintaining an ESD control program.

The fundamental ESD control principles that form the basis of this Standard are as follows:

- Avoid a discharge from any charged, conductive object (personnel and especially automated handling equipment) into the ESD System.
- Avoid a discharge from any charged ESD sensitive device. Charging can result from direct contact and separation or it can be field induced.
- Once outside of an EPA it is often not possible to control the risks mentioned above, so ESD protective packaging may be required. ESD protection can be achieved by enclosing ESD sensitive products in static protective materials, although the type of material depends on the situation and destination.

Each company has different processes, and so will require a different blend of ESD prevention measures for an optimum ESD control program. It is vital that these measures are selected, based on technical necessity and carefully documented in an ESD control program plan, so that all concerned can be sure of the program requirements.

The Requirements for ESD Flooring

The following standards detail the requirements for an ESD floor system: IEC/BS & DIN EN 61340-4-1 (2004-12) and DIN EN 61340-4-5 (2005-03). In order to be able to undertake the measurements in accordance with the standards and the Human Body Model (HMB) the flooring must be tested in combination with the person, shoes and flooring to ensure the protection of electronic components against the electrostatic discharge of an individual

The requirements and limits are described in the standard IEC / BS/ DIN EN 61340-5-1 (2008-07)

The following current requirements have to be fulfilled by the ESD flooring:

	Limit according to IEC/BS/DIN EN 61340-5-1 (2008-07)	Norm	Comment
Resistance to ground Rgp of the flooring to earth	Product Limits Rgp <1x10^9Ω (corresponds <1GΩ)	IEC/BS/DIN EN 61340-4-1 (2004-12)	Conditioning and test climate have to be agreed between the contract parties. If not agreed or specified differently, the following is valid according to the norm IEC / BS/ DIN EN 61340-5-1 (2008-07) Temperature: 23 ± 2 °C Relative Humidity:12 ± 3 %
Resistance to ground Rg_{system} of the system "person/shoes/flooring" against protective earth or function earth Walking test – Measurement of the body voltage U	Product Limits Rg_{system} <3.5 x 10^7Ω (corresponds < 35MΩ) OR Rg_{system} <1 X 10^9Ω (corresponds<1 GΩ) And Body voltage<100 Volt (mean value of the 5 highest readings)	IEC/BS/DIN EN 61340-4-5 (2005-03)	Conditioning and test climate have to be agreed between the contract parties. If not agreed or specified differently, the following is valid according to the norm DIN EN 61340-4-5: Temperature: 23 ± 2 °C Relative humidity: 12 ± 3 %

- All testing should be carried out in accordance with IEC/BS/DIN 61340-4-1:2004 Standard Test Methods for Specific Applications – Electrical resistance of floor covering and installed floors.
- Six measurements should be taken at random spots across the floor and calculate the geometric mean of the individual readings.
- The limits according to IEC/BS/DIN EN 61340-5-1 (2008-07) has to be secured without ESD floor finish

Static Dissipative vs Static Conductive

Static Dissipative & Static Conductive Flooring Comparison Charts	Static Dissipative	Static Conductive
What flooring should I use for what application?	**1 x 10 E6 to 1 x 10 E9**	**2.5 x 10 E4 to 1 x 10 E6**
Meets Standard for use as **Primary Ground** in Electronics Manufacturing & Handling Facilities according to BS EN 61340-5-1 / ANSI20:20 / IEC BS EN 61340-5-1	**NO**	**YES**
Meets Standard for use as **Secondary Ground** in Electronics Manufacturing & Handling Facilities according to BS EN 61340-5-1 / ANSI20:20 / IEC BS EN 61340-5-1	**YES**	**YES**
Meets Motorola R56 / ATIS-0600321 / FAA STD 019e for Calls Centres, Telecommunication Facilities, Flight Control Centres etc.	**YES**	**YES**
Meets NFPA 99 for Healthcare Installations	**YES**	**NO**
Meets IBM recommendations for Data Centres	**YES**	**NO**
Lifetime Static Control Properties	**YES**	**YES**
Meets DOD Explosives Handling Requirements	**NO**	**YES**

How to Test Your Floor and The System

Surface Resistance – Using the appropriate test equipment test the floor across two or more tiles and take a minimum of 9 readings across random points. Calculate the average reading from your tests to get an accurate surface resistance reading.

- Measuring the resistance between two points on the tiles = Surface Resistance.

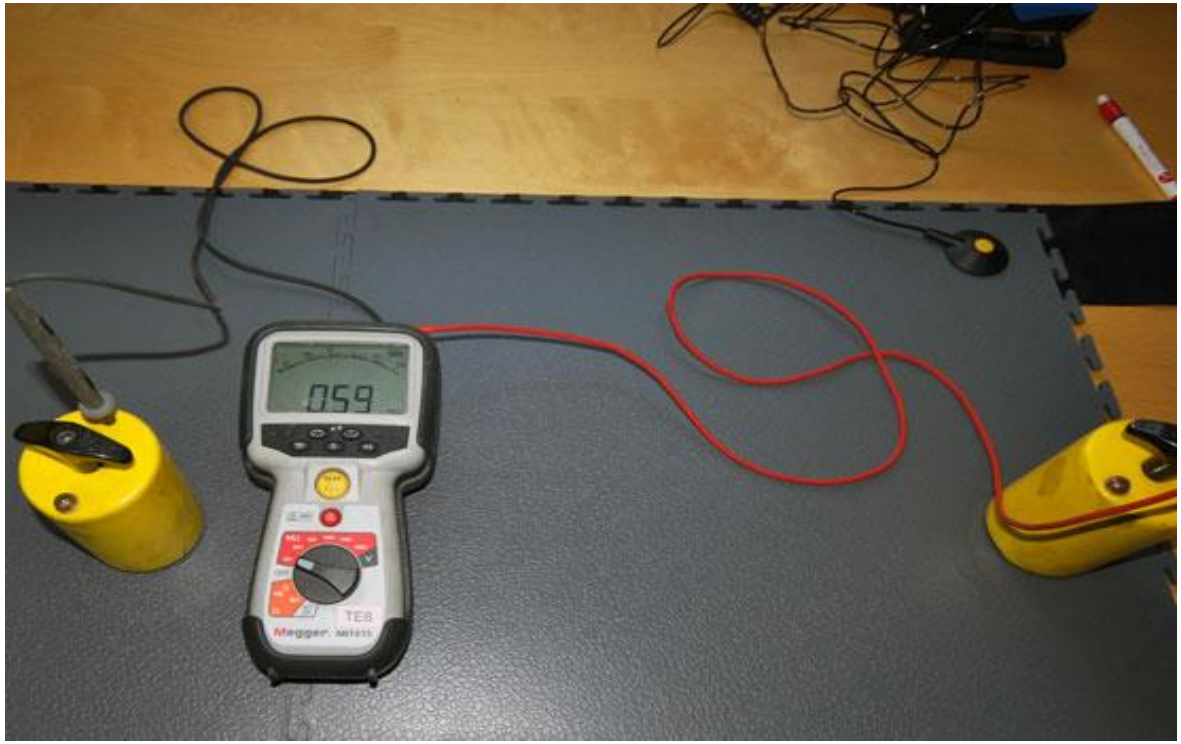
- In this example the surface resistance is 0.59megΩ = 5.9 x 10 E5

☑ Correct Test Method

- Use weights or suitable test plate to ensure good surface contact.

☒ Wrong Test Method

- Do not use prong contacts to test the floor, insufficient surface contact.

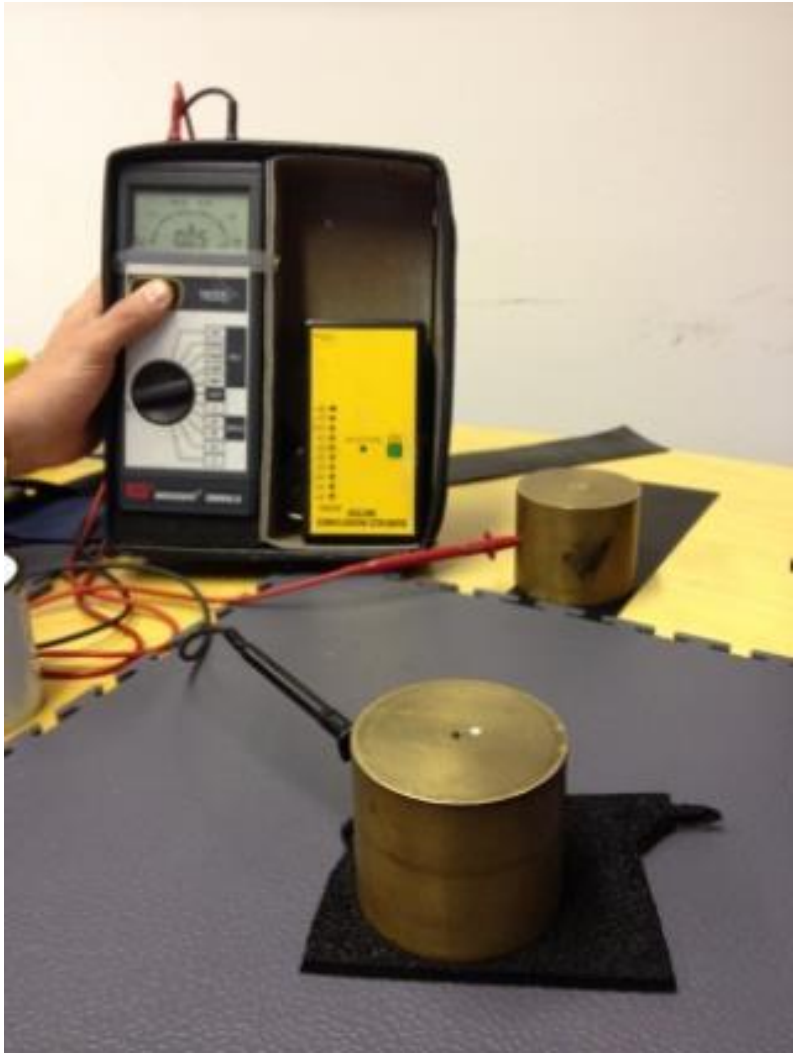


How to Test Your Floor and The System

Resistance to Ground of the Floor – To measure the resistance to ground of the floor tiles in isolation test from the tile to either the grounding stud or the grounding tape (not via the grounding cord because the cord includes a 1 megΩ resistor). To test the resistance to ground of the entire floor system place one probe on the floor and connect the other connection to the end of the grounding cord.

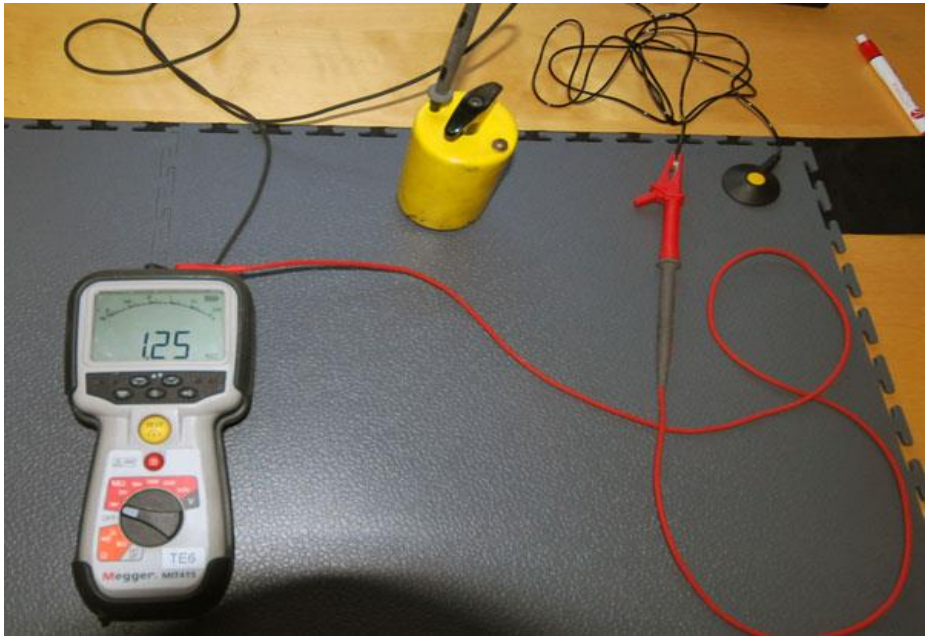
☑ Correct Test Method 1

- Test from the floor first to your grounding point.
- Target Resistance to be less than 1 x 10 E6. i.e. suitable for use within an EPA zone/electronics manufacturing facility.

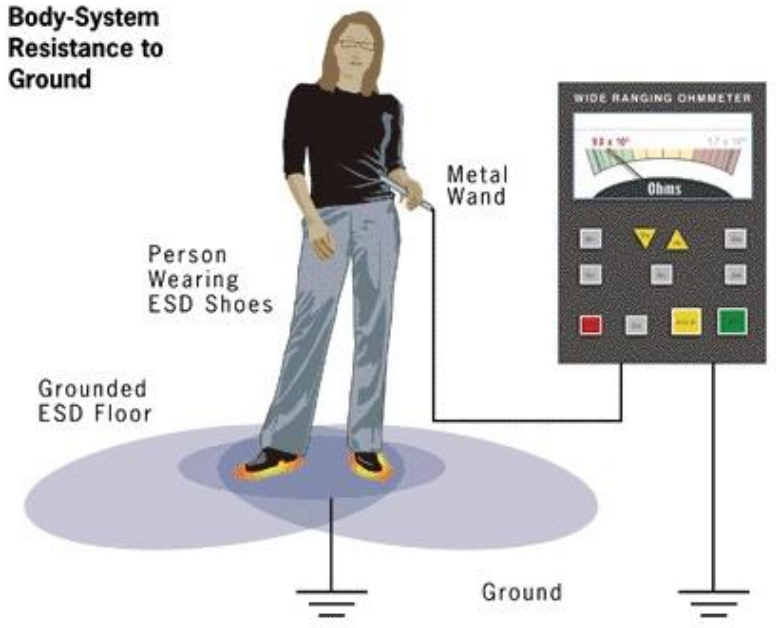


How to Test Your Floor and The System

Resistance to Ground of the System– To measure the resistance to ground of the system (the combination of the person, footwear and floor) hold one probe in the palm of your hand, connect the other probe to your grounding point and test. The results should be from 1 x 10^6 or 1 MegΩ and not exceed 3.5 x 10^7 or 35MegΩ.



Test the resistance via the grounding cord with the 1megΩ



Test the resistance of the system, the individual, the footwear and the floor.

☑ Correct Test Method 2

- Test from the floor next to your grounding point to test the resistance to ground of the floor via the grounding cord with the 1meg Ω resistor.
- Target Resistance to be between 1 x 10 E6 and 3.5 x 10 x E7 – i.e. The safety zone in the event of an electrical short circuit.

Interpreting your Test Results

SCIENTIFIC NOTION

How to interpret your reading (Example):

- 0.429mΩ = 4.29 x 10^5 - Explanation: 0.429 is between 0.1 and 1 is in the range for 10^5 and the 0.429 represents where in the range it is located
- 5.9Meg = 5900kΩ = 5.9 x 10^6 - Explanation: 5.9 between 1 and 10 is in the range for 10^6 and the 5.9 represents where in the range it is located

Ohms (Ω)	Notation / Integer	KΩ	MΩ	GΩ	Description	Guidelines
100	10^2	0.1	0.0001		= CONDUCTIVE	but below recommended safety guidelines, resistance above 10^4 recommended
1000	10^3	1	0.001			
10000	10^4	10	0.01		= CONDUCTIVE	Range for an ESD floor if it is to be used as a primary ground
100000	10^5	100	0.1			
1000000	10^6	1000	1	0.001Gig		
10000000	10^7	10000	10	0.01Gig	= DISSIPATIVE	Range for an ESD floor if it is to be used in addition to a secondary ground (i.e. Bench top mats and wrist straps)
100000000	10^8	100000	100	0.1 Gig		
1000000000	10^9	1000000	1000	I Gig	10^9 to 10^{11} = Anti-static	

Experiencing Static Shocks with Ecotile

Ecotile as a floor product cannot and will not generate static by itself, it will be caused by a combination of events including the type of activity taking place on site, what other equipment or machinery, packaging materials or processes are being carried out, the operative footwear, atmospheric conditions or any combination of any of these circumstances.

If you have only started to experience the static shocks since installing your new Ecotile floor the chances are that your old floor was either concrete or wood, materials that have hygroscopic properties (i.e. will attract moisture from the air), the moisture helps minimise the build-up of static. If your operatives wear footwear with insulative soles such as trainers or rubber soled safety boots they may be building up static in their bodies caused by the friction created between the insulative sole of their footwear and the Ecotile.

Immediate Solutions

1. Touch a metal object using another metal object to release static discharge. This allows sparks from the discharge to affect the metal object, and not your skin. For example, touch a doorknob using a key instead of your hand at first to lower the risk for electric shock.
2. Avoid wearing clothing made from wool and synthetic fabrics. Wool and synthetic fabrics such as polyester, rayon, and spandex are more prone to rub together and create friction and static electricity.
3. Wear Antistatic (also called low charging) footwear or use heel straps or a wrist strap will help reduce electrostatic build-up between the operative and the floor and will help dissipate electrostatic charges.
4. Increase humidity levels in your environment. Dry, cold environments with low humidity levels generate a higher level of static electricity. Consider using a humidifier in your home or office to achieve between 35 and 50 percent humidity.
5. If you have specific problems with a machine, filing cabinet etc. make sure that the metal surface is earthed, alternatively **ground the static by touching a grounded appliance, wiring a ground circuit, or by applying a neutralizing charge**. Static only accumulates and causes a problem in areas where the charge cannot escape.

Long Term Solutions

6. **Use the correct cleaning and maintenance routine** – Clean and maintain the floor using Ecotiles recommend anti-static cleaner. Mix with water at 20:1 and use as your daily or weekly cleaning regime. The cleaning chemical will leave an anti-static residue on the surface of the tile that will reduce the risk of static build up. *(Please see EcoTile Cleaning Guidelines)*
7. Alternatively, **apply our ESD floor polish** to the tiles to create and ESD / Static Dissipative floor Surface. *(Please see EcoTile Cleaning Guidelines)*

Summary

There are multiple factors that can impact on the test results such as humidity, temperature, cleaning methods, dust and dirt on the floor and how well hydrated the individual undertaking the test is. To achieve both a floor that is safe for the manufacture of components that are susceptible to damage from electrostatic discharge and that is also safe for the individual to work on you MUST view the system as an entirety:

The floor should have a resistance ideally between 5 x 10^4 or 50,000Ω and not exceed 1 x 10^6 or 1MegΩ. This allows a margin for error in the event of low humidity or dirt build up on the floor. This will ensure that individuals working on the floor will safely discharge any electrical charge that they may build up whilst working within the area covered by your ESD floor.

The floor should be grounded using a grounding cord with a 1Meg resistor, in the event of an electrical short circuit the resistor will blow and the route to ground will be cut ensuring the safety of the individual.
The floor must be viewed as part of an ESD system, the floor, the footwear and the individual have to be tested in conjunction with the objective that the overall resistance of the system does not exceed 3.5 x 10^7 or 35MegΩ.

Remember that an ESD floor will only work if used in conjunction with ESD shoes or ESD heel straps. Without the appropriate footwear the floor will prevent the individual from generating more than 100V whilst working on the floor but it will not discharge any electrical charge that the individual has built up via other activities (i.e. handling packaging materials, walking across carpet etc.)