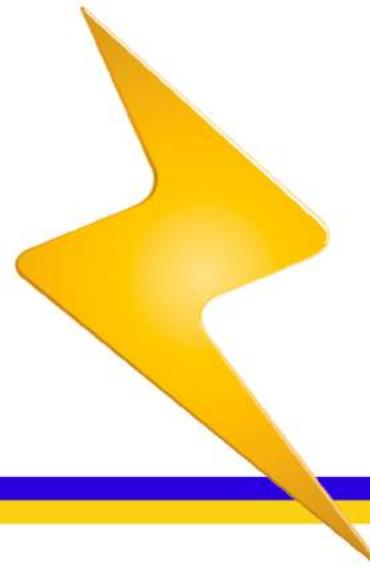


BONDLINE

ESD Matting Selection Guide



Introduction

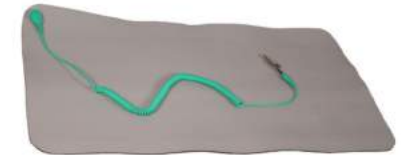
This guide takes an in-depth look at ESD matting. We will explore how ESD matting works as well as helping understand what's the best matting to use for your application.



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ESD Matting

Several methods are available to prevent ESD from damaging your electronic components. To eliminate electrical buildup, it is a good idea to start from the ground up. To ensure ESD protection, all ESD control plans must include ESD mats. ESD mats are the core assets of an ESD Control Plan.



Key Considerations

For electronics manufacturing, the ESD Standard recommends a resistance to ground (RG) for working surface matting of 1×10^4 to less than 1×10^9 ohms. The bench mat needs to be grounded using a ground lead from the surface connecting to the common point ground which in return is linked to ground, preferably equipment ground. Best practice is that ground connections use firm fitting connecting devices such as metallic crimps, snaps and banana plugs to connect to designated ground points. The use of alligator clips is not recommended.

ESD floor matting is an integral part of a flooring / footwear system which is a personnel grounding alternative for standing or mobile workers. Any static charges will quickly and effectively drain through the heel grounders or shoes and ESD floor to Ground. The ESD Standard requires the resistance of the person/footwear/flooring to be less than $3,5 \times 10^7$ ohms (resistance in series of operator plus footwear plus floor). It is therefore recommended to use conductive flooring ($RG < 1 \times 10^6$ ohms) as the resistance can increase with dirt.

Glossary Of Terms

Buried layer

Refers to a mat comprising 3-layers where a conductive layer is sandwiched between two static-dissipative layers. Buried layer is also known as 3-layer.

Dissipative

Dissipative materials have a surface resistance of $>1 \times 10^5$ ohms and allow any static charge to be dispersed.

Conductive

Conductive materials allow an electric charge to be conducted away to a desired Earth point. They have a lower surface resistance of $<1 \times 10^5$ ohms.

2-layer

This describes an ESD-safe mat that consists of a surface dissipative layer and a lower conductive layer.

What Is ESD Matting?

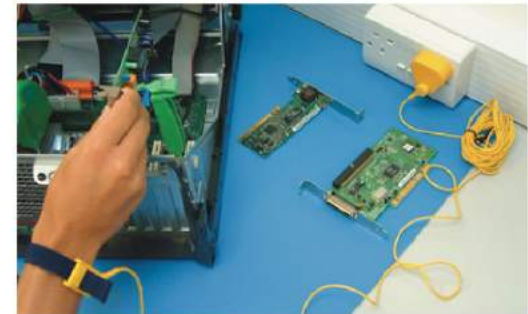
ESD protective matting aids in the prevention of damage to static sensitive components and assemblies from Electrostatic Discharge. There are two different types of matting available: ESD bench matting and ESD floor matting.

ESD matting is an integral part of the ESD workstation, particularly in areas where hand assembly occurs. It is important that each bench, or work surface, is covered with the proper ESD material and is properly connected to Earth using a system of cords and Earth Bonding Points (EBPs).

Types of ESD Matting

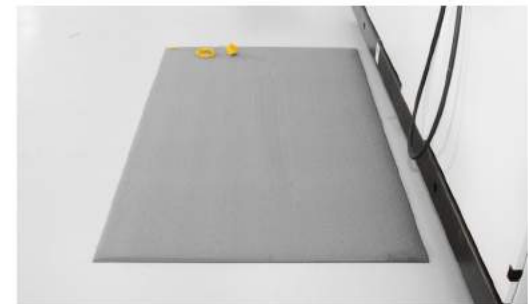
ESD work surface mats

ESD work surface mats, also known as table top mats or bench mats, have a smooth or lightly textured embossed surface. The embossed surface helps to reduce the reflective properties of the matting, reducing glare and therefore aiding workers with complicated electronic assembly tasks. Bench mats tend to come in light colours for easy visibility of smaller components. They are available in single layer vinyl homogeneous material, two layer rubber material and three layer with homogeneous vinyl top and foamed vinyl on the back with a carbon layer in the middle. Compared to floor mats, they tend to be much thinner. ESD bench mats are designed to be used with other ESD controls such as ESD wrist straps and grounding points.



ESD floor mats

ESD floor mats have a heavy textured embossing or grooves to improve traction and prevent workers from slipping. Some types have an anti-fatigue cushioned surface for increased ergonomic safety to help reduce stress on the body for long periods of standing. The floor mats are usually designed with dark colours to hide dirt and scuffs from worker's shoes or production equipment. ESD floor mats are much larger and thicker than table mats to help absorb wear and tear. Floor mats have more durability than table mats and, because of their strong formation, they often last longer too. ESD floor mats are designed to work as part of a wider ESD protection scheme.



ESD Matting Applications

The purpose of an ESD protective working surface is to prevent damage from Electrostatic Discharge to components and assemblies that are ESD sensitive.

There are two ways in which an ESD protective working surface protects:

1. Antistatic surfaces limit the generation of static electricity below potentially damaging levels by providing low-charging (antistatic) working surfaces.
2. Electrostatically discharging objects that have been placed on the surface of the workpiece.

Use of ESD Mats in Common Environments

ESD mats are used in environments that are electrostatically sensitive or where static electricity is a risk.

This includes:

- Cleanrooms (flat panel manufacturing, etc)
- Manufacturing plants for microchips and autos
- Buildings where electronic equipment is assembled
- Service centres for computers
- Rooms where operations take place
- Inflammable materials are present in flammable environments
- Shops that repair automobiles
- Offices of medicine and dentistry
- Rooms dedicated to computer servers



How ESD Matting Works

ESD mats help to protect static sensitive components from electrostatic discharge. They are engineered to drain static charge from items placed on their surface and serve to protect the surface of the ESD sensitive components or devices from wear and tear. They do this by slowing down the flow of static charge, which neutralises the static electricity and moves the charge into the grounded mat, away from the electronic components being worked on.

To work properly, a mat must be able to conduct electricity so the range of conductivity is important.

Electrical Properties

Work surfaces for ESD protection can be categorised as **conductive** or **dissipative**. The performance of ESD matting is based on the material its constructed with, as well as its electrical properties and ability to withstand heat, chemicals and mechanical abrasion.

According to most standards, a conductive working surface is one with a surface resistance of less than 1×10^4 ohms. Those materials that conduct electricity ground a charge the fastest, however, too much discharge can harm them. Those materials are classified as dissipative if they have a resistance of 1×10^4 or less, but not more than 1×10^9 ohms. Using dissipative materials is recommended when handling electronic components, as they dissipate charges more slowly. Surfaces used for benchtop working are most often made with dissipative materials.

If the mat's resistance is too low, static transfers to the mat and a spark is created causing an electrostatic discharge (ESD) which will in turn damage static sensitive electronic components or devices.

If the mat's resistance is too high, static transfers slowly and any items placed on the mat will not lose their charge. When the item is removed from the mat, the static charge will be capable of discharging to other items.

Test Methods

ESD matting can be measured in three ways:

Resistance To Ground (RTG):

The main measurement, and the one we'll focus on most in the examples below. RTG measures the resistance given between the most heavily used part of the ESD mat and the electrical ground.

Resistance to Groundable Point (RTGP):

This functions like RTG with one difference. It measures the resistance between a single point on the mat's surface and the grounding point of the work surface.

Resistance Point to Point (RTP):

Surface resistance from one part of the mat's surface to another point ten inches apart.

Construction

Anti static mats can be made from solid sheets, multiple layers and suspended particles, offering differing electrical performance. There are four common structures for vinyl and rubber mats:

Structure of Homogenous Mats (Vinyl and Rubber)

Homogenous or solid mats are made of a single layer polymer mix and therefore consist of the same material throughout. These mats provide good mechanical service with electrical performance normally limited to about 10^9 to 10^{10} RTG.

Dissipative Vinyl or Rubber

Three Layer Mats (Vinyl)

Three layer vinyl mats are constructed with a conductive metal/carbon inner layer that sits between a vinyl top surface and a foam backing. The conductive layer improves the electrical properties by acting as a fast track to move the static charge to ground. The foam back layer provides a cushioning effect, making it easier to pick up parts.

Dissipative Vinyl

Conductive Metallised Layer

Dissipative Vinyl Foam

Two Layer Mats (Vinyl)

Two layer vinyl mats typically combine the foam used in three layer vinyl mats and dissipative vinyl from the solid mats. As they contain no metallised layers, they provide average electrical performance.

Dissipative Vinyl

Dissipative Vinyl Foam

Two Layer Mats (Rubber)

Two layer rubber mats, generally consisting of a static dissipative surface layer and a conductive backing, provide the same electrical performance as the three-layer vinyl mats. However, out of the two, the two layer rubber mats have a greater tolerance to heat and chemicals. This type of material does come with a cost premium.

Dissipative Rubber

Dissipative Rubber Foam

ESD Matting Materials

Before choosing your matting, there are four types of materials you need to familiarise yourself with first. The type of matting material you choose can provide you with different benefits, whether it be a more cost-effective solution or provide better static dissipation. Generally, antistatic mats are available in a vinyl or rubber material.

Matting Materials Explained

PVC (vinyl) mats

PVC, otherwise known as vinyl, is the most widely used material for table top or work surface applications. Vinyl mats are cost-effective, easy to cut to size and provide excellent static-dissipation overall. PVC vinyl is resistant to many different oils, chemicals and alkalis. This is a hygienic material, it does not support the growth of bacteria.

PVC (foam) mats

PVC (closed cell) foam provides a cushioned foam anti-fatigue standing surface, with thermal insulating properties. This material should only be used in dry environments without oils or liquids.

Nitrile/NBR mats

Nitrile (synthetic) rubber mats offer excellent resistance to oils, grease, chemicals, coolants and alkalis. This material also has high heat resistance.

Rubber mats

A heavy-duty material. Rubber is generally used where high resistance to heat and chemicals is required. Mats made from rubber are resistant to hot solder, whereas a vinyl mat would melt. Compared to vinyl matting where the mats can change and become harder in cold conditions, rubber matting remains in its same form, staying stable; its ESD properties cannot change. Rubber mats are generally cheaper to manufacture. Therefore, they tend to be a cost-effective matting solution.

Guide To Selecting The Right Mat

Test Results and Information

Below is a basic guide to help you select the right materials for your application:

Mat Type	Electrical Properties		Usage	Features
	R_{TG}	R_{TT}		
Homogeneous	$10^{(9)} - 10^{(10)}$	$10^{(9)} - 10^{(10)}$	Table/Floor	Durable material
Three layer	$10^{(7)} - 10^{(8)}$	$10^{(7)} - 10^{(8)}$	Table	Excellent electrical properties
Two layer vinyl	$10^{(10)}$	$10^{(10)}$	Table	Low cost
Two layer rubber	$10^{(7)} - 10^{(8)}$	$10^{(7)} - 10^{(8)}$	Table	Heat/solder tolerant Chemical resistant Excellent electrical properties

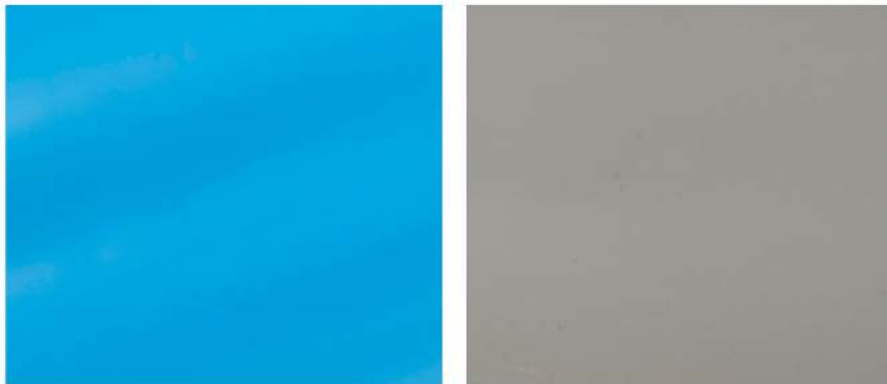
Guide To Selecting The Right Bench Mat

Most ESD mats come with either a smooth or textured surface. Both come with their own unique benefits and choice is down to user requirements.

Smooth vs Textured

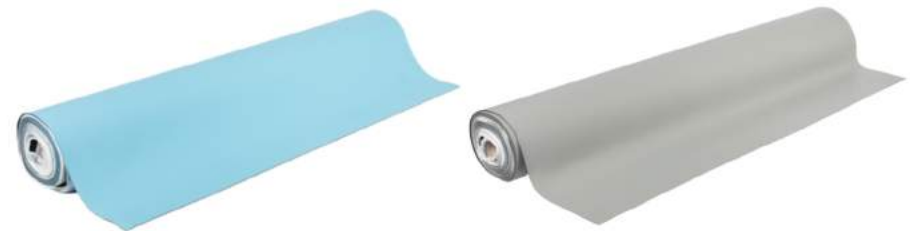
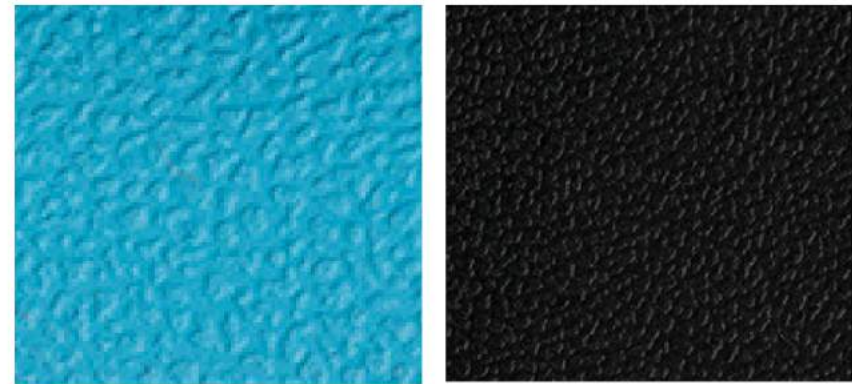
Smooth mats

ESD bench mats with smooth surfaces are much easier to clean compared to textured mats. They should be used where there may be large amounts of contamination.



Textured mats

ESD bench mats with textured surfaces are used to break down the surface's reflective properties, reducing glare and improving operator comfort.



Guide To Selecting The Right Bench Mat

ESD Field Service Kits

Field work is perhaps the most risky situation of handling ESD sensitive components / devices as there are usually many potential ESD sources in the environment. It is also often the most neglected aspect of ESD damage prevention.

ESD Field Service Kits are typically used by electronics industry service engineers when they're away from their permanent workplaces. These kits create a temporary ESD Protected Area (EPA) enabling engineers to repair static sensitive components or devices at off-site locations to ensure safe work to the IEC-61340-5-1 standard.

This enables individual components to be inspected, repaired or replaced without the risk of doing further damage and having to transport the item back to a fully installed EPA.



ESD Work Station Kits

ESD Work Station Kits provide a comprehensive, easy to install, basic ESD workstation. They help to save money by buying as a kit and include all the equipment needed to create a static controlled workspace or environment. Equipment usually includes an ESD bench mat, signage, wrist strap and cords and an Earth grounding point.

ESD Work Station Kits enables you to stop any unnecessary damage to delicate static sensitive electronic components or devices. It is perfect for repairs on electrical items such as PCBs, laptops, tablets, computer parts, medical equipment and audio devices, etc.



Our Range of ESD Bench Matting / Mats

1. Premium Textured ESD Bench Matting



2. Mid-Range Textured ESD Matting



3. ESD Smooth Matting



4. 3-Layer Matting With Conductive Centre



5. Conductive Textured Black Matting



6. Black 2-Layer Shelving Material



7. Black Conductive Material



8. ESD Cushion Matting



9. ESD Work Station Kit



10. Full ESD Work Station Kit



11. Static Control Work Station Kit



12. Killstat Field Service Kit



13. Vinyl Bench Matting



14. ESD Work Savers



To view our full range of ESD matting, scan the QR code to the right.



Guide To Selecting The Right Floor Mat

While standard matting can be used on the floor of an EPA there are other flooring options which can be used with specific key benefits. Choosing these over standard matting is highly recommended.

Anti-Fatigue Matting

Anti-fatigue matting is perfect for operators who stand around in the EPA for many hours at a time. These mats are designed to cushion the impact from standing on hard floor surfaces. Its soft ergonomic style provides additional support for production staff improving standing comfort by around 50%, creating a durable floor surface for your EPA.

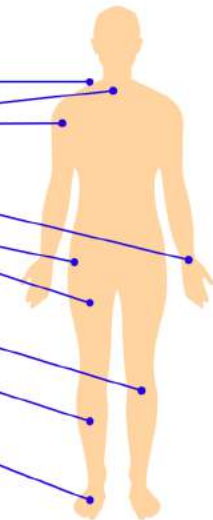
Importantly it can lead to more serious health conditions often associated with Musculoskeletal Disorder (MSD) and circulatory problems. Standing can lead to pain in the feet, legs, back and neck. This pain can gradually worsen and become more acute over time. By reducing fatigue from standing, mats help to combat the serious problem of MSD-related conditions and other accidents in the workplace.



Musculoskeletal Disorder (MSD) In Detail

Body areas affected:

- Upper and lower back
- Neck and shoulders
- Hands and wrists
- Hips and thighs
- Knees
- Calves
- Feet



Common problems include:

- Pain
- Tenderness
- Inflammation
- Muscle spasm and/or weakness
- Pins and needles/numbness
- Lack of movement/flexion in joints
- Reduced or lack of grip
- Ganglion - cyst-like swellings



Guide To Selecting The Right Floor Mat

Many slip-related accidents can be prevented through the installation of anti-slip floor matting. Taking the necessary steps to reduce such risks is essential for the workplace.

Heavy Duty Conductive Rubber Matting

Heavy-duty rubber mats provide a comfortable standing surface for operatives. The material is extremely durable, and therefore is long-lasting. Because of its high durability, it is commonly used in heavy traffic areas around machinery such as wave solder machines. Designed with a non-slip surface finish, it offers effective slip-resistance preventing trips and falls. The surface layer is resistant to solder-splash and most commonly used oils and acids.

Non-slip, diamond pattern surface



ESD Rubber Floor Mats

ESD rubber floor mats are designed to be used on the floor to help protect static sensitive components and human operatives. The rubber material remains in its same form even in cold or warmer conditions; the ESD properties will not fluctuate. This type of floor matting is abrasion-resistant, heat-resistant, slip-resistant and has a high wear rating. Depending on substrate, they can be suitable for chair castors.



Why Is Slip Prevention Important?

HSE statistics* suggest that slips, trips and falls are the most common kind of non-fatal accident in the workplace. In 2016-2017, they accounted for 29% of workplace reported injuries. Slip-related accidents can range from minor cuts and bruises to more serious injuries.

Guide To Selecting The Right Floor Mat

Temporary floor protection products provide a quick and effective solution to dirt control while helping to shield carpets and hard floor surfaces.

Tack Contamination Control Mats

Tack contamination control mats are a very economical solution to contamination control.

Our tack contamination control mat is made with a proprietary blend of polyolefin resins and an anti-microbial agent. This anti-microbial agent helps to protect against the growth of organisms such as bacteria, mould and mildew.

The mats have a hygienic pad of peel-off, disposable sheets which are ideal for use in cleanrooms, office entrances, food applications, hospitals, general industrial environments or any area where cleanliness and hygiene is important. Once the top sheet becomes soiled, the soiled layer can be peeled off and disposed of to reveal a clean sheet.



Supplied with self-adhesive backing that adheres to most floor surfaces. The coated adhesive surface captures dirt and dust particles from shoes, trolley wheels and other wheeled equipment.

Factors To Consider

Floor Surface

Some products are designed specifically for carpet or hard floor surfaces. It is important to select the appropriate product.

Cleanroom

Cleanroom environments require mats with contamination control. Opt for a our Tack Contamination Control Mat where hygiene and bacteria control is top priority.

Reusable/Disposable

Our Tack Contamination Control Mats are disposable. Replacement refill pads are available.

Typical Applications

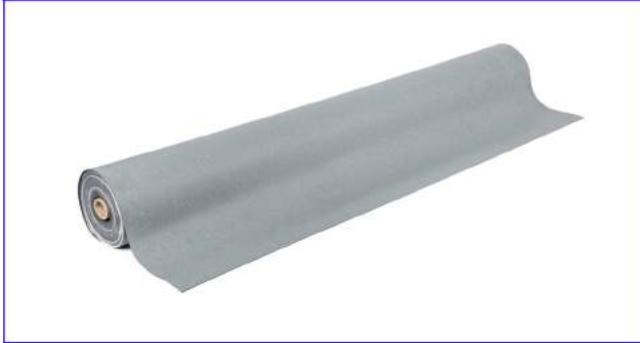
- Entrances to cleanroom environments
- Entrances to offices from shop floors
- Food applications
- Hospitals
- Electronics manufacturing
- General industrial environments

Our Range of ESD Floor Matting / Mats

1. Heavy Duty Conductive Rubber Matting



2. ESD Rubber Floor Material



3. Rubber ESD Anti-Fatigue Mats



4. Tack Contamination Control Mats



5. Anti-Fatigue ESD Matting



To view our full range of ESD flooring materials, scan the QR code to the right.



Guidance On Setting Up An ESD Mat

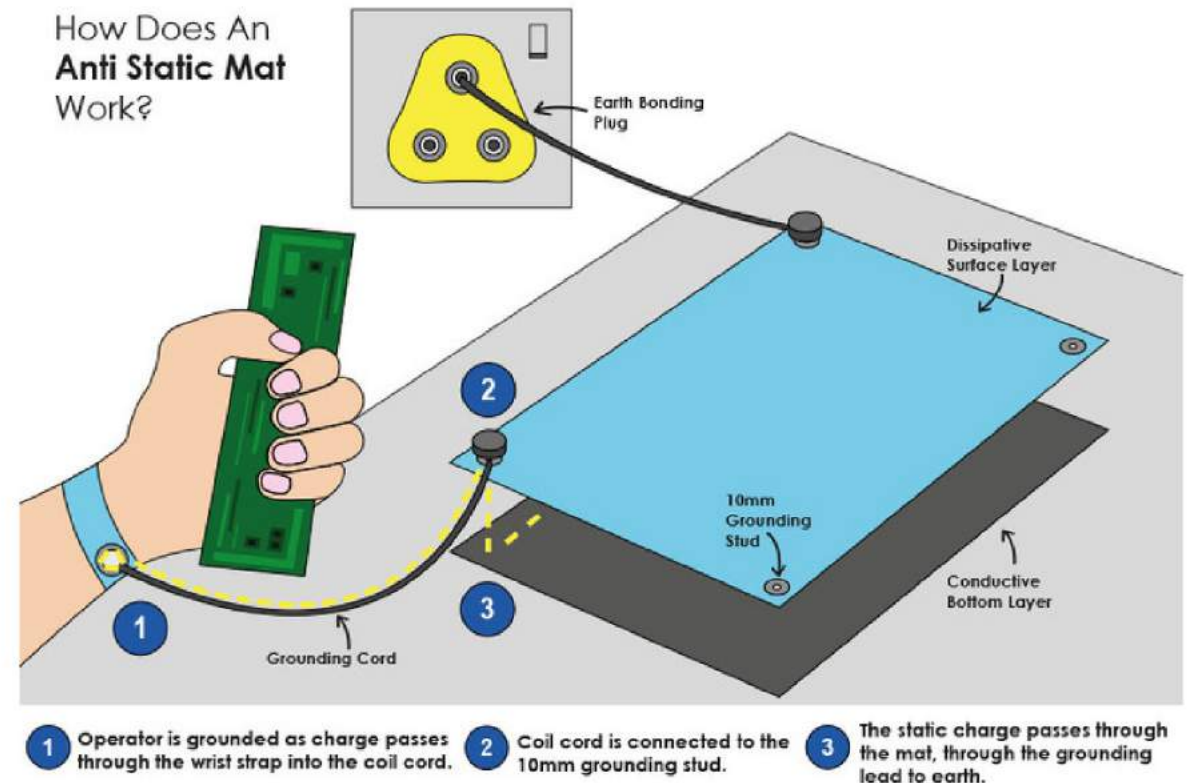
Step 1) The ESD Table Mat should be placed on your workbench when assembling general electronics. For workers who are doing electrical work or handling chemicals, ESD rubber mats are a good option. Static electricity is dissipated by the mat, which provides a route to the ground for static electricity buildup.

Step 2) A ground snap is attached to your ESD bench mat to connect your ESD ground cord. Make sure the ring terminal of your ground cord is connected to a grounding receptacle nearby. You can accomplish this task by placing the outlet cover plate screw through the ring terminal.

Step 3) Install your ESD wrist strap and insert the banana plug coil cord into the receptacle of the common point ground. The coil cord connects the wrist strap to the user. Wrist straps are attached to the ground wire over the coil cord. With the coils, the wrist strap can be easily moved.

Step 4) Lay your ESD floor mat before your workbench to prevent the buildup of static electricity. Static electricity builds up in the mat, which allows it to be discharged to the ground.

Step 5) Connect the ground snap of your floor mat to the ground snap of your low profile ESD ground cord. The ring terminal must be connected to the grounding receptacle as described in step 2. To keep the shoes connected to the floor mat, wear ESD heel straps when standing on the ESD mat. If ESD safety shoes are worn, the ESD heel straps need not be worn.



Bespoke ESD Matting

Often, customisation of ESD matting is needed to meet a specific requirement. This could be a specific mat studding placement or a bespoke size. Fortunately, many suppliers offer the option to customise your matting.

Specific Mat Studding

While the majority of ESD mats come with studs in all 4 corners as standard, depending on the supplier, there may be an opportunity to customise the stud position / placement if the standard studding does not quite fit your requirements.

Bondline can supply custom stud placements on request.



Bespoke Mat Sizing

Most ESD mats can be cut to any specific length or width that is required for your application.

Bondline offer the option to customise the size of your mat to any size required for your application on request. This is done in-house by our team.



Customise ESD Matting With Bondline

If you would like to customise the size or studding of our ESD matting, please get in touch with our sales team on **+44 (0)1793 511000** or send us an email to sales@bondline.co.uk detailing your requirements. Please note, all bespoke cut mat sizes will have a +/-10% manufacturing tolerance dependent on size.**



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