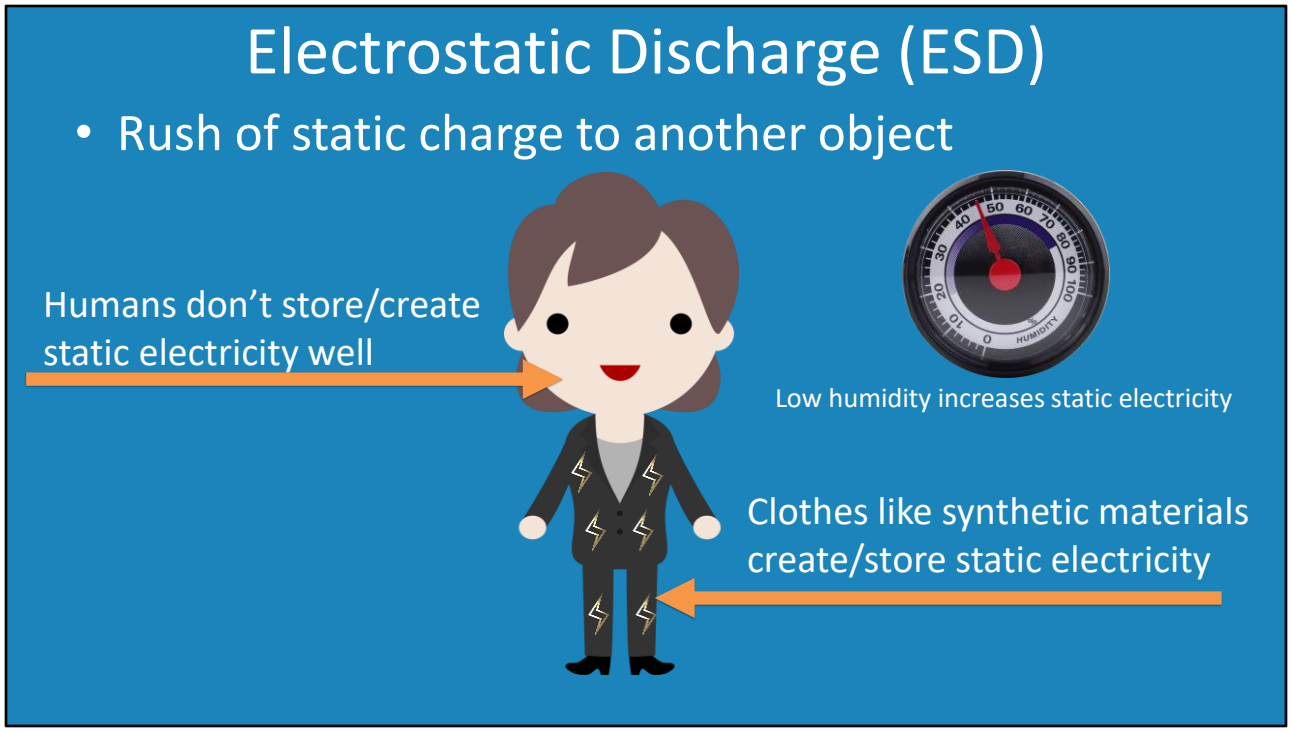
In this video from ITFreeTraining, I will look at electrostatic discharge. Electrostatic discharge occurs when a statically held charge moves to another object that has an unequal charge in order to balance the charge held between the two objects. This can damage electronic devices. This video will look at how you can prevent electrostatic discharge from damaging your equipment.

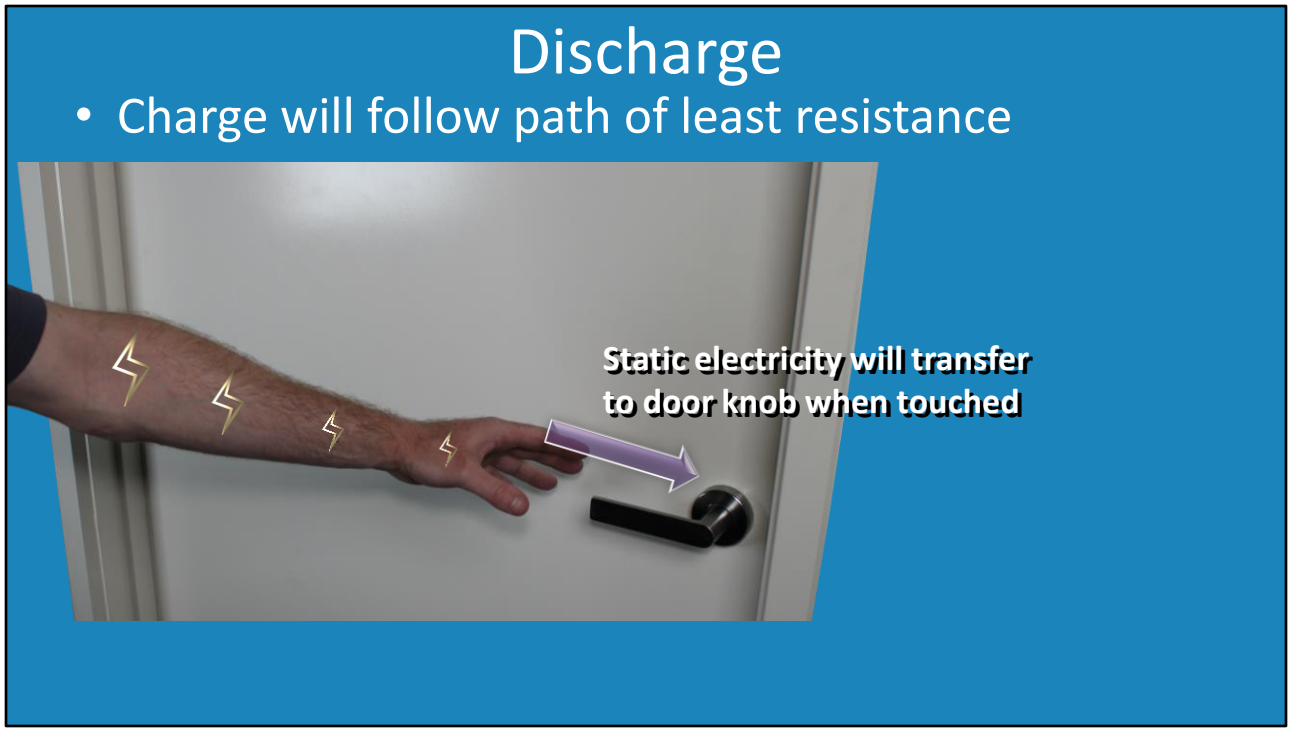


0:24 To start with, I will look at what electrostatic discharge or ESD is. Electrostatic discharge is simply a rush of static charge to another object. So, when an object with a lot of charge comes into contact with an object with no charge, the charge will attempt to equalize across the two objects.

To understand this better, consider that you have a human. Humans don't store or create static electricity that well. This is because humans are mostly made of water and our bodies don't generate a lot of electricity. We only need a small amount of electricity to move our muscles and make are hearts beat etc.

However, things like the clothes that we wear can create and store a lot of static electricity. Clothes made of synthetic materials are more prone to creating and storing static electricity. Material like cotton does not create or store as much static electricity as synthetic materials do.

Also, if the humidity is low, this increases the amount of static electricity that can be created. For example, static electricity can be built up by the body quite easily by shuffling your feet across a carpet. If the humidity is low, the amount of static electricity that is built up is a lot higher. So, let's consider what happens when your body builds up a static charge.

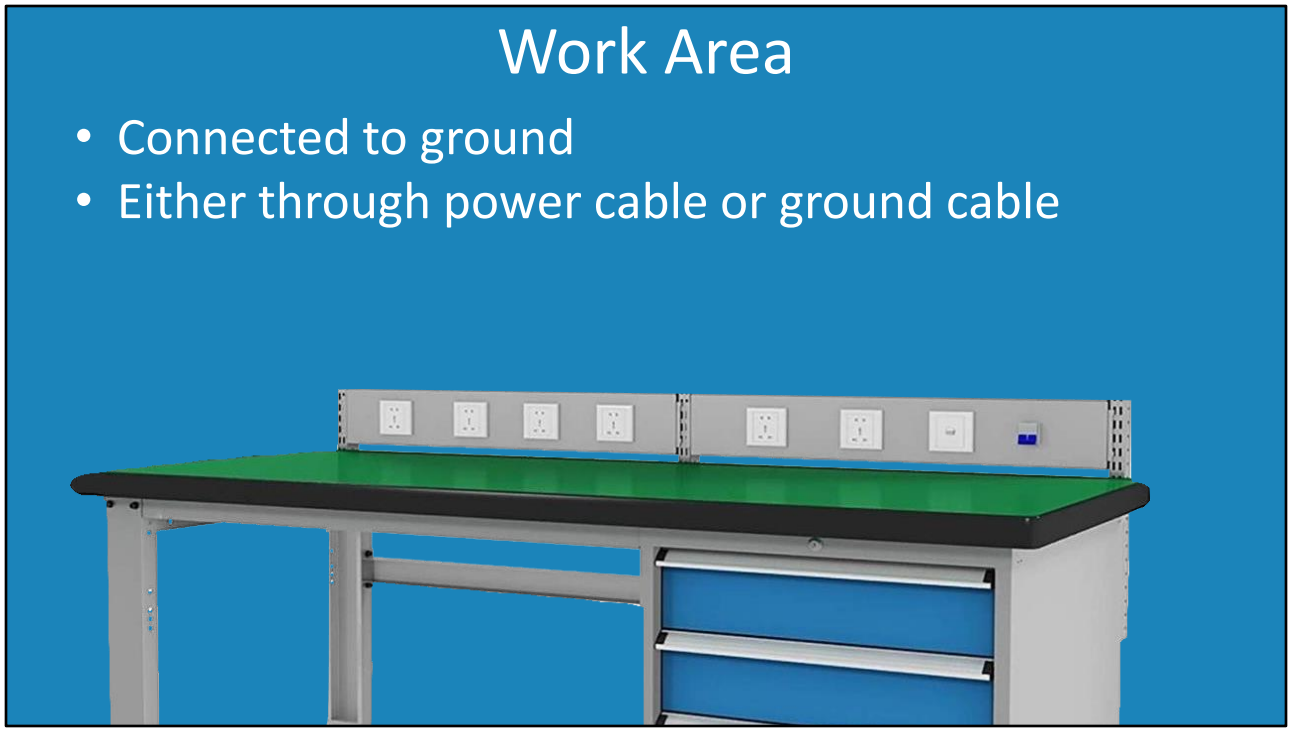


1:46 When your body builds up a static charge, the charge will follow the path of least resistance. The destination will be a body with unequal charge. So essentially the static electricity is attempting to balance the charge out with another body.

One of the most common examples you will come across of static electricity is when you touch a door knob. If your body is charged up with static electricity, usually from walking or dragging your feet on the carpet, when you touch a door knob the static electricity will be transferred to the door knob and to ground. When this occurs, you will usually get a mild electric shock.

To get around this, rather than touching the door knob, grab the door knob with your whole hand. This will increase the surface area of contact and thus increase the amount of surface area the static electricity can travel through. This will decrease the chance that you will get an electric shock.

Touching a door knob while statically charged won't cause any problems other than a minor electric shock. However, touching an electrical component can cause damage. Let's have a look at how you can prevent this from happening.



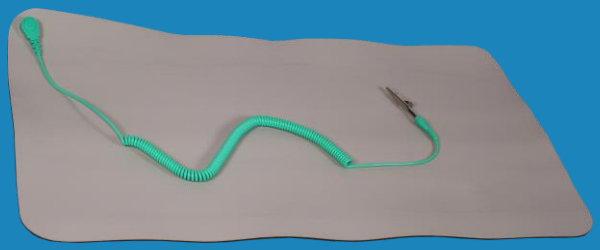
2:56 To start with, let's consider what a work area may look like when it is designed with anti-static protection. Keep in mind, this is just a simple example and there is a huge range of anti-static devices and furniture you can purchase. Everything from the floor, the chair, the desk and your cabinets can be designed with anti-static in mind. For the general IT technician, unless it is a specially designed area, you will probably have little anti-static prevention by design.

The most common ESD equipment that you will come across is a workbench. An ESD workbench will need to be grounded to give somewhere for static electricity to go. This is done either by a power cable or ground cable. Using a power cable is the more common way of doing it.

You will find that some devices and cabinets use the power cable to provide a ground. Static electricity needs to have somewhere to go, but it's not always about providing a path of least resistance. Let's have a look why.

Anti-Static Mats

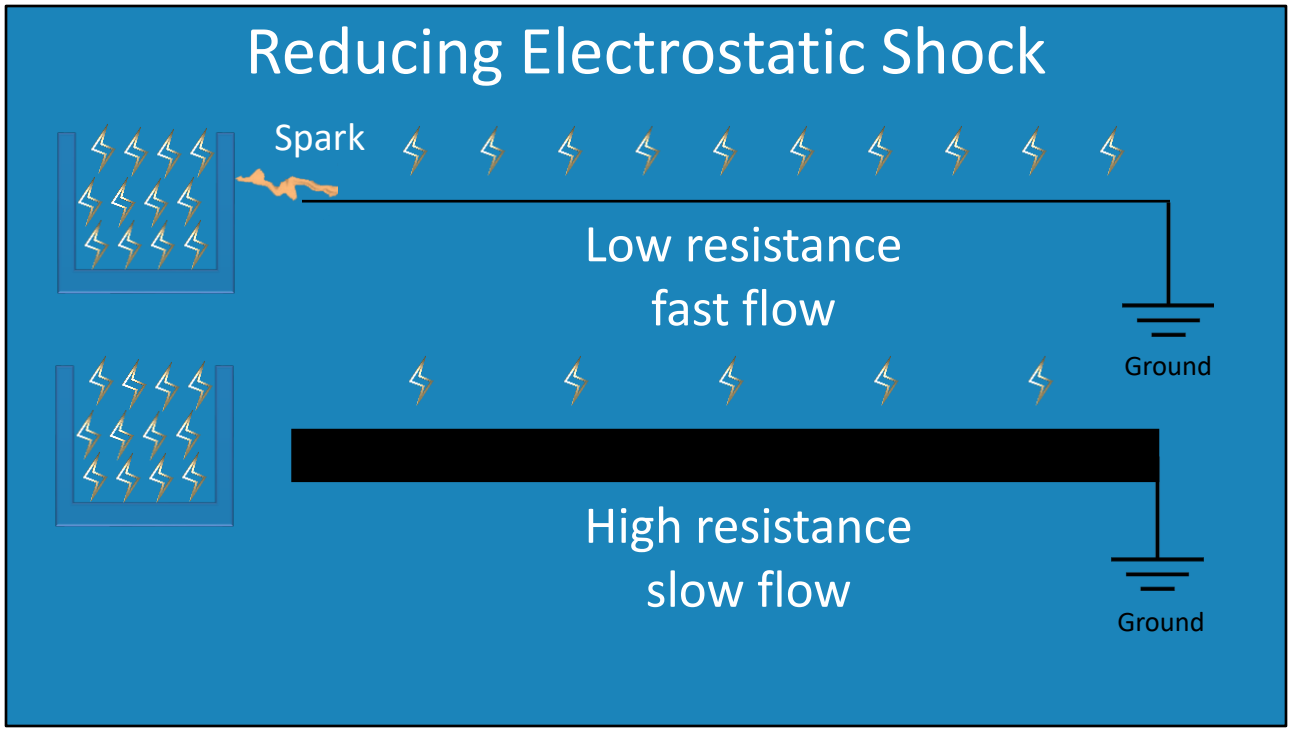
- High resistance material
- ESD flows across the material at a slow rate



Anti-static mat

3:58 To help prevent electro static discharge from damaging electronics, one common method is to use anti-static mats. The mats may be stuck on a table or purchased as separate mats. It may surprise you but anti-static mats are made of high resistance material. Essentially this means that ESD will flow across the material at a very slow rate.

I keep talking about having a path of least resistance, so why would you want something of high resistance material rather than providing a path of less resistance?



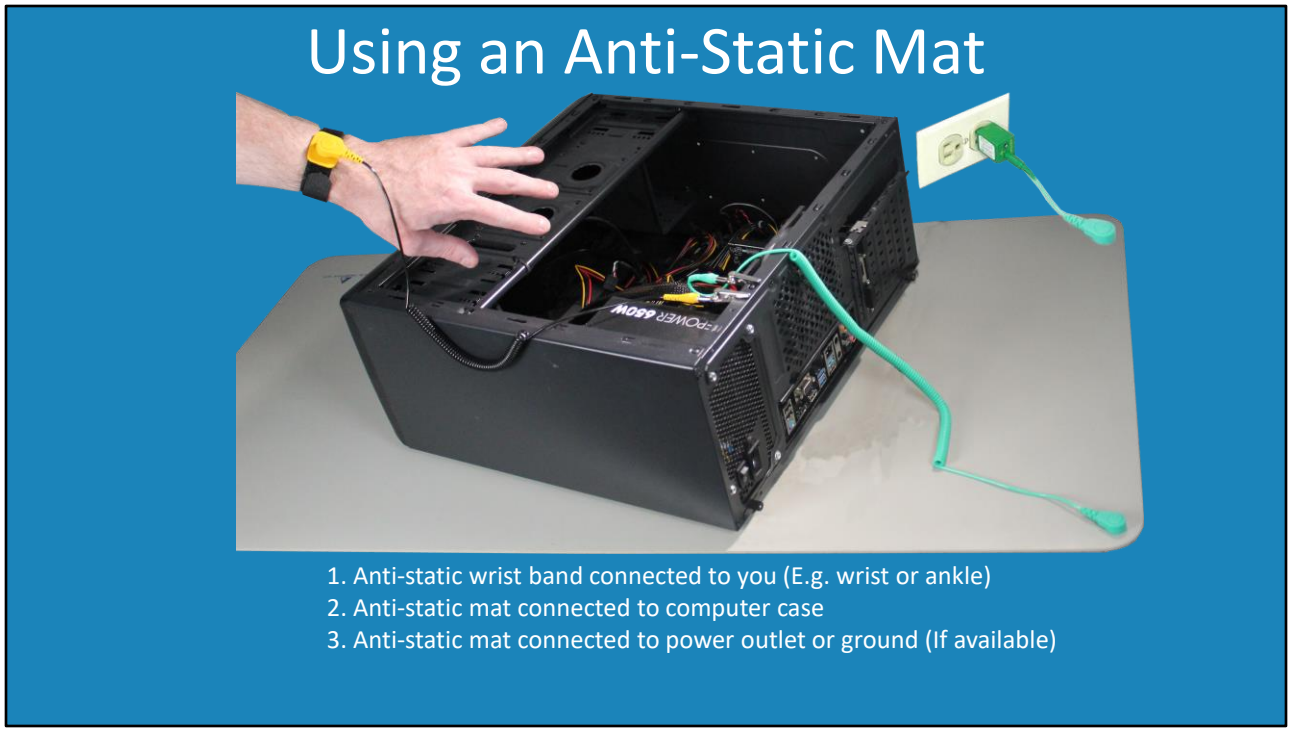
4:33 To understand how an electrostatic mat works, consider that we have two objects that contain a static charge. One object is near an object that is made of steal. The steal is connected to ground and has low resistance and thus allows a fast flow of electricity to pass through it.

The second object is near an anti-static mat that is also connected to ground. This has high resistance and thus a slow flow of electricity.

When the object comes close enough, the static electricity will pass over the material attempting to reach ground. The problem occurs if this happens to quickly, a spark can be created between the object and the material. Even if a spark does not occur, too much static transfer at once can damage electrical equipment.

The component is more likely to be damaged if the static electricity travels quickly. Remember, static electricity is just an imbalance of electricity attempting to balance itself. So, if you put an electronic component on an anti-static mat and then you touch it, the static electricity is wanting to go to ground. The anti-static mat in-between slows down this process so it is less likely the component will be damaged.

Anti-static mats tend to be blue or green. However, they can be any color. The anti-static mat will generally be made of a number of layers. The top layer is generally a protective layer and the next layer is used to slowly conduct electricity. Let's have a look at how you would use one.



6:09 To use an anti-static mat, place it down and place what you are working on, onto the anti-static mat. The next step is to connect the anti-static wrist strap to yourself. Usually this will be on the wrist, but you could put it on your ankle if you wanted to. Make sure that it is in contact with your skin, not blocked by something like a long-sleeved shirt. If it is blocked, the anti-static wrist band won't work effectively.

The next step is to connect the computer case to the anti-static mat. This will allow any static electricity collected in the computer case to travel to the anti-static mat.

Some anti-static mats will have a second connection. If your anti-static mat has this connection, this will be connected to the power or a ground point. This is optional, as without it, the static electricity will drain into the table or surface it is placed on or eventually into the air.

You will notice the green and yellow alligator clips I have connected next to each other on the computer case. You want to put them next to each other as this provides a short distance for the static electricity to travel.

It is best practice to connect the alligator clips to an unpainted metal surface on the computer case. Unfortunately, a lot of modern computer cases don't have any unpainted surfaces, so this makes it difficult. An easy way around this is to connect the alligator clips to the metal screws on the power supply. Just remember, when connecting the clips, that static electricity will flow through these points. So, you don't want to connect them to something that has electronics between. I will have a closer look at this in a moment.

Electronic components nowadays are designed to be resistant to static electricity; however, even a small amount of static electricity can damage the component. It may not fail right away, but may suffer enough damage to reduce the life span of the component.

Connecting Anti-Static Clips

Connected to painted case. Not ideal. Paint insulates electricity from flowing

Connected to power supply. Good solution. Subject to clips falling off

Don't do. Connected to plug. Not connected to case and may damage components

Can be creative and connect one clip to the other

8:09 Before I connect the alligator clips to the computer case, I will first connect my anti-static wrist band. An anti-static wristband is simply a Velcro strap with a metal plate in the middle connected to a plug. Most people will connect the wrist band to their wrist, but there is nothing really stopping you from connecting it to your ankle or any other part of your body. As long as it is connected to you somewhere, it will drain any static electricity from you.

The next step is to connect the alligator clip to the computer case. This computer case is painted, thus it is not ideal to connect the alligator clip to a painted surface as it will prevent the static electricity from flowing to and from the case. This defeats the reason for using the anti-static mat in the first place.

The makers of this computer case have done a good job of making sure every part of it is painted. Generally, screws are not painted and make a good place to connect alligator clips. Having said that, you need a screw that is connected to the case, not insulated or connected to a component.

ITFreeTraining cannot take any responsibility for misplacing alligator clips on your equipment or causing damage to your equipment. Ensure you read your product documentation before starting maintenance work on your computer.

The best location on this computer case is the metal screws connected to the power supply. The power supply is grounded and the screws provide a good connection to the computer case. If you need to also connect your anti-static mat, this can be connected to another screw on the

power supply.

In this case, even though there is a gap between the two alligator clips, there are no components between the two screws. Thus, when static electricity passes through these points it is not going to damage anything.

The problem with connecting the alligator clips to screws is that they can easily come loose and disconnect themselves. It is just a matter of reconnecting them, and hopefully if they come loose you'll notice them coming loose.

You may be tempted to connect the alligator clips to any metal area. However, you should be careful where you connect them. Don't connect them to the pins of the power supply or any other powered connection. Even if the power is disconnected, electronic components can still hold a charge.

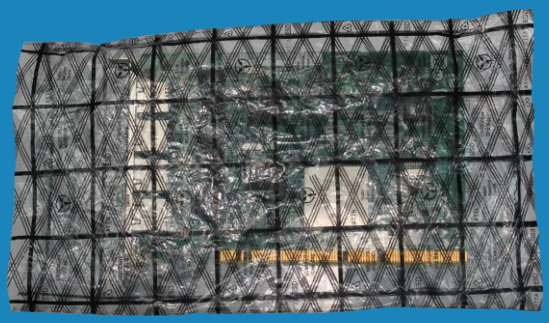
You will notice that the video plug on this computer is easy to connect the alligator clips to. It is not a good place to choose. The connection is insulated in plastic and not connected to the computer case to start with. Essentially doing this provides a connection between the two alligator clips and you may as well connect the alligator clips together. If for some reason the connector is not correctly insulated, you are putting any electronic components near the plug at risk.

Sometimes you may need to get a bit creative on where you put the alligator clips. On this case there is a screw in the expansion card area. It is not connected to any expansion card so we can place our alligator clip here. For the second alligator clip, there is nothing stopping us connecting it to the first.

I would personally not connect the alligator clip to a screw that is connected to an expansion card, but in this case it is just a screw connected to the case. Remember that you are creating a pathway for electricity to flow and you don't want part of that pathway running through your components if at all possible.

Anti-Static Bags

- Won't stop large amount of static electricity
- Don't use if torn or damaged



11:34 The last topic that I will cover in this video is anti-static bags. An anti-static bag is essentially a bag that you can place your components in. The anti-static bag comes in a number of different forms. Generally, they are metallic in color, however they can come in other colors. The anti-static bag may also have padding inside to protect the item in it from impact damage. Anti-static bags will generally have writing or symbols on it to indicate that it is an anti-static bag.

The metallic colored anti-static bag is essentially a shielding material that helps prevent the items inside from anti-static discharge. The idea being that if the anti-static bag comes in contact with static electricity, the static electricity should stay on the outside of the bag and not go inside the bag. That is, it provides a barrier between static electricity and the items inside.

The pink anti-static bag is designed to prevent build up of anti-static charge by dissipating the charge when it comes in contact with a surface. It also dissipates the charge to the atmosphere.

Some anti-static bags may have lines printed on the bag. In the case of this anti-static bag, you can see the lines printed on it. These anti-static bags are made of anti-static material. The printed black line is a conductive printing ink for static electricity to travel along, essentially dissipating a charge across the whole bag. Remember static electricity is caused by uneven electric charge between two points. In order to balance the static electricity, it is beneficial to have a larger area so the charge is lower.

The point to remember is that anti-static bags won't stop large amounts of static electricity. You should use an anti-static bag where possible, but still take some care. Before you handle the anti-static bag you should still ground yourself.

Don't use an anti-static bag if it is torn or damaged. A damaged bag can allow anti-static charge to enter the bag and damage what is inside. Also, a damaged bag effects the ability of the anti-static bag to dissipate the charge across the bag, essentially reducing the ability of the anti-static bag to discharge any static electricity it has obtained.

Summary

- Static electricity needs somewhere to go
- Ground yourself
  - Use anti-static mats or equipment that is grounded
- Use anti-static bag for storage and movement

13:51 To end this video, I will do a summary of the major points. Remember, static electricity needs somewhere to go. Essentially you need to create a circuit connected to ground for static electricity to go along. The easiest way to do this, is to ground yourself.

To ground yourself, use anti-static mats or equipment that is grounded. For example, before touching a component, touch the computer case or a grounded table. This will remove any anti-static electricity that you may have accumulated.

When you are storing or moving components, place them in an anti-static bag. This will help to protect the components from becoming damaged. Electrical components are more resilient to static electricity than they used to be, however even a small charge to a component may reduce the life span of that component.

I hope you have enjoyed this video from ITFreeTraining and found it informative. Until the next video from us, I would like to thank you for watching.

References

"The Official CompTIA A+ Core Study Guide (Exam 220-1001)" Chapter 3 position 2989-3528
"Picture of officer worker. Suit" https://openclipart.org/detail/293106/suit
"Static electricity" https://en.wikipedia.org/wiki/Static_electricity
"Picture of anti-static bags: Background removed"
https://en.wikipedia.org/wiki/Antistatic_bag#/media/File:Antistatic_Bags.jpg

Credits
Trainer: Austin Mason http://ITFreeTraining.com
Voice Talent: HP Lewis http://hplewis.com
Quality Assurance: Brett Batson http://www.pbb-proofreading.uk