DVD-78C
The Seven Sins of ESD Control

Below is a copy of the narration for the DVD-78C video presentation. The contents for this script were developed by a review group of industry experts and were based on the best available knowledge at the time of development. The narration may be helpful for translation and technical reference.

ANNOUNCER (v.o.)

Before the dawn of recorded time the Druid peoples danced and played in these now-barren fields. But their entire civilization has mysteriously disappeared, leaving behind only these seven stones as mute testimony to their knowledge of Electrostatic Discharge.

Look! A light cast across the stones reveals inscriptions, warnings... If only someone could tell us what is meant by these “Seven Sins of ESD”.

NARRATOR

Before we shed some light on the seven sins of ESD, let’s briefly review the problem. ESD is the sudden transfer, or discharge of electricity from one object into another. 2000 volts is the lowest level of ESD that most people can feel. But static zaps under twenty volts are capable of damaging or destroying some of the sensitive electronic components we handle every day. In fact, there are some that can be damaged by as little as 1.5 to 3 volts.

In the beginning we’re taught the correct procedures and techniques for effective ESD control. But after a while we get comfortable with our jobs and start doing tasks automatically – which makes it easy to develop some bad habits. And we may not even be aware that we’re doing anything wrong. That’s because ESD is an invisible problem.

It’s important to realize that people are the biggest cause of ESD. Our bodies constantly pick up static electricity. In fact, our skin can store relatively large amounts of this electric charge.

(Druid silently suggests moving on with the program)

Okay, okay. Don’t get so pushy. You want me to name the seven sins. I’m ready. We have number one -- no personal grounding; then static producing clothing; static producing activities; static producing materials; non-ESD safe work areas; improper handling; and improper storage

and transport. Any one of these sins can ultimately cause an entire electronic system to fail. In this program we'll be examining each of these bad habits – explaining why the habit is a problem, how it causes an undesirable result and what needs to be changed to control the situation.

Sin number one – no personal grounding.

Sometimes, in the course of a busy day, we may pick up an ESD sensitive device without being properly grounded. Or someone forgets to put on their shoe grounders after returning from lunch. Or maybe they're wearing shoe grounders, but their feet are off the floor and they've neglected to plug in their wrist strap. Or their wrist strap malfunctions because it wasn't properly tested. Or a non-manufacturing person comes into an area that has been designated ESD safe without being properly grounded, then picks up an ESD sensitive assembly.

These zaps can cause some pretty bad results. For example, the tiny circuit paths in these sensitive devices can be burned up, or severed by an ESD voltage so small that our sense of touch will never detect it. With some zaps, the assembly may initially pass an electrical test, but over time the weakness may lead to intermittent failures, or even an entire system failure.

The way to remedy the problem is to drain off charges we may generate or hold while doing our jobs in an ESD safe area. The idea is to drain off the charges in a controlled manner before they reach an ESD sensitive item.

To do that, all conductive surfaces -- including our bodies -- need to be connected to a common grounding point. When a static charge comes into contact with a partially conductive surface, this contact safely channels the charge away from the ESD sensitive item and neutralizes them into the earth, or ground.

Most companies and industry standards require the use of two shoe grounders for standing operations – and a wrist strap for seated activities. The reason you need a wrist strap for seated activities is that many operators may raise their feet when seated and lose contact with the conductive floor. On the other hand, when you're engaged in stand up operations, the long cord from the wrist strap becomes cumbersome. Or worse, it's not long enough to keep you connected when moving to check a malfunction.

Wrist straps should be worn snugly against bare skin. They should be attached securely to a ground wire with a current limiting resistor and some form of quick connect/disconnect. Shoe grounders should be worn so that one end is in contact with your sock and the other end is in contact with the floor. The moisture from your sock aids in completing the electrical connection from your body to ground.

It's also very important to follow your company's policy for testing shoe grounders and wrist straps at regular intervals. Wearing defective personal grounding equipment will cause ESD problems – and you won't even know it.

With shoe grounders, you'll need to test each foot separately. That's because testing both feet at the same time will not cause a failure in one strap unless both straps fail. While testing wrist straps, it's important to shake your wrist to check for intermittent failures.

Now let's take a look at the second sin – static producing clothing. Some operators come to work trying to make a fashion statement. But sometimes clothing that's in style isn't necessarily the

best choice for doing our jobs. Other operators don't seem to care how they're dressed – as long as their clothes are clean. But this choice can also create a problem. That's because clothing made from wool and synthetic materials stores static charges. If their clothing comes in contact with sensitive components, ESD damage can occur.

One obvious remedy to charge producing clothing is to wear a conductive smock. Conductive smocks not only cover charge producing clothing, but they also drain any charges harmlessly to ground.

Some operators get into the habit of not fully buttoning the smock, or rolling up the sleeves to keep them out of the way. These habits tend to defeat the purpose of the conductive smocks since the charge producing clothing is now exposed. Therefore, it's important to completely button the smock so that no part of your clothing shows – and to not roll up the sleeves to the point where you can see the underlying clothing.

When smocks are not provided, it's better to wear clothing made of cotton to help control ESD. It's also important to avoid wearing loose clothing that drapes down and may come in contact with an ESD sensitive component.

Next, let's take a look at the 3rd deadly sin of ESD control – static producing activities. The way we work can have an impact on how ESD is controlled. Let's take a look at some static producing activities that are not acceptable in an ESD safe area. Many of these are simply nervous habits that we're not even aware of.

Sometimes we get so busy that we leave clutter around our workstations. But this clutter, along with accumulations of dust can lead to conditions that cause an ESD event. That's why it's important to do some housekeeping every day to minimize this potential problem.

We always need to be aware of our movements in ESD safe work areas. Rubbing hands together, raising arms, shifting feet and legs and putting on or taking off smocks around ESD sensitive items can cause possible damage to components and assemblies. And combing hair is another huge generator of static charge. Let's stop for a moment to review all of the information we just covered.

Sin number 4 – static producing materials.

Many common office materials might appear harmless, but when brought into ESD safe areas they can cause an ESD event. A number of these materials can generate and hold static charges -- thereby creating charged fields. For example, when a charged object, such as these plastic safety glasses, is brought close to an ESD sensitive device, the electric field causes *charge separation* in the ESD sensitive device. If the ESD sensitive device then comes in contact with a conductive item while exposed to the field, the device can be damaged.

The best remedy for this problem is to completely eliminate these types of non-conductive materials from the workstation. This includes common plastics such as hairbrushes and tape dispensers; styrofoam food and beverage containers; vinyl binders, non-ESD safe plastic document holders, post-it notes and other paper products; plastic pens; bubble wrap; and equipment with plastic housings. This also includes items you may bring in to decorate your work area – like family photos in plastic frames and balloons. Even plants and flowers. You get the idea.

When static generating materials are necessary for your job, there are several methods available for reducing the effect these items might have at the workstation. For example, you may be required to apply an anti-static solution to these hand tools at regular intervals.

Air ionizers can also help neutralize charges. This machine blows ionized air into the work area to help neutralize any positive or negative charges that accumulate on non-conductive items, or items that are not connected to ground.

Another method of reducing charge buildup is to operate with controlled humidity. Dry air tends to make ESD problems even worse. Again, it's best to eliminate as many static producing materials from your work area as possible.

The fifth deadly sin is working at a non-ESD safe work area. Imagine this. You're carrying a tote with ESD sensitive assemblies and components and you realize you forgot to plug a component into a socket. You stop at the first available location, set the assembly on a clean surface and plug in the component. There should be no problem. After all, you're properly grounded.

But the ESD sensitive items have become charged along the way – and because the work- space is unsafe, the items discharge rapidly. This rapid transfer of a charge to a conductive surface may cause damage to the ESD sensitive components and assemblies.

That's why ESD sensitive items should only be handled at an ESD safe workstation – consisting of a grounded static dissipative work surface and static dissipative flooring, or floor mat. These dissipative materials are partially conductive – meaning they are conductors of electricity – but they do it slowly enough to leave ESD sensitive devices undamaged.

Sin number 6 is improper handling. As we work hard to meet production deadlines, it's easy to forget requirements for handling products safely. In our rush to get things done we might simply stop noticing how we're touching or moving the components and assemblies.

It's important to realize that improper handling of ESD sensitive items – even *when* you're properly grounded and doing your job at an ESD safe workstation – can cause damage to components and assemblies.

The first rule of proper handling of components and assemblies is to minimize handling as much as possible. Then, make sure you correct any of the following bad habits when handling components.

For example, we may get into the habit of sliding a component across a work surface. This movement generates static charges and can damage the component. A better practice is to pick up the component, move it, then set it down.

It's important to handle the body of the component rather than the leads. The leads are the most conductive pathway for an ESD zap. It's also important to set components down -- with the leads *on* the static dissipative surface – which allows any built up charge to discharge slowly.

In terms of circuit board assemblies, it's important to handle them only by the edges – minimizing contact with any conductive surface. Because all the components are connected, ESD damage to one component can spread to others.

Finally, you'll need to avoid any extra movements that create friction when handling ESD sensitive components and assemblies.

The last deadly sin – number seven – is improper storage and transport of ESD sensitive devices. There are times when it seems more convenient to simply set assemblies aside, rather than find the proper container for them. Or if there is a proper container, maybe you set an assembly on top of it while you do something else. Or you set a router or traveler on or near a container.

There can also be problems when you move ESD sensitive items from one area to another. Sometimes you can't find an ESD approved rack near your workstation and you grab the closest pushcart that may not be properly grounded. Again, another potential for an ESD event.

The remedy for this bad habit is to store and transport all ESD sensitive items in static dissipative or static shielding containers – or sometimes both – using ESD racks with grounding chains.

For example, ESD sensitive assemblies should be loaded into the partitions of ESD protective totes. The totes need to be clean. They also need to be the right size. The totes must be static shielding *and* covered when transporting materials outside of an ESD safe area.

It is usually permissible to transport items in open racks or totes within an ESD safe area, however, movement of product outside of an ESD safe area requires static shielding packaging that completely encloses the product and is sealed.

ESD sensitive components should be kept sealed in their original packaging until used. If low moisture packages need to be opened to remove some components, they should be resealed with a humidity indicator and a dessicant. Your company will explain its policy for environmental packaging.

These ESD considerations also apply to shipping product to customers. Some companies use static shielding boxes with partitions for the assemblies. Other companies pack each assembly into a low charging and dissipative bag. This package is then sealed inside a static shielding bag before being boxed up.

And finally, remember to transport ESD sensitive items on pushcarts or racks that are designed to protect the devices.

You've just taken a refresher course in how to break bad ESD control habits. Remember, the seven sins of ESD control included no personal grounding, static producing clothing, static producing activities, static producing materials, non-ESD safe work areas, improper handling and improper storage and transport of ESD sensitive devices.

ESD control works most effectively when you assume that all the components and assemblies that you handle are ESD sensitive – even when they're not. ESD sensitive items should be properly labeled, but occasionally someone forgets. That's why it's important to get into the habit of performing all activities with ESD awareness – using safe practices.

I guess the most important thing we can learn about ESD control is that *we* are the most important part of the equation. That's because ESD is usually caused by people. If we can eliminate our bad habits, we'll go a long way in creating quality products.

ANNOUNCER

Avoid the seven sins of ESD and experience a renaissance in your workplace.