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# DVD-66C

## The Seven Sins of Safety in Electronics Assembly

*Below is a copy of the narration for DVD-66C. 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.*

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### **Introduction**

In the beginning we receive a safety orientation. We're taught how to identify hazards in the work place and how to take precautions when doing a variety of tasks. But after a while we get comfortable with our jobs and start doing our activities automatically – which makes it easy to develop some dangerous habits. At first these habits don't seem to have an effect. But ultimately they may result in unnecessary injuries. Let's face it – in the course of a given day there are numerous opportunities to hurt yourself. It doesn't matter if you're at home, at work, on a walk in nature or driving your car to the store. Learning to take the proper precautions goes a long way in keeping you healthy, productive and injury free.

That brings us to the seven sins of safety in electronics assembly – which happen to be personal protection issues; improper use of tools; improper workstation design and set up; hazardous materials; improper handling and positioning of materials; muscular skeletal disorders; and inadequate housekeeping. Safety violations in any of these areas can ultimately cause health problems or painful injury.

In this program we'll be examining each of these safety considerations – explaining a potential problem, how it causes an undesirable result and what needs to be changed to alleviate the dangerous situation.

### **Sin number one – Personal protection issues**

Personal protection issues involve both your personal appearance and the protective equipment you'll be required to wear. Let's start by discussing how your personal appearance can become a safety sin. Long hair can be very attractive, but when it's unrestrained it can be a safety hazard on the production floor. It could get tangled and caught in the moving parts inside assembly equipment causing serious injury. The solution to the long hair problem is to contain your hair to shoulder length – using ties, pins or a hairnet. In the case of a pony tail, you may still need to secure it to keep it from moving around.

Loose clothing is a potential hazard for the same reason as long hair. Those long, flowing sleeves may look great, but they can get caught in equipment – or simply get in your way as you work. Unrestrained hair and loose clothing should also be avoided because they can create ESD issues that destroy assemblies. It's also important to pin down ties or scarves.

Another part of your personal appearance that can affect your safety is dangling jewelry. Those long earrings, necklaces and large, loose bracelets can be hazardous around certain types of production equipment – and may result in injury, electrical shock or burns.

Now let's examine the personal protection equipment you'll be required to wear for your job. Many assembly jobs have potential eye hazards. Clipping component leads, for instance, can create tiny flying pieces of metal that could injure your eyes. You also need to protect your eyes when soldering or working around automated assembly equipment. Safety glasses are required in many assembly areas to protect against eye hazards. In some facilities eye protection is required in *all* materials processing areas. Safety glasses usually include side shields for additional protection.

Your job may also require that you wear safety shoes. These shoes protect your feet with solid construction and steel toes. In other, less hazardous work areas, safety shoes are not required, but you may be required to wear closed-toe and flat-heeled shoes. Closed-toe shoes are designed to protect your toes from various minor foot hazards in your work area, while flat heels will help prevent your shoes from getting caught in open floor grates. Flat heels are also a lot less stressful on your feet, ankles and legs.

Other personal protection equipment you may be required to wear include respirators, face shields, protective aprons, and chemical and heat resistant gloves. If this equipment is not worn when required, or if it is worn improperly, serious injury can occur. Both nose/mouth and full face respirators depend on an effective seal between the respirator and the user's face. Facial hair, missing dentures and perforated ear drums prevent effective seals with respirators.

### **Sin number 2 – Improper Use of Tools**

Some of the hand tools used in the assembly process can become a safety hazard if they are not used correctly. For example, soldering irons can heat up to temperatures nearing 800 degrees Fahrenheit. Soldering irons can cause serious burns after being in contact with your skin for only a fraction of a second. They can easily burn through your clothing too. A hot soldering iron can also be the source of ignition for flammable liquids like isopropyl alcohol.

Remember to pick up the soldering iron by the handle only. A soldering iron should only be in your hand when you are using it to solder. It should never be used as a screwdriver or a scraper – or even worse – as a pointer in a conversation. When you need to remove excess solder from the tip, wipe the tip on a damp sponge that should be securely mounted in a sponge holder. Never flick the molten solder off the tip. This practice has the potential of injuring you or a co-worker. Also, turn soldering iron off before changing the tip. Make sure you use gripper hot pads or pliers when changing the soldering iron tip – since a hot tip and cold tip look the same.

Another hand tool you'll need to be cautious with is the scalpel, or Exacto knife used in various rework operations. They are very sharp and can cut your skin quite easily. Scalpels need to be used carefully, stored securely and covered when not in use. Leg cuts from scalpels falling off work benches have happened. When cutting, make sure you cut away from your body. Dispose of the used blades in an approved blade or sharps container.

The point is that most tools you'll be using have the possibility of causing some injury if they are not used correctly. The particular job that you do will have a complement of tools you'll need to become familiar with. If you have any doubt on how to use a tool properly, be sure to ask your lead or supervisor.

### **Sin number 3 – Improper Workstation Design and Set-Up**

You enter the production area. You proceed to your workstation. You plug in your wrist strap and begin working. You observe the obvious safety precautions. But there are some subtle conditions regarding workstation safety that most people would never even notice – like the adjustment of your chair height. A simple thing like improper chair height adjustment can result in injuries, low productivity and job dissatisfaction. When your chair height has been adjusted correctly, your hands and wrists will be straight when doing your job – meaning there won't be extra stress on the muscles and tendons that could lead to strains, sprains and pains.

Other examples of less obvious safety considerations at your workstation include the back support for your chair; support for your feet; proper positioning of the tools and materials you're working with; lighting; and ventilation.

Your back needs to be supported while seated at your workstation. It's important to sit up straight. This keeps your back in a neutral position – meaning less strain on the spine. There's also more support for your body when your feet are flat on the floor, or on a foot stand. Allowing your feet to dangle is guaranteed to create more stress on your legs and back.

Tools and materials should be arranged so they can be reached without leaning, twisting or over-extending. A good technique is to arrange all your tools and workstation items in an arc around you. In this way, you'll always be reaching the same distance for everything.

Inadequate lighting causes eye strain. It also makes it more difficult to do your job properly. Inadequate ventilation means not enough oxygen goes into the bloodstream – making it easier to become fatigued on the job. Proper ventilation is extremely important at workstations where a lot of soldering is done. That's because the fumes from solder and flux are quite noxious. These workstations should be equipped with some form of local exhaust ventilation, or LEV. The smoke that comes off all solder resin and flux will be ventilated away from your nose and mouth – meaning you'll be able to avoid inhaling these fumes. We'll discuss other chemical hazards later in the next chapter of this DVD.

To resolve all these types of workstation problems it's important to understand the science of *ergonomics* – of fitting workstation conditions and job demands to your capabilities. Other co-workers who might use your workstation on alternate shifts probably have different body dimensions. When your workstation is properly arranged for you and your body is supported in a comfortable position, you won't be susceptible to as many physical and psychological stresses.

The last, and perhaps most important, workstation issue involves evacuating the area in the event of an emergency. You will need to know both primary and secondary evacuation routes. If there's something you don't understand about how to exit the building, please ask your supervisor.

### **Sin number 4 – Hazardous Materials**

Most assembly jobs include working with at least some hazardous materials and chemicals. A *hazardous chemical* is any chemical that can cause physical harm, or appears on a hazardous chemical list – such as those listed on the Material Safety Data Sheets, or MSDS.

The lead in solder wire and solder paste is also a potential hazard. We'll examine this first. The smoke that comes off all solder resin and flux looks a lot like cigarette smoke – and is just about as unhealthy for you. The yellowish smoke contains a mixture of noxious gases – including formaldehyde and hydrochloric acid. That's why we emphasized the need for adequate ventilation earlier.

It's important to follow your company's procedures for correct soldering temperatures. That's because solder heated above 850 degrees Fahrenheit can become atomized – meaning that lead fumes can be generated. Lead is a poison that can severely affect your central nervous system. Lead can be absorbed into your body by either breathing in airborne lead fumes or particles, or by ingesting lead or lead particles. Ingestion is the most likely route of entry while performing electronics assembly.

The way to avoid the small possibility of creating lead fumes is to never change your soldering iron's temperature from the setting specified for your workstation. Selecting the correct soldering iron and tip size for the job will allow you to solder correctly without using excessive temperature. Soldering iron temperatures should be limited to 700 degrees F, or 371 degrees C.

To avoid ingesting lead, never bite off solder wire with your teeth. Instead, use the proper tool. Gloves are recommended for handling solder wire or solder paste. One common way of accidentally ingesting lead is touching food, cigarettes, chewing tobacco or make-up after handling tin-lead solder, solder paste or soldered boards without hand protection. To avoid this problem, always wash your hands in soap and water before touching any item that will come into contact with your mouth – such as food, drink or a cigarette. And definitely, no eating, drinking or smoking at your workstation.

Solder paste needs to be handled particularly carefully. The lead in the solder balls that make up the paste can get on your fingers or under your fingernails. The lead in the solder paste is made of particles so small that they could be absorbed into the skin if exposed to high pressure. Therefore, never use compressed air to remove solder paste or anything else from your skin or clothing. Use a brush or vacuum instead.

Wave soldering machines also have potential risks – including lead dust – especially during maintenance. Always follow your company's safety guidelines whenever you service a wave soldering machine – whether adding solder bars, removing dross or performing more complex maintenance. These safety guidelines usually involve wearing the correct gloves, clothing, eye and face protection, an apron, an approved respirator and proper footwear.

Now, let's look at what you'll need to know about other hazardous materials. If your job involves working with hazardous chemicals, you will receive detailed training in learning the physical and health hazards of the materials and how to read the labeling system they require. You'll also learn about protecting yourself from hazardous chemicals and how to detect the presence of a hazardous chemical in your work area.

Most importantly, you'll learn about the Hazardous Materials Classification System and the Haz-Mat sign. This familiar diamond shaped sign shows the severity of the four levels of danger associated with a chemical. These are the health hazard of the material; how flammable it is; the material's reactivity; and any specific dangers associated with the material – such as the warning not to mix water with a particular chemical.

Finally, you'll learn about the Material Safety Data Sheets that are produced by the manufacturer of every hazardous chemical. They contain specific safety information about the product and how to handle it safely.

By learning about the dangers of working with tin-lead solder and other hazardous materials – *and* following proper precautionary procedures – you will be able to safely do your job.

### **Sin number 5 – Improper Handling and Positioning of Materials**

What is this person doing incorrectly? There is a right and wrong way to lift objects. Many companies have policies that describe the amount of weight and the types of objects you are allowed to lift. Let's look at the correct lifting posture for picking up a heavy object. Always make sure you bend at the knees – not at the waist – and that you get close to the load. Then tighten your stomach muscles, and with your back straight and lower back curved inward, stand up. Notice that you don't bend your back. Your *legs* should do the lifting. And make sure that you never lift and twist at the same time. This will almost always result in some form of back injury. If you test lift a corner of something that looks heavy, and it is, get help in lifting a heavy object. Don't try to do it yourself.

It's important to keep the distance that you reach as short as possible. The further you have to reach in order to lift, the more stress you put on your lower back and shoulders. It's like lifting an extra 50 pounds – depending on how far you have to reach. If necessary, rearrange the task so that you can get closer to the object.

It's a good practice to store items on shelves whenever possible – keeping commonly used items closest to the edge of the shelf and at waist level. Make sure you don't store heavy items on shelves below the knee or above the shoulder height. Following these guidelines will make the majority of lifting and moving jobs easier and less stressful. And don't forget, lift with your legs, keeping your upper back as straight as possible.

### **Sin number 6 – Muscular/Skeletal Disorders**

There are certain repetitive actions or movements in the assembly process that, if performed incorrectly, may put you at risk for developing what are called *muscular-skeletal disorders*.

Your elbows, shoulders, wrists, fingers, neck and back are all parts of your body that may develop this condition if they are used in an awkward position and with force or repetition. A muscular-skeletal disorder is a physical condition that occurs when you perform a simple task over and over – that slightly hurts some part of your body, usually a joint, such as your wrist. These repeated little traumas can, over time, lead to a painful condition.

There are several ways to reduce the likelihood of developing a muscular-skeletal disorder at your workstation. We spoke about these earlier during the workstation issues section. We're talking about adjusting your workstation, adjusting yourself and adjusting the materials with which you'll be working.

If you are standing for long periods, shift your weight from one foot to the other from time to time. Use a footrest of six to ten inch height for the non-weight bearing leg. This helps to relieve the stress on your back.

The most common joint to suffer muscular-skeletal disorder is the wrist. There are some ways to lower the risks of wrist injury pain, or to avoid them altogether. Make sure you keep your wrist in

a neutral position when using any tool. What this means is to avoid using your wrist in a bent or twisted position. Instead, try to keep your wrist straight – in line with your hand – so you don't pinch your wrist. You may need to reposition your work in order to have your hand a wrist in the proper position.

The way you grip a tool is also important. If a tool is designed to be held with the whole hand, don't grip it with just the thumb and index finger. This will put a lot more pressure on your wrist. Use the power of your whole hand. It's fine to use the thumb and index finger grip on smaller instruments such as soldering irons and small picks for short periods of time. For long holding times, add a slide-on grip enhancer. This will increase the grip diameter, making it more comfortable and ergonomically desirable.

Avoid holding objects the same way for long periods of time. Use a mechanical device to hold boards that are being inspected. Try to occasionally rest your hands and change the way you hold things to avoid the *pinch* grip.

One of the best preventative measures for your wrists, as well as your entire body, is to do some simple stretching exercises every few hours. Your safety representative should be able to recommend a series of stretches for the arms, hands, wrists, fingers and the rest of your body. Stretching frequently relaxes the tension that builds up in the muscles. Stretching also lowers the risk of injury and allows you to feel more comfortable while doing your work.

### **Sin number 7 – Inadequate Housekeeping**

A messy work area is an unsafe work area. So the simple way to keep your work area safe is to keep it clean and neat. The only items on your work surface should be those you need to do your job. Your workstation should always be kept organized – with the bench top free of debris – especially clipped leads and solder drippings. Waste material should be recycled or thrown away according to the correct procedures for your area.

Aisles and passageways around your work area should be kept clear – so others can move safely through them. Something as simple as a piece of paper or a pen on the floor can be a real slip or fall hazard. Be on the lookout for safety hazards and report any unsafe condition to your supervisor right away. If you can correct the problem, it's a good idea to take care of it immediately. When a hazard has been identified, inform others in the area about any unsafe condition.

Pay particular attention to the many electrical cords on and around your workstation. Power cords can be easily melted by soldering irons – which can lead to an electrical short. You could get shocked, or even start a fire. Tag any item with a damaged electrical cord and report it to maintenance.

Don't use any electric tool that has frayed or exposed wires, or a faulty plug. When unplugging a tool, always pull by the plug itself, rather than by the cord to avoid damaging the plug and causing a problem. And only use tools and equipment with three prong plugs. The third prong is an electrical ground connection – which helps protect you.

Another aspect of good housekeeping is observing the warning systems being used by maintenance or safety personnel. These are the lock-out – a label and lock that disable the energy source to a piece of equipment; the tag-out – a red tag warning that a piece of equipment is not to

be used; and barrier tape – yellow caution tape around an area that is temporarily off limits during repair or spill cleanup.

**Summary**

You've just taken a refresher course in how to work safely, happily and productively in electronics assembly. Remember, that the seven sins included personal protection issues; improper use of tools; improper workstation design and set up; hazardous materials; improper handling and positioning of materials; muscular skeletal disorders; and inadequate housekeeping.

A safe work place isn't just a given. It requires effort – both by you and your company. Take responsibility for your own safety. Your company may provide safe working conditions – but there are people that manage to hurt themselves watching football games on the couch. That's why safety depends on you. Don't expect others to keep you from harm.