DVD-57C

Stockroom Materials Storage and Distribution

Below is a copy of the narration for DVD-57C. 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.

Introduction

Stockroom Employee

The stockroom is a very unpredictable place. There are times when it is very calm and there's not much to do. And then there are times when it is very stressful and we are running around trying to get parts to the line so they can get product to the floor.

Narrator

When we think of electronics assembly, we usually focus on the processes. For through-hole technology, that may mean component sequencing and automatic insertion; manual insertion; and wave soldering. For surface mount technology it's solder paste printing; component placement; and reflow soldering.

If these processes are not supported by an organized stockroom -- with an effective storage and distribution system, manufacturing comes to a halt. The materials required to build an assembly must be on the production floor -- in their proper quantities -- when they are needed.

This program will describe some typical methods of receiving, storing and distributing stockroom materials. The actual practice may be modified for larger or smaller operations. We'll be taking a look at incoming inspection; materials handling and ESD issues; stockroom organization and materials storage; and the "kitting" and distribution of the materials to the production floor.

Let's start at the beginning. The first step occurs when a purchase order is placed for the items on a customer's bill of materials. To avoid mistakes, the purchase order should be independently reviewed before the order is placed. Next, the materials that were ordered arrive on the receiving dock.

For many companies in the Electronics Industry, these materials are the circuit boards and the electronic components required for a finished circuit board assembly. Some companies not only manufacture and test circuit board assemblies, but also build and test the electronic products themselves. In addition to the circuit boards and components, these companies receive materials such as wire harnesses, circuit board racks, power supplies, front panel switches and the system chassis.

Once materials are received, they may need to be checked. This operation is called receiving, or incoming inspection. The purpose of incoming inspection is to verify that what has been received is -- in fact -- what was ordered. It is also used to make sure that the materials are free from shipping damage.

Incoming inspection may be very detailed, or may be bypassed altogether. Many companies are using a system of certified suppliers to minimize incoming inspection. The supplier takes responsibility for the quality of the materials. Companies may perform periodic audits at the supplier's facilities. This system is sometimes called "dock to stock." Materials are left in their packaging and are simply checked by bar code reader for correct part number and revision level. Other companies perform more detailed inspections on the materials they receive. Regardless of the method used -- the point is to be able to ensure reliable products.

Here's what's involved in the more detailed incoming inspection. Typically, one sample circuit board from a particular lot is inspected. The sample board is first checked for the correct part number and revision level. Then we make sure the board has been manufactured to the proper dimensions. These dimensions are specified on the design documentation for the circuit board. Next, the hole sizes are verified using appropriate tools. There are a variety of other features which can also be checked at the discretion of the user. They include solder mask, hole pattern, track pattern and part marking. In addition, this sample circuit board may be run through the wave soldering or reflow soldering machine to verify solderability. Your company should have a procedure for the incoming inspection of circuit boards. It's important to follow these instructions.

Now, let's turn our attention to the electronic components. Components are usually checked for correct part numbers and quantities during incoming inspection. Solderability testing may also be performed on sample parts. There are basically two categories of electronic components -- through-hole and surface mount. Through-hole components have leads that are inserted through the holes in the circuit board. Surface mount components have leads or terminations that attach directly onto lands -- on the surface of the board.

Through-hole components such as integrated circuits come in dual-in-line packages, or DIPs. These DIPs usually arrive from the manufacturer in plastic tubes. Small axial and radial components such as diodes, resistors and capacitors are generally packaged on tape and reel. They are packaged this way for automatic sequencing and insertion - or component preparation. Some components are simply packaged in bags or boxes. These components normally require manual insertion.

Surface mount components arrive from the manufacturer three different ways -- on tape and reel, in tubes or in matrix trays. After verifying part numbers and quantities, as well as polarity, components should be resealed in their original packaging. This is especially true with moisture sensitive components delivered in air-tight packages. After opening for verification, desiccant and/or a moisture stick should be placed into the bag. Then reseal the bag.

The form factor should also be checked. Form factor means that the components are packaged in the desired packaging material -- such as tape and reel or matrix trays. Form factor is important because placement machines are set up and programmed to pick components from specific locations and packaging. As we said earlier, some companies will be receiving more materials than circuit boards and components.

The materials required for building a complete system also need to be inspected. The incoming inspection of wire harnesses may involve verifying the type of wire and connector; checking for proper connections against the assembly drawing; performing continuity tests; and verifying the strength of the connection using a pull test. Power supplies are usually checked for part number and quantity, and are perhaps tested. Circuit board racks and the system chassis may be checked for proper metal thickness and for any irregularities.

Again, your company should have specific requirements for incoming inspection. It's critical to make sure that the materials that have arrived are the materials that were ordered. For example, if the wrong reel of components was sent by mistake -- and that mistake isn't discovered -- then the wrong component may be soldered onto the circuit board. This error will be detected during electrical test. But then the assembly will have to go through expensive rework operations. Also, delivery schedules may be missed -- and not all products are tested prior to being shipped. This can result in unhappy customers. Not a good situation. Be sure to follow your company's procedures for handling incorrect or missing materials. This situation is unacceptable and must be rectified as quickly as possible.

Before we discuss stockroom organization and storage of materials, let's review two very important topics -- material handling and electrostatic discharge, or ESD control. We'll take a look at material handling first. Handling actually begins with the supplier, or manufacturer of the electronic components. Components that are not properly packaged from the supplier, or have been sitting on a shelf for an extended period of time will most likely have some amount of oxidation. Oxidation occurs as a result of the interaction between oxygen and other materials. Oxygen is a very reactive element. Whenever it comes into contact with other metals such as lands on a circuit board or component leads, it creates oxides. Oxidized metals can be very difficult to solder.

The critical issue is to receive materials with a known cleanliness and solderability -- and to maintain that cleanliness and solderability. Once the components arrive at your facility, care must be taken not to violate the integrity of the packaging until it is time to process the devices. But this is easier said than done since most inventory systems require the material handler to verify the component count as delivered by the supplier. This verification procedure sometimes violates the integrity of the packaging. In the case of desiccated dry packs used for moisture sensitive devices, the issue becomes even more serious. It may be necessary to store the devices in an inert

atmosphere to help eliminate oxidation. They may also need to go through a baking operation prior to assembly to remove any absorbed moisture. This baking may result in further oxidation.

In terms of the circuit boards, they should be stored in their sealed packaging until they are required for assembly. This will help reduce moisture absorption, oxidation build-up and possible physical damage. Stacking boards without slip sheets can also lead to board damage. In some cases the solderability of the board is jeopardized. Even with a solder mask coating on the boards -- the land areas are left uncovered. These exposed lands can scrape against each other under the weight of the stack.

Now let's turn our attention to ESD control. ESD occurs when static electricity from your body or other objects in the area is discharged into an electronic component. This discharge of electrical current can degrade or destroy the functionality of many types of components. If you're involved with handling or otherwise processing ESD sensitive components, you should receive ESD awareness training prior to handling ESD sensitive components.

There are a wide variety of materials and techniques to eliminate the build up and discharge of static electricity. The general principles, however, are easy to remember. Always be sure that your body is properly grounded by wearing ESD approved wrist straps or footwear. Don't forget that ESD approved footwear must be used in conjunction with ESD approved floors or floor mats to be effective. These grounding techniques will conduct any charges harmlessly to ground. If your company elects to use footwear for grounding, remember to wear them on both feet, since one foot may be off the floor for a time. In fact, many companies allow footwear only for operations where employees will be standing -- and require wrist straps when personnel will be sitting down.

Another potential ESD damage consideration is transporting the materials on a rack exposed to the environment. Some facilities operate with high humidity -- and allow open racks for transport. Your company should explain its policy. In fact, the stockroom should be regularly monitored for temperature and humidity. IPC offers detailed videos on Material Handling and ESD prevention.

Storage

Now, let's examine how materials are properly stored. First, we'll look at how a typical stockroom is organized. At most companies, circuit boards are stored in a separate area, away from the components. If you're working with bulk materials such as wire harnesses, power supplies, card racks and chassis' -- these are probably stored in a separate area as well.

Stockrooms may be divided into separate sections for through-hole and surface mount components. In some companies, surface mount materials are in a completely different stockroom. Sometimes stockrooms are organized where a particular customer's materials are in a separate location. This usually occurs when high volume assemblies are manufactured for that customer.

Your stockroom is most likely a restricted area and requires authorized access. This is so inventory can be controlled. Personnel are normally trained and certified before being allowed

access to the stockroom. Your stockroom may also have an additional restricted area that remains locked. This area is for the storage of high dollar materials and vendor consigned inventory. It may also contain consumer items such as memory chips and processors. The purpose of this restricted area is to prevent theft.

It's important to learn how your stockroom is organized. All materials are assigned to a specific location. Knowing these locations will make you much more efficient when you're storing parts, or removing them for kitting and distribution.

Now let's take a look at some general guidelines for properly storing the materials. Before placing any material into its stockroom location, it's important to check receiving inspection records to make sure the parts are correct and acceptable. Both components and circuit boards should be stored in bins made of ESD protective materials. These bins reduce charge buildup during handling, but should not be used for primary ESD protection unless they have covers that fit securely.

Let's start with the storage of circuit boards. Circuit boards normally come packaged in sealed protective wrapping -- often ten boards in a package, or some other convenient quantity for that size of board. The circuit boards are stored by part number in specific bin locations. As we mentioned earlier, they should be left in their protective wrapping. This helps to avoid scratches and other potential defects that can be caused by exposure and mishandling.

Now let's look at storing the components. We'll start with through-hole. Tubes of DIP components are usually grouped by part number. They may be placed horizontally, or stood upright in the appropriate bin. The shelves should have sufficient clearance so that the tubes of components can be easily stored and retrieved from the bins.

Reels of axial and radial components are also stored by part number in bins. They may be placed on their sides or stood on end in appropriate racks.

The other types of through-hole components are packaged in ESD protective bags or boxes. Again, these components should remain in this packaging while they're in storage. When these components are removed from protective packaging, there can be solderability problems -- as well as bent leads caused by mishandling.

All of these considerations are also true for storage of surface mount components. Surface mount components tend to be smaller and more sensitive than their through-hole counterparts. Therefore, they should be handled and stored with even greater care.

Again, tubes of components may be placed horizontally, or stood upright in the bins. And components on tape and reel are normally stored on their sides. This is so more can fit in a bin since the width is more narrow than the through-hole components on tape and reel.

Since many surface mount components look identical -- even though they have different part numbers -- it's important to verify the part numbers before storing them in a particular storage

location. In fact, many smaller parts, such as chip resistors and capacitors, aren't marked at all -- which makes careful handling that much more important.

The larger surface mount components are packaged in trays. Conductive Velcro straps may be used to hold the trays together. Never use rubber bands for this purpose since you'd be violating safe ESD practices. The trays are stacked in the bins. Remember if at all possible, keep these devices in their protective packaging.

Before we continue, let's discuss what we call FIFO. FIFO stands for first in first out. What this means is that older parts should be used before newer parts. We do this to minimize oxidation and degradation of the solderability of components and circuits boards. We also perform FIFO to prevent older parts from exceeding their warranty before use.

In addition, parts on tape and reel may separate if stored too long. This means they'll fall off the carrier during handling and processing.

Perishable products such as rubber goods also have a defined shelf life and should observe the FIFO rule.

In terms of storage, all newly received components and circuit boards should be placed in the back, or on the bottom of the bin -- and the older parts moved forward.

FIFO becomes less critical for materials such as wire harnesses, card racks and the system chassis. But it's still a good practice in order to limit the impact of possible design changes. These materials should remain in protective packaging and be stored in appropriate locations.

Stockroom audits may be performed periodically to check for shelf life, as well as inventory and handling issues. Many companies have inventory control systems that allow parts to be reordered automatically when they are down to a certain level. Sometimes suppliers audit their own stock and keep inventories at appropriate levels.

Distribution

Our last topic deals with the distribution of the materials we just stored. Distribution of these production materials is essential to a smooth manufacturing operation. Most companies have planners who schedule the purchase of materials and the production deadlines. These schedules are based upon criteria such as customer requirements and production capacity. For each production job, planners issue a pick list. The pick list will typically contain the part number and quantity of all the material required for an assembly job.

As the scheduling date for the job draws near, the pick list will be sent to the stockroom. The responsible stockroom person then pulls the specified materials -- in their proper quantities -- and delivers them to the production floor. This process of collecting these production materials is called kitting.

When there are mixed technology assemblies -- and the through-hole and surface mount components are in separate stockrooms -- duplicate pick lists may be sent to each stockroom. Both the through-hole and surface mount assembly areas should have scheduling systems which show the status of all the jobs in production. As one job is completed, the remaining scheduled jobs are moved up higher in the queue. The pick list should indicate when the kit is needed on the production floor. In order to keep up with production, a good rule of thumb is to always have the next job kitted.

In many facilities, component preparation may be part of the kitting process. Component leads may be cut and formed. Wires may be cut, stripped and tinned. Proper ESD and handling procedures must be followed in component preparation.

Now, let's watch a typical kitting operation. As we said earlier, the pick list contains the part number and quantities of the materials to be kitted. A particular job will require a specific circuit board. There will usually be a revision letter or number associated with the part number of the board. Circuit boards are typically loaded in ESD approved totes with static sensitive inserts. One package of boards is loaded into each insert. Remember to leave the boards in their protective packaging.

One way to pull the components is to remove them in the order listed on the pick list. After taking out the correct quantity, place a check mark next to the part number. It's not a bad idea to double check that you've pulled the correct component. Many companies use bar code systems to assist in picking and verifying components.

Again, you'll want to observe the FIFO rule -- pulling components from the front or top of the bin first. A more accurate way of doing this is to check the date code on the packaging. The earliest date codes should be removed first. Your company should have a standard operating procedure on the kitting and distribution of components. It's important to follow this procedure exactly.

Unless told otherwise, components should be left in their protective packaging. Components need to be handled carefully. The leads may be delicate and can be easily bent. Dropping a reel of components may not only dislodge some components, but can also damage the reel. The same can be said for components in tubes and matrix trays.

Sometimes there will be loose components in a bin. These components should be collected and placed in appropriate ESD protective packaging. They may also be placed in the small ESD protective bins that are used on the manual insertion lines.

After all the components listed on the pick list are verified and removed from storage, they are loaded into an ESD protective tote. A rule of thumb is to load the heavier material at the bottom of the tote. The lighter material goes on top. It's important to pack the tote carefully so the components don't get damaged.

Materials may also be loaded onto kit carts. Kit carts have designated locations for specific components. Once packed, the totes and/or kit carts are delivered to the destination indicated on the pick list or company procedures.

In some companies there are two distribution areas -- one for through-hole assembly and one for surface mount. The parts in the totes or kit carts are then distributed to the specific manufacturing areas where they are needed. For example, tubes of DIP components will be taken to the particular DIP inserter scheduled for the job. Tubes are then loaded by part number into feeder locations identified in the machine set up documentation. Through-hole components that can't be automatically inserted will be delivered to the manual insertion area.

Surface mount components are delivered to the particular surface mount line where they'll be needed. When pick and place machines are being set-up, a buddy system is often used to verify that the correct reel of components is being placed into the correct feeder location. Bar code readers are also useful for this operation.

Circuit boards are also delivered to the areas where they are first processed. In through-hole, it is usually masking or board preparation. Masking is used to protect certain areas of the circuit board during the wave soldering operation. Then the boards would go to the first component insertion operation. For surface mount, the first process is usually solder paste printing or adhesive application.

With all the materials in place, production begins. The actual operations are specified on the production router. In some companies, the router stays with the product through all of the assembly sequences -- including component attachment and soldering. Other companies, usually those with high volume and/or single product lines, choose not to use routers for tracking production runs.

Once the production run is completed, any remaining materials are removed from the machines. Any unused circuit boards, as well as unused and partially used reels, tubes, trays and loose components should be placed in ESD protective totes. The same care in handling materials during kitting should be used when gathering any excess materials.

The totes are normally returned to the stockroom via receiving inspection. Then the materials are properly stored in correct bin locations.

Items such as wire harnesses, power supplies, card racks and chassis' should be delivered to the appropriate hardware build-up areas when they are needed. Remember, this only occurs in companies responsible for building the entire electronic product.

At this point you're probably asking yourselves, what happens to scrap materials? Many companies have a scrap control system for measuring unplanned issues and scrap materials. The purpose of a scrap control system is to keep the percentage of scrap to a desired level.

Our final stockroom topic deals with shipping issues. After the assemblies have completed all necessary processes, they're ready to be shipped, or sent to the next assembly operation. One of the more popular ways to protect the finished assemblies from both ESD and rough handling is to seal them in ESD protective bags and surround them with an ESD protective foam. Your company should have procedures that define the safest way to package your specific product.

Remember to handle the assembly carefully during packaging. Circuit board assemblies should be handled by the edges of the board. And don't forget to wear appropriate ESD protection such as wrist straps or footwear. In fact, some companies may even want you to wear ESD protective gloves while handling the product to prevent contaminating the assembly. Careful handling is also important when packaging and shipping an entire electronic product. Considering all the time and care it takes to manufacture electronic assemblies, it's frustrating and costly when any product is damaged due to mishandling.

This program has provided an overview of stockroom operations. First, we discussed the types of materials received and their incoming inspection. Next, you were provided with some material handling and ESD concerns. Then we examined stockroom organization and materials storage. Finally, we took a look at kitting -- and distributing the materials to the production floor.

An effective stockroom operation is crucial to the success of any company. It is your willingness to follow exact procedures and pay attention to the details of your job that significantly contributes to the overall production environment.