ELECTRONIC COMMUNICATION AND MULTIMEDIA EQUIPMENT SERVICING

NTQF Level-II

Learning Guide-11

Unit of Competence:	**Assemble and Disassemble communication & multimedia Equipment**
Module Title:	**Assembling and Disassembling communication & multimedia Equipment**
LG Code:	**EEL CMS2 M04 LO1- LG- 11 1019**
TTLM Code:	**EEL CMS2 M04 TTLM 11 10 19 v1**

LO2:- Solder/ De-solder components to the board

Instruction Sheet	Learning Guide #11

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Performing ***Soldering and de-soldering processes***
- Checking process according to established standards and requirements
- checking soldered products in accordance with quality standards

Specifically, **upon completion of this Learning Guide, you will be able to**:

- Perform ***Soldering and de-soldering processes*** in accordance with OH&S policies and procedures
- Check process according to established standards and requirements
- check soldered products in accordance with quality standards

Learning Instructions:

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 20.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.
4. Accomplish the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4”.in page _____.
5. Try to answer self-check, you can ask your trainer for correction. If you finished answering the Self-check, take correction or explanation from your trainer if it is not clear.
6. Submit your accomplished Self-check. This will form part of your training portfolio.
7. Read the information written in the “Information Sheet 2”. Try to understand what are being discussed. Ask you Instructor for assistance if you have hard time understanding them.
8. Read the information written in the “Information Sheets 3. Try to understand what are being discussed and ask you teacher for assistance if you have hard time understanding them.
9. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (To get the key answer only after you finished answering the Self-check 3).

Information Sheet-1	Perform Soldering and de-soldering processes

1.1. Perform ***Soldering and de-soldering processes*** in accordance with OH&S policies and procedures

Introduction

Soldering is a process used for joining metal parts to form a mechanical or electrical bond. It typically uses a low melting point metal alloy (solder) which is melted and applied to the metal parts to be joined and these bonds to the metal parts and forms a connection when the solder solidifies. It is different to welding in that the parts being joined are not melted and are usually not the same material as the solder. Depending on the part and type of joint it may be possible to simply re-melt the solder and remove the part, or it may be necessary to remove the solder from the joint so the part can be

freed. Some methods for removing solder are solder wick, solder sucker or de-soldering tool. Solder wick is a copper braid which is applied to the joint and heated with a soldering iron. De-soldering is the process of removing soldered components by the help of sucker melting the connection using soldering iron, and soldering gun and SMD or hat air gun.

1.1.1. S**oldering**

1.1.1.1. prepare the materials and equipment needed

Before we are just getting start the session it is difficult to know what tools are or aren't very essential, or what must urgently prepared and what are not. So the required materials are dependent on what we are covering in give session. As general we expected

Fig. Hand tools and power tools

Soldering Iron

The plating on all soldering iron tips will, in due course, fail, even under the most benign conditions. The life of this plating depends upon the application (specially the temperature), the types of solders and fluxes used, and - primarily - the operator's technique. Plating failures can be divided into four main categories:

a) Stress or cracking.
b) Corrosion.
c) 'De-wetting'.
d) Wear or abrasion.

1.1.1.2. wipe the soldering iron tip on a damp sponge and wet it with a small amount of solder

A clean surface is very important if you want a strong, low resistance solder joint. All surfaces to be soldered should be cleaned well.

- **Let the iron cool before cleaning it.** Turn off your solder iron and let it cool down for 15-20 minutes before cleaning the tip. This will allow you to clean the device as thoroughly as possible without risking burns. Clean the tip immediately after the solder iron to limit buildup over time. Place a sticky note near your workspace if you find yourself forgetting often to make cleaning the iron a priority.
    - Used to clean off soldering iron tip
    - Can be made of various materials
    - Should be used every time before soldering a joint

Fig. soldering flux

Wipe the iron off with a damp, cellulose and sulfur-free sponge. Take a wet sponge and rub it over the top of the solder iron. Doing this first will take care of any mild buildup and help you discern in a safe way whether the tip is still too warm to touch with bare hands. Use sulfur-free sponges made specifically for soldering, as regular sponges will not remove the solder as efficiently.

Use dampened steel wool to get rid of surface stains or rust. If you do not regularly clean your solder iron, you may have more stubborn stains or discoloration. Take a steel wool pad and dampen it slightly, then scrub it over the iron's tip to remove rust and any other heavy staining.

Steel wool is the only cleaning item safe to remove rust or stains with. Avoid sandpaper, which is too corrosive for solder iron tips

Fig. cleaning soldering iron

Wear eye protection while tinning the tip. After cleaning the tip, it is advised that you coat the tip in a thin, even layer of solder. This is called "tinning," and it helps protect the tip from rust or oxidization. That being said, many chemicals in solder are eye irritants. Solder has a tendency to "spit," or pop if you accidentally hit an air pocket, so keep safety goggles on at all times.

- Tin the solder iron after every use to prevent rusting.
- Make sure to wear eye protection at all times while using a hot solder iron.
- Although gloves are not required for tinning, it is suggested that you wash your hands with soap and water afterward.

- **Apply a small amount of fresh solder to the iron tip.** Melt a small dot of solder over the tip in a thin coat. If applied evenly, this will keep the iron's heat flow in check when it is next used in addition to preventing rust accumulation.

Fig. adding fresh solder

- **Keep the solder in place with an alloy cleaner.** After turning the solder iron off and letting it cool, apply a small layer of alloy cleaner over the tip with a microfiber cloth. This will prevent dust buildup over the solder and further diminish the chances of oxidization.

Fig. using soldering flux

- **Use high-quality solder.** Although using cheap solder may seem cost-effective in the short term, it can cause damage over time. Impurities in your solder can cause buildup on the tip and inhibit its heat-transferring abilities. 60/40 or 50/50 solder is ideal, with the top number representing what percentage of tin is in the solder.

Fig. cleaning solder

- **Remove debris buildup after every use.** After soldering an item, turn the solder iron off and wait for it to cool. Then, remove the tip and tap the barrel to dislodge any debris. This will prevent buildup from clogging your solder iron over time and diminishing its efficiency.
- **Check the solder iron's cord for burns or cracks.** A solder iron's cord is prone to damage because of the high heat the device is used under. If you notice any cord damage, hire a professional electrician to replace the cord. Solder irons with cord damage are not only inefficient but also dangerous to work with.

Fig. checking soldering iron

- **Wipe off the iron's tip between strokes.** Cleaning the solder iron's tip while it is in use will result in better soldering work. Wipe a wet sponge across the solder iron's tip after each stroke to avoid buildup on the tip. When you're finished with your soldering job, you will have less to clean from the tip if you wipe the iron periodically while using it.

Fig. soldering gun

1.1.1.3. apply the hot iron to one side of the joint and then feed in solder from the other

Heating the joint: Placing the iron tip on both the component lead and pad--the goal is to get as much surface area contact between the iron tip and joint as possible.

Apply a very small amount of solder to the tip of the iron. This helps conduct the heat to the component and board, but it is not the solder that will make up the joint. To heat the joint you will lay the tip of the iron so that it rests against both the component lead and the board. It is critical that you heat the lead and the board; otherwise the solder will simply pool and refuse to stick to the unheated item. The small amount of solder you applied to the tip before heating the joint will help make contact between the board and the lead. It normally takes a second or two to get the joint hot enough to solder, but larger components and thicker pads/traces will absorb more heat and can increase this time.

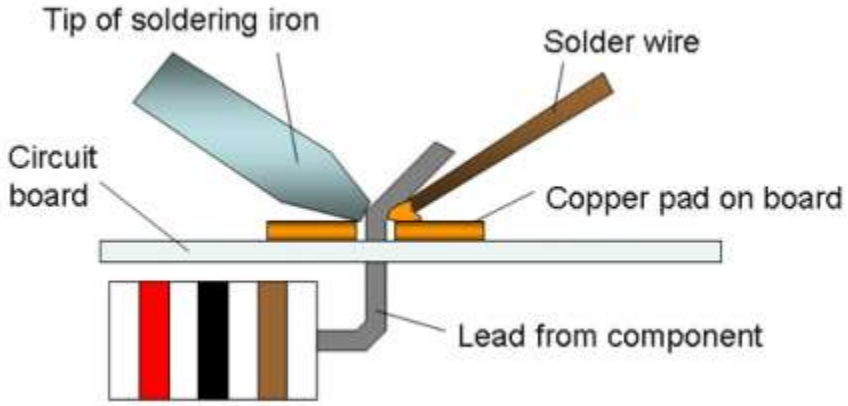
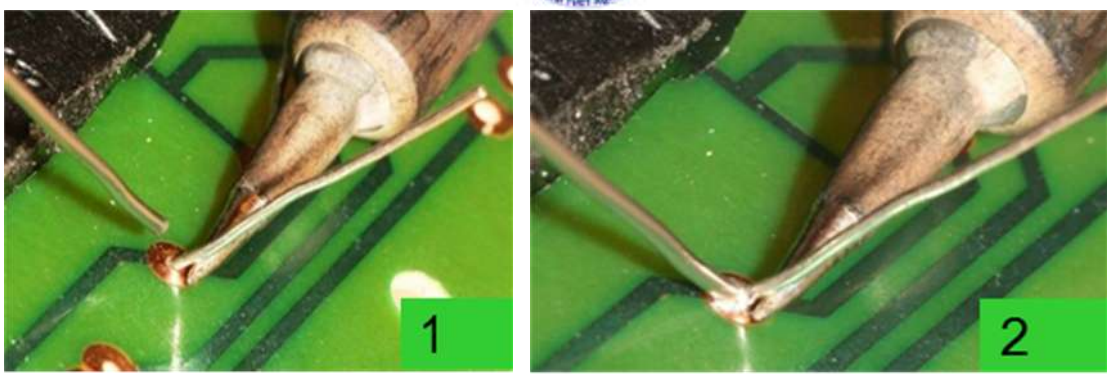


Fig. heating solders

Heat both items at the same time by applying the soldering iron to the copper pad and the component lead.

1. Heat both items at the same time by applying the soldering iron to the copper pad and the component lead.



2. Continue heating and apply a few millimeters of solder. Remove the iron and allow the solder joint to cool naturally.

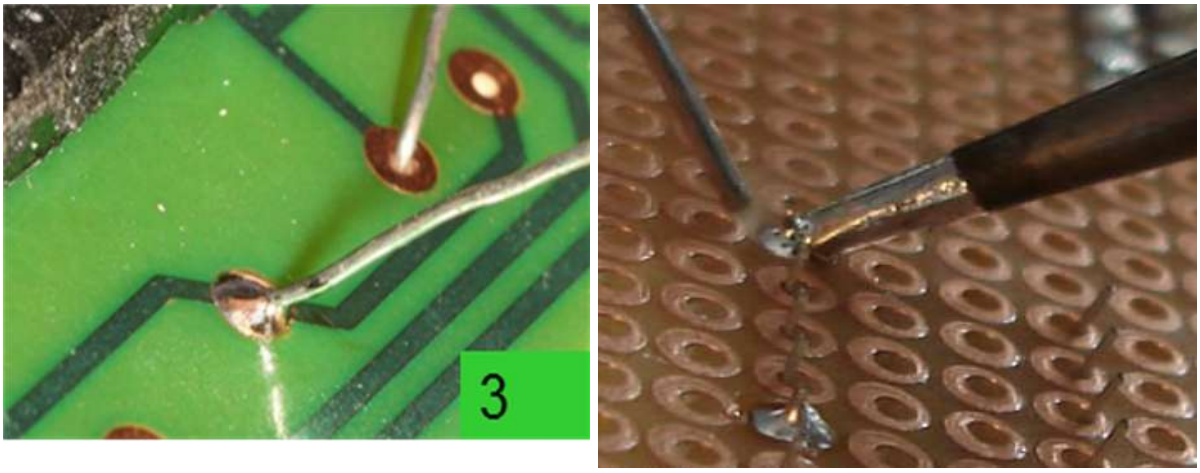


Fig. removing solders

A Good Solder Joint

- Smooth
- Bright
- Shiny
- Clean
- Concave fillet

Procedures for Soldering

Fig. soldering process

1.1.1.4. allow the flux to work on the surfaces and the solder to flow across the whole joint Usually touching the tip with rosin-cored solder will supply enough flux so that oxides can be removed with a damp sponge. If this isn't sufficient, you can purchase "tip tinners and cleaners" that are a mixture of solder paste and flux. The flux is oftentimes stronger (more activated) to help remove oxides.

Fluxes are used to:

- assist the wetting process by removing oxidized layers from metallic surfaces, and by modifying the surface tensions
- protect the surfaces of both the solder and the parts to be soldered from oxidation during the soldering process
- Assist in the transfer of heat between parts being soldered, and thus help equalize their temperatures.

The constituents of flux

A flux may be solid, pasty or liquid, depending on how it is to be used. Its principal constituents are:

- a ‘flux base’, together with widely variable quantities of
- 'activators’ and

- solvents.

When used for wave soldering, fluxes are generally ‘low solids’ with perhaps only a couple of percent of flux, and the balance solvents. The resulting materials are relatively thin and mobile. However, when formulated as part of a paste for reflow soldering, the flux will also contain additives to improve the paste ‘rheology’ (flow characteristics) and ‘tackiness’, and to help slow the sedimentation of solder particles. In many cases, paste components will have more than one function.

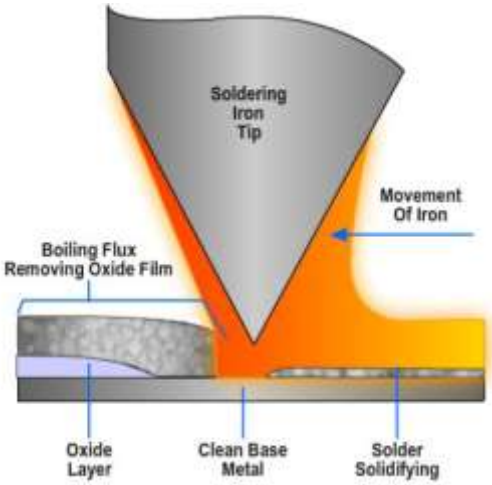


Fig. using soldering flux

1.1.1.5. remove the solder, then the iron

Anyone who solders should know the basics of how to use a solder wick, which is braided copper wire. This tool will help to remove solder from any solder joints that you need to change. This is an especially useful tool for those who need to remove solder from circuit boards and other electrical components. Because soldering can be difficult when you first begin, you will want to have solder wick on hand so that you will be able to repair any mistakes that you might make. The use of these wicks is very simple, and they can save you from having to replace parts that you soldered incorrectly

Step 1 - Prepare Safety Materials

Set up the exhaust fan so that it will carry the fumes from soldering away from you. If you do not have an exhaust fan, or if the material on which you need to work is not in a location where a fan will work, you can use a safety mask. Do not forget to wear your safety goggles to protect your eyes from solder and other debris.

Step 2 - Plug in the Soldering Iron

Plug the soldering iron into the outlet and wait for it to reach a working temperature. Make sure that the iron is safely in its holder so that it does not fall out. It will generally take three to five minutes for most soldering irons to heat to their optimal temperature.

Step 3 - Use the Solder Wick

Take a length of the solder wick and hold it on the joint from which you need to remove the solder. Now that the soldering iron is heated up, you can apply the iron to the tip of the wick as well. The heat from the soldering iron will melt the solder. As the solder melts, it will be drawn onto the copper wiring. The process through which this occurs is called capillary action. The solder will fuse to the copper braids on the wick as it cools. This will remove all of the solder from the joint.

Step 4 - Cut the Wick

When the wick is coated with the solder that you want to remove, take the wick away from the heat and return the soldering iron to its holder. You can then cut off the tip of the solder wick that is now covered in solder. Check any of the other joints that might need to have solder removed and repeat the process. If you have one joint that has a large amount of solder, you may have to repeat the process.

Step 5 - Clean Up

Turn off the soldering iron and wait for it to cool down when you are finished. Dispose of the solder covered wick and clean up your work area so that it will be ready for you the next time that you have to solder.

1.1.1.6. inspect the work

Methods of inspection

In order to make sure that PCBs are performing as intended, manufacturers must verify all components are assembled correctly. This is done with a range of techniques including simple manual inspections to automated tests that use advanced PCB inspection equipment.

Manual visual inspections are a great starting point. For simpler units, they may be all that's needed. At Electronic Manufacturing Services Group, we perform a manual visual inspection under magnification of every board we produce to ensure we meet all customer expectations. We also offer other inspection services that involve the use of advanced equipment.

This equipment can speed up the inspection process and may be necessary for more complex board types, such as multi-layer boards and those with high numbers of components.

1. **Visual inspection:-** is non destructive method to the solder joints the accuracy is about 80% effective. However in Visual Inspection method, the ability of

technician to find faults in electronic products vary in size, complexity, density and total amount of opportunities

Instrumental testing method: - multi-meter is one of the most necessary instruments to test and inspect solder of PCB.

Structural Process Test System (SPTS)

Digitalization and analysis system of real-time and automatic video capture is capable of dramatically improving allowance and repeatability of visual inspection. Therefore, structural process test system depends on some form of emitting light like visible light, laser beam and X-ray. All those systems acquire information through processing images to find out and measure defects concerned with solder joint quality. Similar with visual inspection, SPTS is implemented without the need to physically contact circuit board. Different from visual inspection, however, SPTS features such high repeatability and eliminates subjectivity from defect measurement.

Automatic/Automated Optical Inspection (AOI)

AOI system relies on multiple light sources, programmable LED library and some cameras to shine solder joints and take shots. Under reflected light, leads and solder joints play a role as mirror reflecting majority of light while both PCBs and SMDs reflect little light. Light reflected from solder joints fails to provide the practical height data while graphics and intensity of reflected light provides information in terms of solder joint curvature.

Then professional analysis will take place to determine whether solder joints are complete, whether solder is sufficient, whether bad wetting takes place. Apart from that, AOI system also inspects solder bridging and missing components or displacement before or after reflow soldering.

Automatic Laser Test (ALT) Measurement

ALT is a more direct technology used to test height and shape of solder joints or solder paste deposition. This system runs to measure the height and reflectivity of some surface components when the image of laser beam focuses on one or multiple position sensitive detectors that maintain a certain angle with laser beam.

During ALT measurement, surface height is determined by the light position reflected from position sensitive detectors while surface reflectivity is figured out from the power of reflected light beam. Due to secondary reflection, light beam perhaps shines on position sensitive detectors at multiple positions, which calls for a scheme to distinguish correct measurement. Furthermore, reflected light beam may suffer from shielding or interference of interference material when running along light of position sensitive detectors.

In order to eliminate multiple reflections and prevent shielding, this system should test reflected laser beam along regulated independent optical path. During multiple height measurement for solder joints, ALT system is **OPTIMAL** for solder paste deposition quantity and position alignment prior to component assembly. It provides data for real-time structural process control of solder paste printing including viscosity, alignment, cleanliness, fluidity and squeezing speed and stress.

X-ray Fluoroscopic System

X-ray fluoroscopic system emits a beam of rays from a single-point light source, which vertically goes through circuit board. With this process carrying on, solder joints weaken the intensity of rays to larger extent than other materials. The intensity changes on ray energy are converted into digital X-ray graphics with a gray scale of 256.

Gray X-ray graphics of some solder joint is actually a density image indicating solder joint thickness, distribution and internal integrity.

On a single-side PCB, X-ray fluoroscopic system is capable of accurately inspecting solder joint defects such as those (including crack, insufficient solder, bridging, misalignment, void etc.) taking place on J-shape wiring devices, gull-wing devices or passive chips. Apart from that, it is able to inspect missing components and reversed tantalum capacitors. When it comes to double-side PCBs, however, X-ray fluoroscopic system fails to accurately inspect those defects due to possible overlapping of X-ray images of solder joints on both sides of a board.

X-ray Lamination System

Compared with X-ray fluoroscopic system, X-ray lamination system generates focal plane of a horizontal section area through scanning or synchronously spinning with X-ray detector. Off-axis images generated on detectors then lead to the generation of section image with surface thickness of 0.2-0.4mm by single swinging or multiple swinging that causes homogenization. Furthermore, components at front side and back side of focal plane become defocused in laminated images so that solder joints within focal plane are departed from other materials on PCBs.

Depending on laser range finder, X-ray lamination system draws board surface position relative to focal plane and rectifies board warpage. After that, circuit board is moved at a small vertical increment so that it goes across focal plane, after which different sections of the same solder joint can be inspected. It works perfectly for **BGA** and **PTH** solder joint inspection.

Double-sided PCB is vertically moved at large increment to go across focal plane to inspect solder joints at both sides of the board. Through modifying beam's scanning radius and vertically moving focal plane, different amplification factors or visual area sizes can be set. X-ray lamination system can measure parameters of all physical solder joints at different focal planes so that process defect coverage can be provided. Due to the indicated relationship between section image of X rays and given solder paste volume, grey scale readings can be converted into practical sizes by regulated standard units or metric units. After analysis on measurement results, data will be provided to characterization and assembly improvement.

For example:- average solder paste thickness or solder paste volume change of solder joints can lead people to be aware of quality levels of solder paste printing and defect sources. X-ray lamination system runs at an inspection speed of 30-40 joints per second. It ensures 100% coverage of key device inspection by running at a flexible sample way, but it fails to cover 100% of devices whose assembly period takes place in

fewer than 45 seconds. X-ray lamination system features the highest cost among all inspection methods but greatly shortens time of searching and rework.

1.1.2. De-soldering

De-soldering is the process of removal of solder and electronics components from a circuit board by using soldering tools for troubleshooting, repair, replacement, and salvage.

1.1.2.1. Lay the iron tip to rest against component leads on the board

Laying iron tip against component lead so as to heat the solder for melting and pumping or wicking using sucker as shown in the following picture.

Steps of de soldering.

1. Locate the terminals for the component to be removed. ...
2. Clean the terminals. ...
3. Attach a heat sink. ...
4. Clean your soldering iron as it heats. ...
5. Push down on the **desoldering** pump. ...
6. Heat the old solder with your soldering iron. ...
7. Vacuum up the melted solder. ...
8. Empty the **desoldering** pump into the trash.

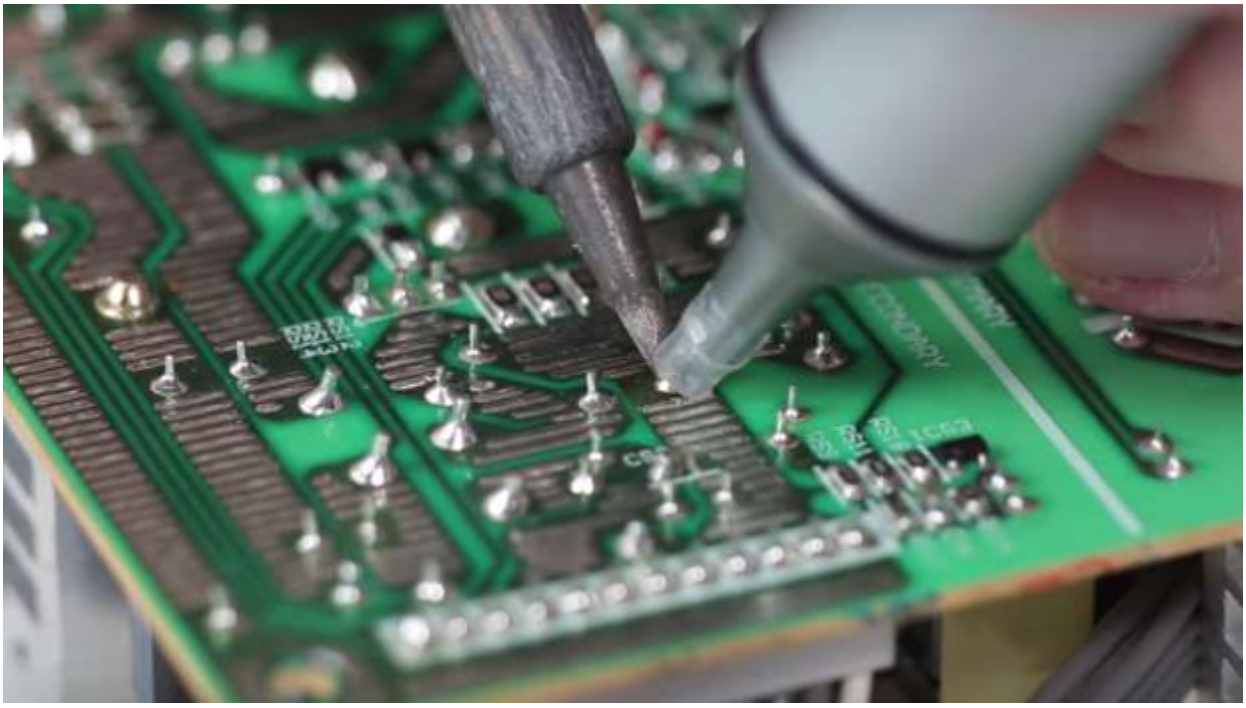


Fig. de-soldering components

1.1.2.2. use solder sucker to quickly remove molten solder on the connection

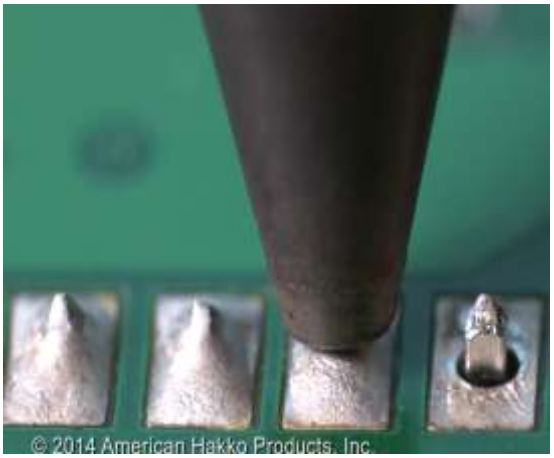
- Solder is a metal alloy and when it cools it creates a strong electrical bond between the parts. Even though soldering can create a permanent connection, it can also be reversed using a desoldering tool as described below
- Desoldering is the elimination of solder from a circuit board. Therefore, the desoldering pump is a device used in achieving the removal of solder from a printed circuit board. Solder sucker it is designed with a spring-loaded plunger.
- The desoldering pump has features which enable it to repel heat and does not get destroyed when the tip is placed on the molten solder. It often requires skill or technical-know-how for efficient use and a better result.

Steps required on how to use a desoldering pump

Fig. A) Soldering sucker

b)

Fig. A) Desoldering gun



B) desolding process

1. The first step is to apply heat to the solder with the aid of a soldering iron, but in some cases, some desoldering pump comes along with the irons.

2. The second step is to apply pressure on the plunger by pressing it down. In case of another pump with bulb, you can squash it.

3. In the third step, once the solder is liquefied, position the head of the pump on the solder that needs to be removed

4. The next step involves the release or discharge of the plunger or bulb; some desoldering pumps are designed in such a way that it possesses a release button, so as not to be held the whole process.

5. The next step is to remove the desired free component. You can repeat using this procedure again to eliminate any additional solder. Press down and release the plunger in a continuous pattern to eradicate the solder inside the desoldering pump.

1.1.2.3. Remove the component on the board

The best technique I have found to avoid pulling out the plated through holes is to use side cutters to snip through each component leg and then to melt the solder and pull the debris out from the hole with pliers, using a solder sucker later to clean up the hole. This does, of course, destroy the component being removed, but it is defective or suspect anyway surely.

It is possible to use a combined soldering iron/sucker to remove the solder and “wiggle” the leg before removing the heat, so it is not adhered to the side of the hole. This works because once the liquified solder is gone the heat transfer from nozzle to leg is much reduced, and once the leg is wiggled free the solder left down the hole solidifies rapidly having no heat applied.

1.1.2.4. clean the solder pad to remove left-over

Still not clean?

If after cleaning on the sponge / brass shavings the tip is still not shiny then melt a small amount of solder onto it and clean again. The flux in the solder will help to clean the tip.

Really oxidized

If the tip is still not clean and shiny then use a tip cleaner. This is a mixture of a more aggressive flux than usually found in solder, and powdered solder. The flux in tip cleaner removes the oxidisation and build up from the soldering iron tip, and then the solder re-tins the tip ready for use.

Fig. cleaning soldering Iron

- To use the Tip tinner/cleaner heat the soldering iron.
- Then dip into the tin of tinner/ cleaner with a slight twisting action
- This step will coat the iron in a mixture of flux and solder.
- Wipe the iron on a damp sponge to remove the excess

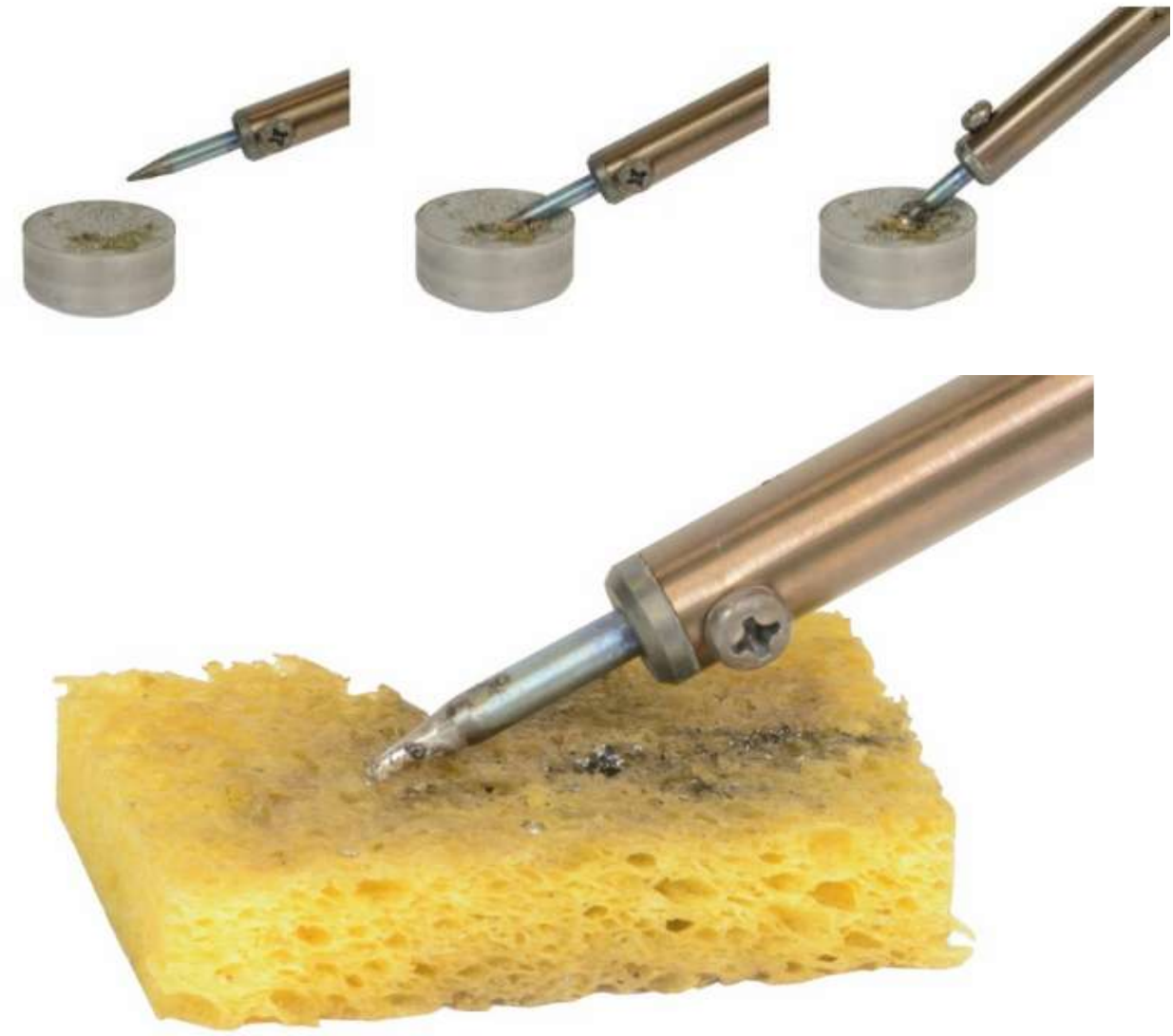


Fig. cleaning soldering Iron

Before we start soldering we want to make sure that the tip is nice and clean and shiny so that it will accept solder. We call this 'tinning'.

We start off by wiping my soldering iron tip through this damp sponge to remove any excess solder and dirt or carbonated material. Then we run some solder onto the tip and wipe away the excess.

Now if we had a tip that was very black and we were finding it hard to get the black material away we can use this which is called tip tinner and cleaner. This helps remove this dark black material.

We run the soldering iron through this and then wipe it through the damp sponge, it helps remove any of this black material.

Again we can run a bit more solder on, wipe away the excess and we have a nice clean, tinned soldering iron ready for our soldering job.

Information Sheet-2	Check Process according to established standards and requirements

2. Check Process according to established standards and requirements

- External visual inspection is a process of verifying the attributes of parts such as Device condition, part markings, and evidence of the device, Ports conditions, dimensions and surface quality. Visual inspection can be used for internal and

external surface inspection of a variety of equipment types, including storage tanks, pressure vessels, piping, and other equipment.

- Visual Inspection, used in maintenance of facilities, mean inspection of equipment and structures using either or all of raw human senses such as vision, hearing, touch and smell and/or any non-specialized inspection equipment.
- **Visual Inspection**, or Visual Testing (VT), is the oldest and most basic method of inspection. It is the process of looking over a piece of equipment using the naked eye to look for flaws. It requires no equipment except the naked eye of a trained inspector.

Fig. Inspection using different methods

Checking is the process of proofing the above activity in:

1. *Visual inspection*
2. *Testing/ automated techniques*
3. *Applying functionality test*

During inspection three elements should be taken into consideration when deciding inspection method:

- Defect type
- Cost and
- Inspection speed

Information Sheet-3	Check Soldered products in accordance with quality standards

2.1. Check Soldered products in accordance with quality standards

Note: To check the quality of solder that performed the trainer must choose available option for his activity.

1. **Visual examination:-** is routinely used to study surface features, finishes and the soldering quality and integrity of solder joints. However, only qualified inspectors are able of a proper failure detection and interpretation according to the applicable regulation. Major points of interest during the visual inspection of solder joints are as follows:
    - **a) Degree of wetting** is a measure of solder joint quality. Properly wetted joints show an uninterrupted layer of soldering material that spreads along the whole contact-pad surface. This results from the good wettability of the solder compound on the contact pads and components.
    - **b) Joints Contours** are also inspected as they indicate the volume of solder deposited. The contour should be concave when the amount of solder is enough; but it shall not extend beyond the device contact (see example of excessive solder in the figure).
    - **c) Thermal damage**. Excessive heating, for instance during soldering, may result in different types of failures such as lifted pads, measling and blistering, charred, burned or melted insulation or burns on base materials.
    - **d) Damages on the devices** caused during handling. Comprehensive external visual inspection allows us to detect gross defects in solder joints.

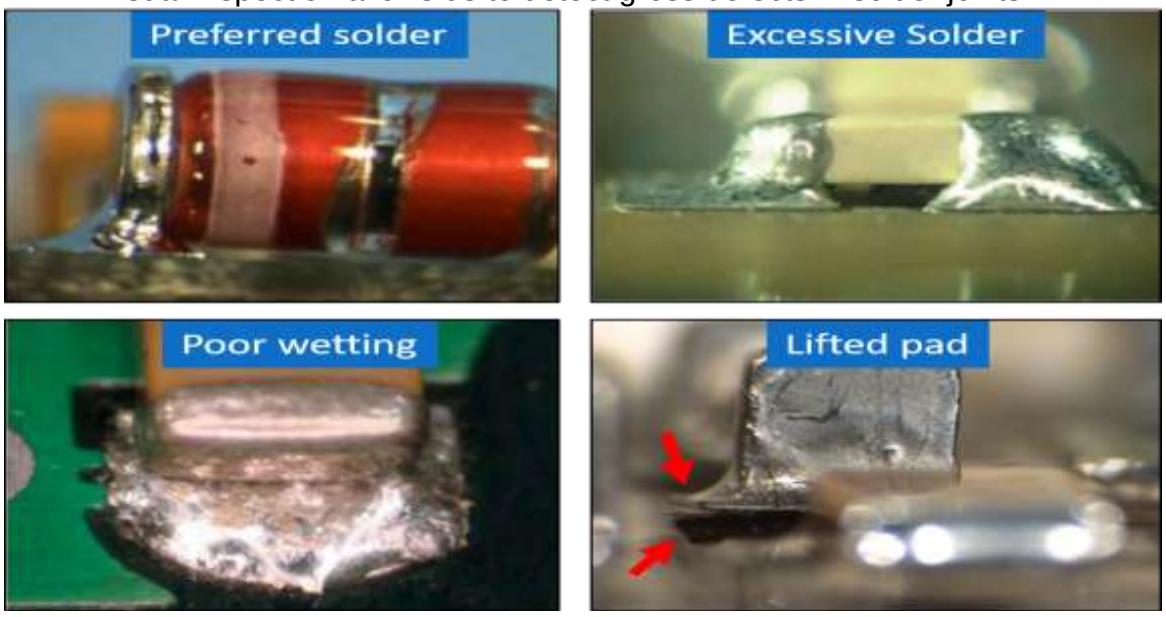
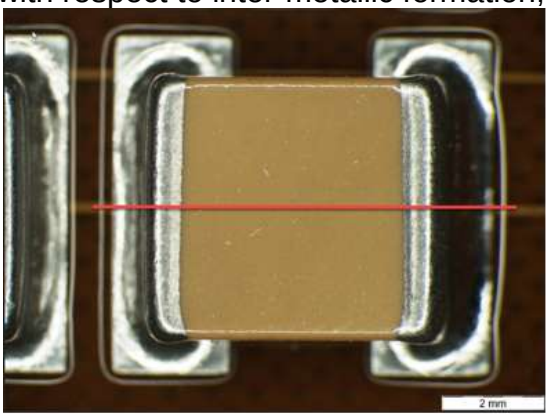


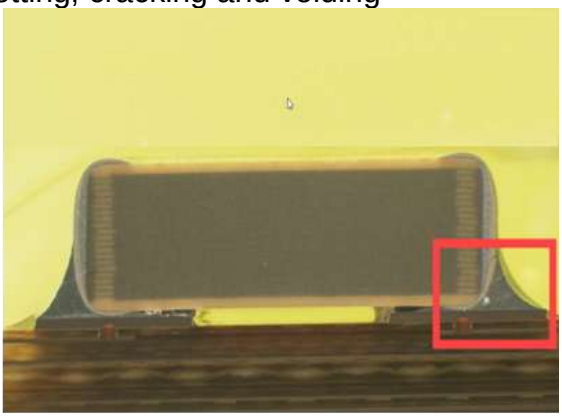
Fig. Check Soldered products

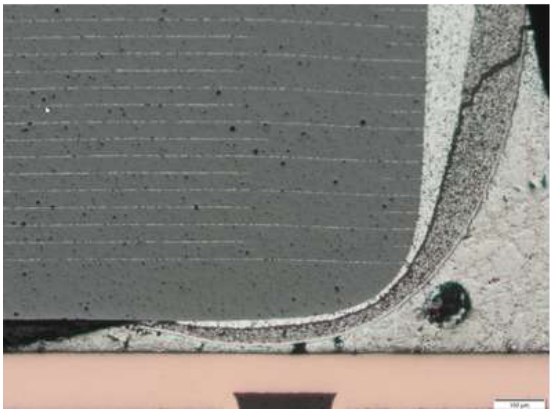
2. **Vibration tests: -** are performed to ascertain the ability of package and solder joints to withstand the dynamic loads related to the intended applications and environment. Vibration environment will cause stress on the **PCB substrate, component packages, component leads and solder joints** due to a combination of the bending moments in the PCB and the inertia of the component mass. With these

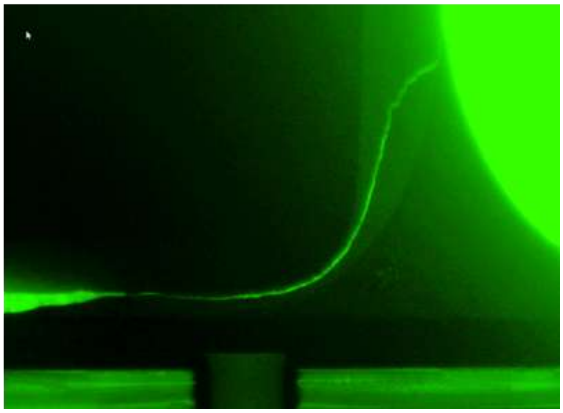
concerns, the standard ECSS-Q-ST-70-08C, clause 13.2, sets out the requirements for PCB and SMD vibration testing.

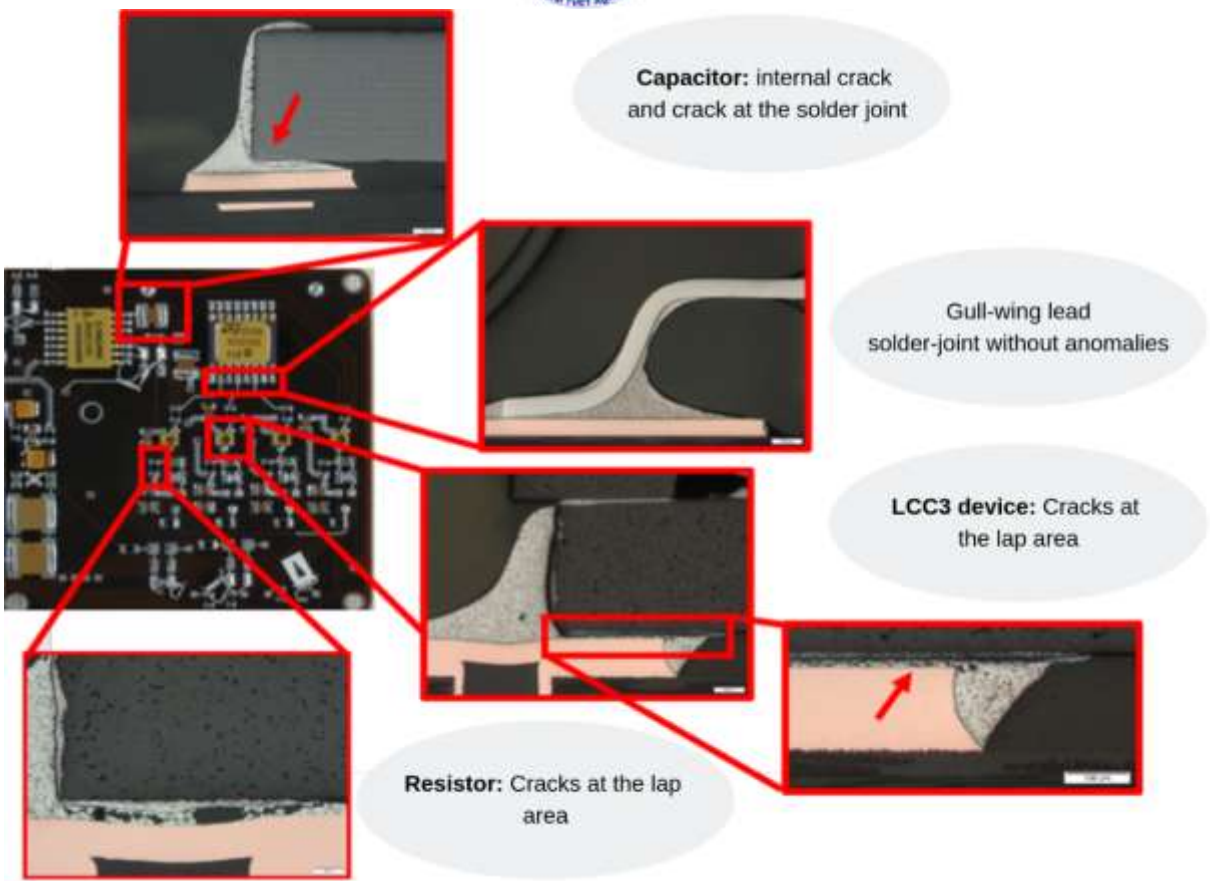
3. **Temperature cycling**:- is the most commonly used accelerated test. It simulates **temperature-enhanced and thermo-mechanical stress conditions on** SMD solder assemblies. Thus, the conditions of testing vary depending on the environment for which the product is designed to operate.
4. **Micro-sectioning Analysis: -** Once the PCB assembly has been submitted to environmental tests, microsectioning inspection is performed in order to evaluate carefully the PCB raw inner layers, internal solder joint integrity and devices internal structure. Microsection analyses are mandatory for the qualification of soldering procedures in agreement to the ECSS-Q-ST-70-38C soldering verification program. This is so as it is the most reliable tool to reveal the morphology of the solder joints with respect to inter-metallic formation, wetting, cracking and voiding










Capacitor: internal crack and crack at the solder joint
Gull-wing lead solder-joint without anomalies
LCC3 device: Cracks at the lap area
Resistor: Cracks at the lap area

Reference

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