# DVD-92C
# Rework of Surface Mount Chip Components

*Below is a copy of the narration for DVD-92C. 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.*



*Chip Components*

This is the second video in the Surface Mount Rework series. In this video we're going to examine the tools and techniques for removing and replacing chip components. There are several types of surface mount chip components that we'll be working with. Let's begin by looking at each of these types, then we'll explain the terminology as well as any special precautions you'll need to be aware of during the removal and replacement operations.

Let's begin with **flat chip resistors**. These are a very common component style. The component body is made from *alumina*, which is an extremely hard white colored material. The resistive material is normally located on the top. Chip resistors are usually mounted with the resistive element facing upwards to help dissipate heat during circuit operation, and for identification purposes. The *metallized terminations* on the ends of the resistor chip will typically wrap around three sides of the component.

Chip Resistors come in several different sizes. While some of them are relatively large, the trend is to use smaller components in today's surface mount designs. Their size is described by a four digit number, for example: 0805. The first two numbers represent the length of the component. In this case, point zero eight inches. The last two digits represent the width of the component. Point zero five inches. Each component will also have a metric size code based on millimeters rather than inches. 2012 is the metric equivalent of the 0805 chip component. The first two digits, or two zero, would equal 2.0 millimeters in length. The 12 represents 1.2 millimeters in width.

Another style of chip components is the **ceramic capacitor**. These components are constructed of several layers of ceramic, with internal metallized layers. Because metal heats up much faster than ceramic, these ceramic capacitors need to be *heated slowly* to avoid internal separations between the ceramic and the metal layers. This internal damage will generally not be visible, since any cracks will be inside the ceramic body of the component. In some cases, a crack may be so small that the damaged component will function properly for a while, but the heating and cooling of the component caused by turning the product on and off will cause the component to expand and contract. This may eventually cause the separation to grow to the point where the component will fail to function properly. This is why we need to avoid rapid heating of ceramic chip capacitors during the soldering operation. Ceramic chip capacitors will require **gradual** heating methods, which we will explain later in this tape.

Another style of chip component has a molded plastic body that protects the internal circuitry. There are a number of different types of components that share this type of exterior package, including **tantalum capacitors**, **inductors**, and **potentiometers**. All of these components have different functions, which are beyond the scope of this video. If you would like to learn more information on the function of these components, you can refer to the IPC video on Component Identification.

The *termination styles* for plastic chip component packages also varies considerably. Tantalum capacitors will often have a wrap-around termination, starting on the outside end and bending around the bottom of the component. Some of the inductors will have terminations that extend out to the end, but are mainly underneath the component body. Finally, there are some potentiometers that have an L shaped termination that extends away from the body.

One other style of component that we will be discussing is the **MELF**, or **Metal Electrode Face** cylindrical components. There are capacitors, resistors, and diodes in this MELF style. It can be hard to tell them apart **-** since there is no universal coloring or component designators printed on the component bodies.

While all of these components certainly look different, they are relatively similar as far as removal and replacement techniques, with the exception of ceramic chip capacitors. We will be working with different component types as we explain each of the various removal and replacement techniques. Whenever there is a specific concern relative to a particular style of component, we'll make sure to cover that information.

It's also important to *always follow the safety requirements* **-** to protect both yourself and the assemblies that you work on. There are separate IPC training videos on operator safety and ESD control. If you haven't already received training in these areas, we recommend that you review both of these videos before you begin using the tools and techniques described in this tape.

*Hand Soldering Iron*

Now let's talk about our first rework tool, the **continuously heated hand soldering iron**:

There are a variety of interchangeable single-point tips available for specific soldering applications. Here are some of the basic tip shapes and terminology that we'll be using:

- **Chisel tips** are basically shaped like a chisel. The flat section of the tip has a lot of surface area which helps to transfer the heat quickly.

- **Conical tips** also resemble their name. Conical tips also come in extremely small sizes for micro miniature applications.
- **Bifurcated or forked tips** are also useful for chip component rework. Forked tips come in several sizes to accommodate many of the different styles and sizes of chip components.

The *size and shape* of the tip will also have a significant effect on the rate of heat transfer. Larger tips with more surface area will transfer heat much faster than smaller tips. Tip selection will be based on the size of the component. While there is no exact rule about how the size of a single point-tip should compare to the size of the termination, it's obvious that if the tip extends too far beyond the edges of the joint, it could come in contact with another component, or the surface of the board. A burned area around conductor traces or lands can reduce the adhesion between the metal and the laminate surface. This can result in a lifted land or conductor trace. To avoid this problem, the width of a single point tip should be slightly smaller than the width of the land. We'll be recommending a specific tip as we explain each rework technique.

Now let's discuss chip component **removal** using a continuously heated hand soldering iron:

It is possible to remove a chip component with a single soldering iron, by moving the tip back and forth in order to melt both solder joints at once, then flicking the component off the lands while both joints are still molten. Perhaps the reason that this method is ever used is that it doesn't require any special tools.

There are some major disadvantages with this technique. For example, as the component is pushed away from the lands, it can lodge against another component. As the molten solder solidifies, the component will be resoldered to the other component. This type of removal operation can also leave a stream of solder on the board. Depending on where this solder ends up, it can create additional problems. The amount of heat needed to keep both solder joints melted simultaneously can also weaken the adhesion of the land onto the surface of the board. If the iron starts to push on one side of the component as the opposite solder joint begins to solidify, the pressure can cause the land to separate from the circuit board.

Some technicians use two soldering irons to remove chip components. This technique can overcome some of the problems we just mentioned. But it does take considerable skill to properly align both tips without touching and burning the surface of the board.

The first recommended method for removing chip components uses a **bifurcated** or **forked tip** with a hand soldering iron. Forked tips are designed to fit over the top of chip components, and to reflow both solder joints at once. There are different sizes of forked tips to fit the various types and sizes of chip components. The ends of the forked tip fit over the component, with just a slight amount of extra space for solder. Learning which components fit into specific tips takes experience.

Before we begin the *tip preparation process*, we need to apply flux to the solder joints. In this case, the flux will help remove oxides and transfer heat between the tip and the solder. We always want to flux the component *before* we prepare the tip, so that the cleaned tip doesn't have to wait around and oxidize while we perform the fluxing operation. The **type of flux** will depend on your company's cleaning procedures. Almost any type of flux will work. The key is compatibility with your cleaning procedures and chemistry. There are also "no-clean" fluxes that are becoming popular. As the name implies, these fluxes do not require cleaning after the soldering operation is complete.

Now we're ready to prepare the tip. Since this particular tip has a cavity, it will require special cleaning and tinning procedures:

- First, we'll need to remove any solder from inside the cavity of the heated tip with a non-abrasive fiber tool. It's important never to use a wire brush for any tip cleaning procedure - since the wire will scratch all the way down to the base metal. This would allow oxidation to form on the base metal and severely decrease the useful life of the tip.

- After cleaning the tip with the fiber tool, the next step is to remove any oxidized solder by ***shocking*** the tip on a wet sponge.

- Now it's time to add solder to the properly cleaned tip. We need to fill the cavity up until there's a small crown of solder that reaches from one side of the tip to the other. Knowing exactly how much solder to add is also learned by experience.

We want enough solder to help transfer the heat quickly - but not enough to fall out of the tip cavity. The solder will also provide *surface tension* to lift the component off the lands after reflow. Since the tip has more metal surface area than the lands on the circuit board, the solder will be drawn toward the metal tip – and so will the component. Forked tips can be used to remove a number of different styles of chip components, as long as they fit properly in the cavity.

At this point, some of the extremely small chip components won't fit into any of the forked-tip sizes that are presently available. To remove these tiny components, you can use a one sixteenth inch chisel tip to simulate the forked-tip removal process. We need the tip to be slightly wider than the length of the component, so that it reaches almost to the end of both lands:

- The first step is to flux the component to enhance the heat transfer process.

- After we clean the tip, we'll apply a little bit more solder than you would normally use to tin the tip.

- Then we'll place the soldering iron at an angle so that the tip lies flat against the top of the component. We'll use the extra solder on the tip to melt both of the solder joint simultaneously. The flat side of the soldering tip has more surface area than the edge of the tip. This additional surface area will help to create the necessary *surface tension* to lift and hold the component.

This technique will only work for the smallest chip components, when properly sized bifurcated tips are not available. Adding the right amount of solder to the tip will also take some experience.

If you add too much solder, especially when the components are tightly spaced, you could end up with solder bridging.

Now let's cover the removal of chip components that are bonded to the board prior to the original soldering operation:

A small dot of *adhesive* is often used to hold chip components in position during the wave soldering process. Typically these chips will be located on the bottom side of a circuit board that has through hole components located on the other side. This way, the through hole leads and the chip components can be wave soldered in a single pass. Whenever you see a board like this, you can generally assume that the chip components have been bonded onto the board. To remove these chips, we'll have to apply enough heat *through* the component body to soften the bond. The bifurcated tip is the simplest tool for removing adhesive bonded chip components:

_ After we prepare and *prefill* the cavity with solder as usual, the tip is then applied to the component. You'll need to leave the tip on the component for one or two seconds after the solder joints are melted in order to transfer enough heat to overcure or soften the adhesive.

_ Now take a wooden stick or curved tweezers and push the component sideways until the bond finally gives way. Some adhesives will loosen up quickly, while others can be a lot more difficult.

*Land Preparation*

In this next section we're going to cover **land preparation** prior to component replacement:

Before we replace any type of surface mount component, it's always best to *remove any **remaining** solder* so that it does not become part of the new solder connection. Remember that when the component is removed, some of the original solder will still remain attached to the land. That solder has already been heated twice. If it becomes part of the new solder joint, it will have been heated at least three, possibly even four times. Reheating solder – even with the addition of flux – can also affect the physical composition of the metals. Every time that solder is reheated close to it's melting point, the molecular structure tends to become increasingly brittle. You'll remember that we want the solder to remain soft, or *ductile*, in order to absorb the stresses of expansion and contraction caused by heating and cooling of the circuitry. That's why its best to remove all of the old solder from the lands and replace it with fresh solder whenever a component is reattached.

There are two techniques for preparing surface mount lands, depending on the type of equipment you have available. The first method uses a **solder removal braid**. Solder braid comes in different widths. We'll want to use one that *matches the width of the land*, or is just slightly smaller:

_ After we place the solder braid over the land, we need to apply heat. The width of the soldering iron tip should also match the width of the land. If the tip is too large for the braid, it will hang over the edges and could potentially burn the board. If the tip is too small, it will take much longer to heat up the braid. Remember that we want to apply heat for the shortest possible time to avoid thermal damage.

_ After we have selected the proper tip and braid size for the land, the application of an external flux is optional. Most solder removal braid already comes with a **powdered flux** inside the copper strands which is melted and activated by the heat of the iron. Adding additional flux will help to transfer the heat even faster, and also help improve the wicking, or *capillary action*, of the copper braid.

_ As you apply the heat, it's important to avoid putting any downward or sideways pressure on the land. Since the adhesive underneath the land is being heated at the same time, the adhesion between the board and the land will be at its weakest. Sideways pressure can also scrape the land right off the board. Downward pressure can result in a bowed land, or an extremely weak bond. The **weight of the iron** should apply sufficient contact to quickly heat the solder braid. The heat that passes through the braid should melt any solder that remains on the land within a few seconds.

_ The wicking action of the copper braid will draw the solder away from the land. This wicking action should be visible to the operator. When the wicking action stops, it's time to remove the braid and the iron. The used portion of the braid should be clipped off and the other land should now be prepared exactly like the first.

After the excess solder is removed from both lands, we're ready to install the replacement component.

The second land preparation technique uses a vacuum extractor to remove the used solder. The solder extractor has a heated tip with a hole in the center to vacuum the melted solder away. There are different tip sizes - depending on the size of the job. Once again, the diameter of the tip should match the width of the land. This is the optimum vacuum tip size. A larger tip would extend over the edge of the land and could potentially burn the board. For this one particular operation, the application of flux is optional.

_ Now the heated tip is placed onto the land until you feel the solder melt and the tip drop. Again, it's important not to use any downward or sideways pressure on the land. The weight of the hand piece is sufficient.

_ After the solder melts, the operator activates the vacuum and the solder is sucked through the hole in the tip into a solder storage chamber. It should only take a second or two for all of the solder to be removed.

_ After the solder is vacuumed from the land, the tool is lifted away.

Remember to allow the vacuum to continue for an additional few seconds – to make sure that the solder has had enough time to travel through the tip into the storage chamber.

The second land should be prepared in the same manner. Now we're ready to install the component on the properly prepared lands.

*Component Removal and Replacement Tools*

*Hand Soldering Iron*

Let's start with installation methods. We'll be able to use the same installation procedures for almost all of the different types of chip components – except for ceramic chip capacitors.

The first technique will be to **prefill** one of the lands with flux cored solder:

_ We'll add enough solder on one land to create a slight crown shape. Again, the best way to learn the right amount is through practice. Some companies may require you to clean off any old flux residue at this point prior to adding additional flux.

_ Now we're ready to align the component in the correct position. You'll notice that the prefilled land will lift the component off the board slightly.

_ Next we need to add flux to remove any oxidation that will be formed during the resoldering process.

_ Now we'll hold the component in position with a wooden stick or tweezers so that the soldering iron won't push the component out of alignment. When we apply heat to the prefilled land, the solder will melt and the component will drop down onto the land. The solder should wick up onto the termination and form a fillet, based on the amount of available solder from the prefill.

_ Now we remove the tip, then wait one or two seconds for the solder to solidify before we remove the holding tool.

The tip should contact both the land and the termination while the solder is added to the opposite joint. Be sure to add just enough solder to form a proper fillet. You can use almost any style of tip you prefer for either soldering operation – chisel or conical. Keep in mind that it's best to use the largest tip possible to transfer heat as quickly as you can without touching the board or any adjacent solder joints.

It's important to not apply pressure or scrape against the component connection. Even a light scraping can scratch away the metallization on the component. This will leave a non-solderable area within the joint - which is not an acceptable condition. Another reason to avoid exerting any pressure is to avoid damage to the land. Since the opposite land may still be hot from the prefill operation, the adhesive resin that holds the land to the board can be easily loosened if any pressure is applied.

After both sides are soldered and cooled off, the flux residue should be cleaned with the proper solvent to keep it from hardening. Again, there are **no-clean fluxes** that don't require cleaning. Just be sure to comply with your company's cleaning procedures immediately after all work on that assembly is completed.

You can also use a bifurcated tip to install chip components:

- In this procedure, we will prefill both of the lands with flux cored solder. We'll need to add enough solder until there's a visible crown present on both lands. You'll learn the right amount of solder prefill after a few tries. Again, it's always best to remove any used flux residue at this point.

- Now we can align the component properly on top of the prefilled lands. Then we need to add new flux, to remove any oxidation that will be formed during the reflow process. We'll have to hold the component in position with a tweezers or a wooden stick.

- Contact both prefills simultaneously with the forked tip. At this point we should be able to see the solder melt and feel the component drop down onto the land. After the iron is removed, you'll need to hold the component down for another second or so until solidification is complete.

Then remember to follow-up with the recommended cleaning procedures required by your company.

There's also another way to secure a chip component without having to physically hold it down. We can apply a drop of adhesive between the lands, and then place the component on top. Now we'll push the component down until it sits flush on the lands. There are a number of different types of adhesive applicators available.

You need to be careful to keep the adhesive off the lands. If you add too much, the downward pressure of the component can cause the adhesive to squeeze out. Adhesive that bleeds onto the lands will get in the way of a good solder connection. The proper amount of adhesive needs to be applied directly in the center - between the two lands. After a few minutes, the adhesive should be hard enough to allow you to solder both sides without knocking the component out of alignment.

We'll be using flux cored solder, and the largest tip you can safely use without damaging the board or any adjacent solder joints.

The size of the solder wire is also an important consideration when soldering small components. If the solder is too thick, it's easy to melt too much solder into the joint. If the solder is too thin, it can take too long to melt the optimum amount into the joint. In this case you would have to leave the heat applied longer - which can cause thermal damage to the board.

This covers all of the recommended replacement procedures for hand soldering chip components.

*Pulse Heated Tweezers*

In this next section, we're going to cover removal and replacement of chip components using a pulse heated tweezers. Let's begin with the removal process:

The pulse heated tweezers has various tip sizes for different components. Once again, we will use a tip size that doesn't extend beyond the width of the land - to avoid possible damage to the surface of the board. The amount of pulsed electrical energy, or heat, will need to be adjusted to the job at hand. The tool manufacturer, or your company's standard operating procedures, should have a reference manual that lists specific heat settings for chip components.

Adjust the dial on the heat source to match the recommended setting for chip components. Now add flux to both sides of the component that we are going to remove, in order to enhance the heat transfer process. If the tips touch another component or solder joint as they are being positioned, they won't cause any damage since they aren't hot yet. This can be a real advantage on high density assemblies. The tips should be positioned about halfway down on each side of the component. A light touch should be sufficient contact.

After the heat switch is activated, the tips will take a few seconds to heat up and melt the solder joints. When the solder melts, you should be able to see it become *shiny* because of the flux. When you're sure that all of the solder is molten, lift the component straight up and turn off the heat. The hot component should be placed on a wet sponge to cool, to avoid burning your work surface.

That covers the chip removal process using a pulse heated tweezers. Now lets talk about component replacement:

Because of the relatively slow heating of the pulse heated tweezers, you have the advantage of using either solder wire or solder paste for component replacement. Let's begin with the solid solder prefill technique:

_ Assuming that you have prepared the lands after component removal, we'll use a soldering iron to melt a properly sized crown of solder onto both of the lands. The relative size of the component terminations will affect the amount of solder in the prefill. For example, a MELF component has more metal surface area on the termination than a chip resistor. This means that it will require more solder in the prefill to create an acceptable fillet. Once again, the correct amount of solder prefill for each component size and type is only learned through experience.

_ After both lands are properly prefilled and cleaned, we need to add new flux. We'll be using the same tip sizes and heat setting from the previous removal operation. Grip the component about halfway up the termination with a light touch. Then position the component exactly where you want it, properly centered over the prefilled lands. After the heat is activated, it should take a few seconds for the solder prefills to melt. You should feel the component drop slightly as the solder melts.

_ Now make any final adjustments for proper component-to-land alignment and then release both the thumb and the finger simultaneously, then deactivate the power.

If one side of the tweezers is released first, the spring action of the tool can push on the component and knock it out of position. You may wish to hold the component with a non-damaging tool to avoid problems in releasing the tips unevenly. If you decide to use a holding tool, you will lose the advantage of the *self-aligning tendency* of the chip component. This means you must make sure that the chip is accurately aligned during the soldering process. Whenever you use a tool to hold a component in position, it's extremely important to keep it perfectly still during solder solidification. If the component moves even a slight amount during the hardening process – look what happens to the structure of the solder. This type of grainy texture is not just a cosmetic problem. It indicates that the structure of the solder is disturbed and likely to fail.

Another technique for installing chip components with pulse heated tweezers uses solder paste:

_ Assuming that the lands have been properly prepared after component removal, we're now ready to dispense solder paste onto both of the lands. There are a number of different ways to apply solder paste - ranging from manual dispensers to air pressure regulated units. You'll need to get experience with the dispensing tool that your company provides. The amount of solder paste will always vary depending on the size of the lands and the style of terminations. Again, larger terminations will require more solder to obtain the correct fillet size.

_ After the solder paste is applied, you're ready to install the component. Pick up the component with the tweezer tips, grasping it about halfway up the termination.

_ Now we align the component while the tips are still cold. Don't press the component down onto the lands - just place it lightly into the solder paste and then activate the heat. Within a few seconds, you should see the solder paste liquefy.

_ After you are sure that both joints are molten, release both sides of the tweezers at the same time. The surface tension of the solder should center the component on the lands.

_ Now the heat can be turned off. After cooling. the flux residue around the joint can be cleaned up.

*Thermal Tweezers*

In this next section, we're going to discuss chip component removal and replacement using continuously heated thermal tweezers. This tool was originally designed for component removal - although some people use it for installation as well. We'll explain both operations, beginning with component removal:

As a starting point, you should set the tip temperature to 316 degrees Celsius. As your skills improve, you will learn to vary the temperature according to the requirements of the job. The continuously heated tweezers have an *adjustment screw* located at the back of the tool. You might want to set this screw so the tips will open around half a centimeter wider than the width of the component. In some cases, there may not be that much working space around the component. You may have to adjust the spacing of the tips to allow for this condition.

There are a much larger variety of tips available for this tool compared to the pulse heat tweezers, including an angled version for chip removal. The angled tips allow you to come in from the side. This makes it possible to work under a microscope to get a better view of what you're doing. For chip components, you'll want to size the width of the tips slightly smaller than the width of the land.

_ We'll begin by fluxing both sides of the component. Then we contact the terminations lightly - without touching any other components or solder joints.
_ In one or two seconds, you should see the solder melt. After you're sure that both joints are molten, lift the component straight up.

Now lets talk about removing chip components that have been adhered to the board:

_ We'll be using the same procedures as before, except that we will continue to apply heat after the solder melts for a few additional seconds. This additional heat will travel through the component and soften the adhesive.

_ At this point you can start to apply a gentle twisting motion to make sure the adhesive has been loosened.

_ Now lift the tool upward and remove the component. Some adhesives will tend to loosen faster than others depending on the size and shape of the component, and the type and amount of adhesive.

Now you can prepare the lands for component replacement. It is possible to replace a chip component with continuously heated tweezers – although it takes a skilled and steady hand to achieve acceptable results.

*Hot Air Pencil*

In this section, we're going to review the chip removal and replacement operations using a hot air pencil.

Lets begin by setting the temperature of the air to 427 degrees Celsius. This may seem hot, but keep in mind that the exit air is always much cooler than the set temperature. Think of this tool like a home heating furnace, where the gas burns inside at around 300 degrees Celsius. The hot air that comes out of the vent will only be slightly over 50 degrees Celsius. The hollow tips that you select will also affect the amount of heat output. There are at least three different styles of tips available for hot air pencils:

· The **small diameter tips** will focus the heat in a small area.
· The **dual-tips** can heat both sides of a component at once.
· The **flat-end tip** will heat up a much larger area.

Tip selection will depend on your personal preference, and on the density, or tightness, of the components. Once you have selected the appropriate tip for the job, it's time to adjust the air pressure to match the diameter of the tip. To do this:

_ We place a tissue or cleaning cloth about half a centimeter away from the tip.

_ Now turn up the air pressure until it begins to scorch. This should be reasonably close to the air pressure for that particular tip. Additional adjustments can be made as required.

Now we should be ready to remove a chip component. If there are other components packed tightly against the one you need to remove, it may be wise to select another tool. Heating adjacent solder joints should always be avoided, from a reliability standpoint.

Let's remove this chip using a small diameter tip. We've already adjusted our temperature and pressure:

_ Now we'll add flux to aid in the heat transfer and to make the solder shiny when it melts. We'll come in from the side and turn on the air when the tip is about one centimeter away.

_ Move the tip back and forth slightly to heat both solder joints at the same time. Both joints should melt within a few seconds if the temperature and pressure are properly adjusted.

If the solder doesn't melt within ten seconds, something is wrong. You'll need to stop and examine the situation. It may be a large conductor or ground plane connected to one of the lands. This will require additional heat to be focused on that side. Thick multilayer boards will also absorb some of the heat and slow down the process.

Let's try again, now with a MELF component:

_ Once again we'll use a curved tip and move the heat back and forth to melt both joints simultaneously.

_ When both of the solder joints are melted, carefully reach in with tweezers or a vacuum tool and pick up the component right in the center.

There are a few important things to keep in mind:

· The first being that you have to be sure that both joints are completely melted before you attempt to remove the component with tweezers.

· If you try to remove the component too soon, the land or component can be damaged.

· If the air pressure is too high, the component and the solder can be blown right off the lands. This can create additional rework.

· Too much pressure can also reflow adjacent solder joints. Even if they don't get quite hot enough to melt, the solder can become brittle from excessive reheating.

· If the pressure is too low, it may take too long to melt the solder - or it may not melt at all. In either case, excessively long heating could affect nearby solder joints, or the internal structure of the board.

You'll need to practice with each of the different tips to see which one you prefer, for different situations.

Now lets talk about component replacement – using the hot air pencil:

_ First we prepare the lands using a vacuum extractor or solder removal braid. It's a good idea to remove any solder residue *before* we apply solder paste onto the lands. Once again, the correct amount of solder paste will depend on the size of the lands and the component termination style.

_ Pickup the component with a tweezers, and place it lightly into the solder paste in the center of the lands. If it's off slightly that's okay, since it should center itself when the solder melts.

We'll be using the curved small diameter tip again, for photographic clarity.

_ Assuming that you have adjusted the power supply for the correct temperature and air pressure, this time we'll want the tip to be positioned directly on top of the chip – about two centimeters away. The extra distance will allow us to *pre-dry* the solder paste slowly. This will allow solvents to evaporate rather than explode. If the tip is not positioned directly on top of the component, it could blow the component sideways when the solder melts.

_ When the top of the solder begins to liquefy, move the tip down to approximately one centimeter away from the component to completely melt all of the solder. It's a good idea to keep the heat applied for one more second after all of the solder appears to be melted to insure proper joint formation. The surface tension of the solder should automatically center the component between the lands.

After the flux residue from the solder paste is cleaned up, the installation is complete.

Now lets examine the second installation technique using the hot air pencil:

_ Once the old solder is removed, we can prefill both of the lands using flux cored solder and a hand soldering iron. Again, the height of the solder crown will depend on the size of the lands and the termination style.

_ Now we'll clean the flux residue.

_ Next we position the component on top of the prefilled lands with a tweezers. This can be difficult with MELF components, because of their tendency to roll off the solder crowns. You may want to hold the component in place with a toothpick or tweezers.

_ Now we apply flux onto both ends of the component terminations and the solder prefills. Assuming you have adjusted the air temperature and pressure according to the tip you've selected, position the tip directly above the component. We don't need to preheat this type of solder, so the position of the tip can start about one centimeter away from the top of the component. If you use a light touch to hold the component in position, you will feel the component drop as the solder melts.

_ You can remove the tool and allow the surface tension of the solder to align the component. Again, you need to be sure that all of the solder in both connections has melted before removing the hot air. One additional second is good insurance.

Now the flux residue can be cleaned and the installation is complete.

*Preheating Ceramic Chip Capacitors*

Before we finish, let’s talk about the special heating requirements for ceramic chip capacitors. As we mentioned before, due to the structure of the alternating layers of ceramic and metal, these particular components need to be heated gradually to avoid internal cracking.

Place the capacitor on the hot plate, then set the temperature to the desired temperature, and turn on the heat. Some hot plates will sound an audible alarm when the component reaches the temperature setting. Others require a temperature probe to determine how hot the component is. Or you can just wait a few minutes – then you're ready to position the component.

You'll want to have the lands already cleaned, prefilled with solder and for this application, already fluxed. The soldering process for ceramic chip capacitors is exactly the same as any other chip component as long as you preheat the component slowly. You can choose whatever soldering method you prefer.

There are many different ways to remove and replace chip components using the basic principles that are outlined in this video. Understanding and applying these techniques – and a sufficient amount of practice – will make your job easier, and improve the reliability of the end product.