Selective Soldering Process

Although many through-hole components are being replaced by their surface mount (SMT) counterparts, printed circuit boards (PCBs) are still being designed with both types of components. Often, there are interconnect hardware, displays, or other components that cannot withstand the exposure to the high temperature involved in the wave soldering process. They are generally soldered by hand. The challenge is to determine the optimal method manufacturers can use to solder these boards populated with mixed technology. For decades, skilled hand soldering personnel have always been the backbone of electronics assembly operations. They can complete connections that are problematic for machine soldering, and are essential for rework and repair. However, in terms of production, hand soldering is slow and inconsistent; the quality of the results is entirely dependent upon operator skill, and can vary widely from day to day and hour to hour.

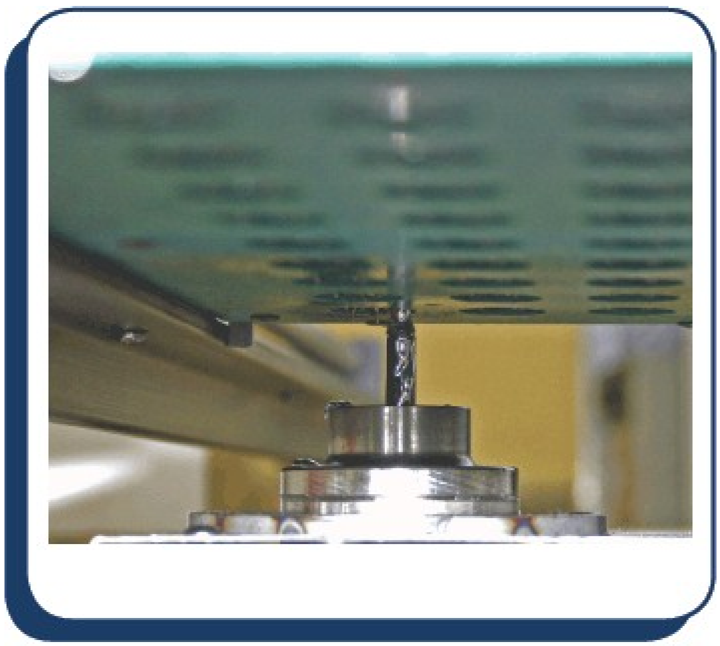

Figure 1-1: Mini-solder wave approaching circuit board component

More and more individual, offline, or challenging soldering operations are being completed with the use of selective soldering machines. This is especially true for high volume assembly operations or for components that simply cannot be effectively hand soldered. Selective soldering is precise, programmable, fast, and consistent. In order to increase productivity and achieve greater product consistency, automating certain processes, such as soldering, is necessary.

Selective soldering machines will precisely solder only the components necessary without disturbing nearby SMT chip components. These are automated, simple to use, machines that use a "traveling mini–solder wave". They are useful for removing or installing through-hole components on SMT boards within close proximity of adjacent components.

This system overcomes the limitations of operator dependent soldering with a flexible molten solder delivery system that can be moved in three axes under computer control (Figure 1-1).

Initial programming is accomplished by teaching the solder pot positioning system all the locations on the PCB to be soldered. This can be done by importing a PCB CAD file containing all the start/stop positions for the devices to be soldered. The process path and script is automatically created. Circular or angular interpolation allows soldering large round arrays in a spiral pattern and connectors not perpendicular to the X-Y plane. In addition, an imaging system can be used to accurately view the start and end of a row of terminals to be soldered and place the positions into memory, building a process path and script, component by component, manually. After teaching these positions for all sites, the X, Y, and Z positions, speeds, solder wave height and other parameters can be adjusted to perfect the process.

The cycle begins by automatically applying flux only to the programmed sites. The fluxer nozzle should be close enough to the board to provide a focused, smooth spray with minimal overspray, but far enough to avoid hitting any board component. At the correct height, the fluxer should deposit a pattern with a ¾ to 1 inch diameter, useful for multiple-row or wide spread components. Next, the mini-solder wave is automatically moved under the component to be soldered. The pot rises to "wet" the first pins and then the solder wave travels the length of the component, soldering the through-hole leads to the PCB. At the completion of the travel, the solder pot lowers and moves to the next site. All programmed sites are soldered in the same cycle. After completing the cycle, the pot returns to the start position ready for the next cycle.

Due to the variety of board configurations, ground planes, and component layouts, the best way to selectively solder can only be determined through experience. Muli-row components, such as connectors, require the solder pot to be moved at a 45° angle at the end of the row to prevent solder bridging. If the board has very tall components on the solder-side, you must consider the traverse height when planning a soldering path. The solder pot must be low enough to clear all the components, to avoid hitting anything on the board.

The height of the solder should be about .050 inch below the board to get the nozzle as close to the leads on the board as possible without colliding with them. Thinner boards can warp when heated, so adjustments must also be made to the solder height.

To avoid swapping nozzles, the largest nozzle should be used that can perform the desired soldering operations on the entire board. Larger nozzles have solder waves that apply more heat to the board and are easier to maintain, They can accept larger board variations without missing pins or flooding.

The solder pot wetted surfaces are constructed of materials which are capable of withstanding aggressive no-lead solders. The heaters can bring the solder safely to temperature within an hour. Solder is re-circulated using a speed-controlled motor coupled to an impeller assembly. The solder distribution system is designed to minimize dross build up while providing an extremely consistent and repeatable solder wave shape. A nitrogen blanket, captured within the enclosed solder pot, minimizes dross, icicles, and solder bridges, while allowing an inert return of the solder from the nozzle back into the pot. The solder temperature is controlled to within ± 2°C of set point. The capacity of the solder pot ensures sufficient solder mass for even the largest assemblies. The nozzles are magnetically fixed and can be easily exchanged.

The change to lead free solder as part of the required RoHS compliance has many board assemblers concerned about lead cross contamination. The ability to swap solder pots in and out of the machine allows most users to simply have two solder pots, one for lead based solder, and one for lead-free. The pots are clearly marked and color coded to prevent mix-ups that can cause cross contamination. Each pot is equipped with its own solder pump and solder delivery system.

Selective soldering equipment can greatly relieve the assembly operation when dealing with mixed technology boards. The inspection process can be shortened due to fewer errors to verify and note, while touchup time can be significantly reduced, or in many cases, eliminated. The cleaning process can also be reduced since less flux is used. A selective soldering machine can increase production without adding labor costs and deliver a more consistent product quality through fewer soldering defects.

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