Migrating from Hand Solder to Robotic Soldering

The purpose of this article is to review the main reasons why a company would migrate to robotic soldering vs. hand soldering today's delicate electronics with manual operators.

Soldering Consistency:

It is virtually impossible for an operator to provide consistent quality over a long period of time. The parameters that need to be controlled are listed as follows:

- Heating Times (pre-heat & dwell time)
- Solder Volume (length of solder per joint)
- Solder Feeding Speed (consistent feed is important for flow)

When utilizing a micro-processor controlled soldering system, these factors are precisely controlled, thus causing all solder joints to have the same appearance, solder volume and barrel fill.

Currently, many of the top automakers are dictating that their Tier I, II & III suppliers do not provide PCB's and sub-assemblies that have been hand soldered due to inconsistent results & intermittent failures.

Of course there are talented soldering operators which provide quality solder results. These are usually your most skilled employees, however, many times get promoted onto better jobs requiring more responsibilities. Re-training & certifying new personnel is time consuming as well as costly. Training an operator to run a robotic soldering system is a much simpler, faster and cost-effective process as the skill level required is not as high.

Soldering robots can also run in a 24 / 7 environment. They do not take sick days, leave early or deliver poor / inconsistent results due to fatigue, eye strain, lack of concentration etc.

Also, many of todays mixed technology PCB's have many densely populated components with solder joints dispersed throughout all locations of the PCB. The robot is programmed to a specific path and does not miss or overlook small profile joints mixed between SMT components.

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Cycle Time:

Studies have been completed that show that the hand soldering iron is in the holder approx. 30%~40% of the time. This means that the operator is not soldering continuously due to fatigue, eye strain etc. The direct impact is reduced & inconsistent yield.

A soldering robot operates continuously without any breaks. The yield from a robot is calculated much more easily as the time per completed PCB will always be the same.

Process Flow:

Hand soldering operators are mainly effective in manual flow lines. There are cases in which an automated conveyorized line, has manual stations. However, this requires removing the PCB's or panels from the conveyor and then loading them back onto the conveyor. This causes chances for component loss or damage and does not allow for the line to operate at a specified rate of flow and subsequently creates bottlenecks in the process.

Robotic soldering systems can operate in the following process flow environments:

- Manual Load & Unload
- Dial Tables
- Conveyors

Utilization of a robotic soldering system in an automated environment will provide for consistent line flow without causing bottlenecks.

Another benefit is that in-line AOI inspection or 2D camera system can inspect the soldering immediately downstream without any handling or loading of a PCB via an operator, thus improving line flow, quality etc.

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Soldering Equipment:

Another reason to migrate from manual soldering to automated soldering equipment is that there are options for varying technologies which address specific application soldering requirements.

Top-side robotic solder systems are the most common which allow for soldering virtually any component type after process soldering such as wave or reflow soldering. Many iron tip profiles, geometries & sizes of tips are available to meet virtually all application challenges.

Bottom-side fountain type systems can provide faster results vs. hand soldering for connectors and large heat sink components.

Laser soldering is normally utilized in micro soldering applications in which an operator is required to look through a micro-scope in order to see the joint. This is time consuming and very strenuous on the operator.

Electronic PCB's, wire & assemblies are being reduced in size in order to meet the demands of micro-electronic & nano-technology devices such as body implants, electronic connectors & wire harnesses just to name a few.

A micro laser can be utilized to solder wire leads that are virtually too small to be able to be soldered by hand, even with the assistance of a microscope.

Technology in Robotic Systems:

Solder Feeding:

Some of the robotic soldering systems incorporate a feature that has a roulette micro-gear that punctures the cored solder wire to the flux core, thus allowing the flux to outgas through the holes. This function virtually eliminates solder balls from forming as the flux can outgas via the holes in the wire as the flux expands as it approaches the heat source (iron tip or laser).

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When feeding solder wire by hand, the flux does not have the ability to outgas, thus, a micro-explosion occurs when the alloy melts and creates solder balls and flux spatter.

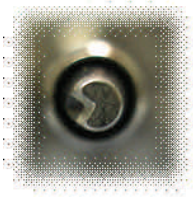
Iron Tip Technology:

The design of the automated solder tips incorporate a multi-layer plating process that provides for a much longer tip life vs. hand soldering tips. In a robotic environment it is important for the tips to last as long as possible so that the line can run without interruption. Many hand solder tips have a life of 2,000~10,000 solder points (shorter with Pb free alloys). Robotic soldering tips have a much longer useful life to minimize change-over.

Many tips have a built-in type K thermocouple and a 130 or 200 watt embedded heater. Together, these features allow for very rapid heating and very stable soldering temperature.

In a lead free process, the use of pre-heated Nitrogen gas is recommended. There can be a built-in N2 sleeve (or external) on each tip that provides a local inert atmosphere around the tip Apex. In-Plant or N2 generators can be used to provide the N2. The advantages are:

- Reduce Process Temperature (the N2 gas is pre-heated)
- Minimize Oxidation (local inert environment)
- Extended Tip Life (lower temp. & minimal oxidation)

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