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Selective Soldering: Pushing the Envelope

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The entire concept of selective soldering is being squeezed as the demands for high quality soldering increase while board space continues to shrink. Today's challenge is to reduce the nozzle sizes available.

Rising to the challenge, Pillarhouse has developed new nozzles and refined other technologies useful in the selective soldering process. The company has managed to produce even smaller nozzles with greater thermal transfer while increasing considerably the life of the nozzle.

Up until recently, the industry standard for solder nozzles, was 2.5 to 3mm. For years, these nozzles have been the benchmark minimum size that can be used within a production environment. However, even with these sizes, there are still potential production issues with regard to heat transfer and "dewetting" which can cause untimely production stops and quality issues.

Nozzles with enhanced capability now include a production 1.5mm nozzle.

Wetting and Keepouts

The company's newly patented solder nozzles achieve consistent flow, higher thermal capacity and reduced de-wetting characteristics. The new design is one that hopefully will reset industry standards and address some of the issues encountered in selective soldering. In the past, because of the limitations of larger nozzle sizes, there has been an issue with dewetting in the wetted nozzle design that is now used by most manufacturers of selective soldering machines. This has become an even bigger issue with the lead-free solder alloys due to the generally higher operating temperatures, higher dissolution rates and correspondingly higher oxidation rates.

To overcome the dewetting issues of the past, a number of techniques have been used such as alternating directions on the wetted nozzle; this helps to avoid the solder biasing to one side causing the other side to oxidize and de-wet. Another method of combatting this issue is to briefly burst the pump after a solder drop-off. This allows the solder to quickly re-coat and re-establish a good wetted flow over all sides. This method is especially important with the smaller nozzles because of their lower flow volume and thermal mass.

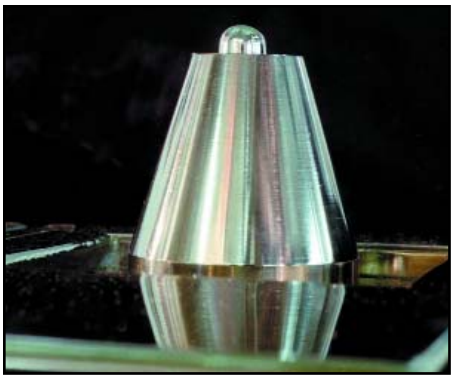
When nozzle de-wetting occurs it causes the solder to flow away from those areas and become unstable, which can affect the solder results. Tight keep-out areas can be greatly affected by this as the flow becomes non-uniform and therefore has a greater variation than when it is wetted properly.

Dewetting & Flux Issues

After dewetting, the nozzles have to be re-tinned using an aggressive flux. Pillarhouse has been working to greatly reduce damage to the nozzle tip thus improving the fundamental performance of wetted tips. The new patented nozzle design keeps all faces on the solder nozzle wetted, irrespective of the direction of movement, even for low flow rates and small nozzles. The new design incorporates non-standard geometry, and this, in combination with a special coating, has reduced nozzle maintenance and repair — those that have required tinning — from three to four times a day to three to four times a week. In addition, this design extends nozzle life up to three times what it had been previously. This increased nozzle life is attributed to the reduced interaction with the aggressive flux chemistry.

Smaller Nozzle Sizes

Thermal and wetting improvements to the company's standard line of nozzles has allowed pushing the process window for reliable use of a variety of



AP-1 Universal Nozzles can consistently apply flux and solder to component leads without disturbing nearby SMT components.

nozzle sizes within a production environment. Pillarhouse can now offer an entire range of nozzles with enhanced capability that includes a production intent 1.5mm nozzle. Nozzles smaller than 2.5mm can develop freezing of the nozzle tip when in contact with the circuit board. This is because of lack of solder volume and resulting reduced thermal energy. Another new patented design enables a very high solder flow from the pump — forcing the solder to be replenished more rapidly. This maintains a consistent solder temperature at the nozzle tip without the need for adding problematic nozzle tip heating elements.

Another problem inherent with small nozzles is the instability of the sol-

6-inch-wide fountain.

der flow produced by the nozzle. This again is typically due to the small amount of solder flowing out of the nozzle's tip. When the solder exits the small tip, it flows down the nozzle's wetted surface. Due to the nozzle's surface tension, the solder flow is then slowed down, which results in a back up (or back pressure) or build up. This in turn causes the solder height of the nozzle to increase. However, when the pressure builds up, the solder flow eventually cannot support the head pressure and it drops away from the solder tip causing the height of the solder to drop momentarily. This all happens fairly quickly — resulting in "instability" of the solder height. This is often misinterpreted as inaccuracy or resolution of the pump system, when in reality it is a lack of consistency in the nozzle performance.

Pillarhouse has been able to greatly reduce this effect by accelerating the solder that passes off of the nozzle tip so the solder height variation is almost eliminated. The company has also introduced a further fail-safe: even though the pump motors are monitored, they now have closed-loop monitoring of the pump shaft. This ensures there is no RPM change of the pump or from the mechanical transfer between the motor and the pump shaft. While it is true that RPM variations are more prevalent in chain-driven systems as compared to Pillarhouse's use of timing belts, pump shaft monitoring will add another level of assurance for customers. When these controls are incorporated with the wave-height and solder-level control systems, the entire pump assembly becomes a closed-loop system.

With the increased accuracy enhancements and the smallest available nozzles and tips, Pillarhouse equipment will create a new standard for access to very small areas of the circuit board. This will also greatly reduce the cost of nozzle replacement and down time that ordinarily result from the need for nozzle maintenance and repair. At the same time, the new nozzle will improve process stability. These new nozzles are available on the full range of the company's equipment both old and new.

In addition to functional enhancements and development, the company has also been pushing the design envelope with new quick-change solder pots on the new Jade Handex and Orissa Synchrodex range of selective solder machines. The new platforms incorporate a bath change system that now eliminates the need to unplug any connectors and fittings. All connections are made with covered and sealed pogo pin arrangements. The new bath configurations allow the use of quick change nozzles among all of the Pillarhouse technologies — AP1, Jetwave-Custom Wave, Multi dip, 150mm wide wave. All of these technologies are able to run in the same solder pot and can be changed within few minutes. This new design feature eliminates machine downtime caused by process changeover within the production environment — a huge advantage to users.

Switching Solder Pots

In some cases, customers would make do with the nozzle size or the process currently fitted to the machine because the changeover time was simply too long. With these new enhancements, customers are able to optimize their process without compromising machine up time. This, in conjunction with the new solder pot exchanger, enables customers to switch a solder pot (leaded to lead-free or vice versa) that is held at the proper temperature and ready to run in a safe and timely manner. This eliminates the warmup time needed for solder pots in most other systems. It also allows machines to have very little down time as the solder pots can be switched in a matter of minutes.

Another new feature is solder pot and solder reel tagging. With the increase of lead-free and multiple solder alloys within the production environment, it is imperative that controls are in place to ensure the correct alloys are being used in the machine. Solder tagging enables the customer to identify a specific alloy for a pot and tag it. The

Dual AP-1 nozzles.

machine then recognizes the type of solder the solder pot has in it. The pot is then linked to the program for the product to ensure that the program cannot be run with the wrong solder. In addition to this feature, the solder spool on the solder feeder is also tagged to ensure that the solder on the feeder matches the solder in the solder pot.

It is Pillarhouse's aim to continue to develop selective soldering technologies. To date, the company has been responsible for many advances in this technology through the years, and its continuing goal will not change; the company's efforts to enhance, develop and deploy new technology will continue.

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