X-Ray Supports Solder Paste Development

by Kathryn Cramer

Selecting the most effective solder paste for each electronics assembly manufacturing application ensures successful results and avoids many problems that can reduce productivity such as tombstoning, beading or voiding. That's why assemblers need to develop a close relationship with their solder paste suppliers, says Henk Mathijssen, Area Sales and Support Manager for Cobar/Balver Zinn, located in Breda, The Netherlands.

"Solder paste has a very complex chemistry," Mathijssen explains. Since each paste consists of various alloys, in different particle sizes, combined with different types of flux, each combination reacts differently to the reflow process. Selecting the right combination for each application is a collaborative endeavor that involves the end user's specifications, the assembler's procedures and the solder paste supplier's expertise.

Figure 1: The JewelBox-70T real-time x-ray system from Glenbrook Technologies helps support the development of new solder pastes at Cobar/Balver Zinn.

"It takes trust," Mathijssen says of the relationships that Cobar has developed with its worldwide network of customers. "The technical team will review the application in detail with the customer. Based on the collected data, the best possible recommendation will be made. If there are still unknown factors, a certified technical specialist will give support during production start-up." Cobar has been producing solder paste since the 1980s. As production requirements – such as the need for lead-free alloys – have changed, the company has developed a full range of paste variations to meet evolving needs.

New pastes expand an assembler's range of options for specific applications and different industries, such as automotive or medical products, LEDs, double-sided assemblies or multi-layered circuit boards as thick as 6 mm. While one paste may serve the majority of applications, having access to other formulations enables assemblers to expand their range of capabilities. Continuous research and product refinement has been key to keeping Cobar in the forefront of the market, offering pastes that include the widely-used SAC305, a new multi-alloy incorporated into a new flux platform called JEAN-151 and the next-generation LMPA (low melting point alloys).

The most commonly used solder paste alloy is SAC305, which Cobar produces in particle sizes ranging from T3 to T5 – the higher the particle number, the smaller the particle size. The finer the pitch of the components being assembled, the higher the particle number required. The alloy may be lead-free, as mandated within the European Union since 2005, or the traditional tin-lead combination still used in some North and South American applications. The flux may be water-soluble or no-clean rosin based, which is the most commonly used variety.

Even with all these different combinations, other pastes may be required for specific applications. Mathijssen recalls one customer who experienced tombstoning – where one end of a component rises up rather than remaining horizontal in the solder paste – when using SAC305 in a vapor phase reflow process. Cobar support specialists, who are IPC-600 and IPC-610 certified, reviewed the situation and recommended switching to SCAN-Ge071 from the company's JEAN-151 range. The new SCAN-Ge071 alloy solved the tombstoning problem in two ways: its narrow melting range of 9°C prevented one side of the component from lifting before the other side was completely melted, and its relatively low flux content reduced pollution of the heating medium Galden 230.

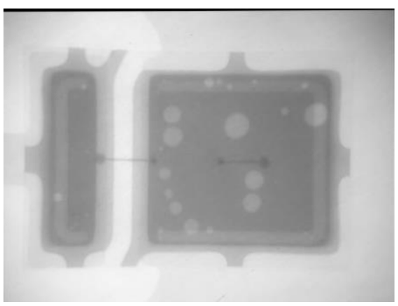

Figure 2: An x-ray image shows that solder paste JEAN-151 SAC305 t4 provides coverage within the IPC specification of ≤30% voiding with no visible beading under an LED body.

Perhaps the greatest benefit of the JEAN-151 line is that it is available in multiple alloys, rather than the three or four variations that other lines offer, all using the same flux. "We are producing eight different alloys now, and still counting," Mathijssen says. "That's really exceptional." Once an end user specifies the JEAN-151 flux, he notes, "the assembler has access to multiple alloys, each with their own application area." This is important for automotive and medical applications in particular, since end users often specify certain alloys. As a result, according to Mathijssen, the JEAN-151 line has become an "all-rounder," suitable for 80 percent of all applications.

Another new paste from Cobar is its LMPA (low melting point alloys) line, which has a peak temperature of 190 to 220°C, as opposed to 230 to 240°C for conventional solder pastes. While LMPAs have been available for nearly 20 years, Mathijssen explains, the solder joints tended to be brittle and could break easily. In Cobar's LMPA the alloy is reinforced, making the solder joint much stronger. LMPA is also beneficial in double-sided assembly; the first side may be soldered with SAC305 and the second with LMPA, ensuring that components on the first side are not disturbed during the second reflow process.

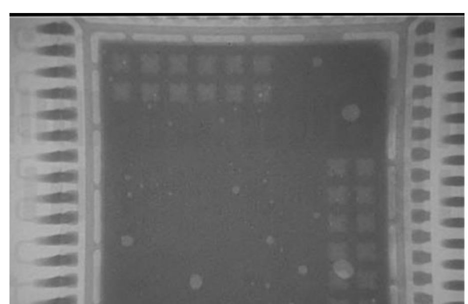

Figure 3: X-ray reveals that using a low melting point alloy in solder paste BZ37LM on a board with a ground area of 9x9 mm in a conventional reflow oven produces extremely low voiding of 5 to 10%.

"At first, the industry was skeptical," Mathijssen admits, "but every week we are getting more requests for samples. We see business is really picking up." Interest in LMPAs is growing in response to the needs of

LED manufacturers, and particularly chip maker Intel, who is the main driver behind this market trend. "The LED business is booming," he says, even though it is a demanding application, requiring a very low percentage of voiding: less than 10 percent, as opposed to the IPC standard of less than 30 percent.

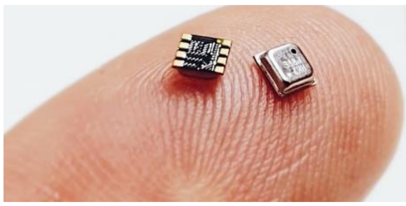

Figure 4a: This miniature Bosch LGA humidity sensor, which measures relative humidity, barometric pressure and ambient temperature, presents an assembly challenge.

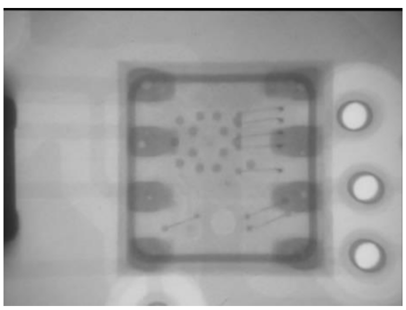

Figure 4b: But x-ray imaging reveals properly deposited solder paste, within voiding specifications, despite the small footprint of the board.

The process of creating any new solder paste starts in the research department, and is based on theory and knowledge, Mathijssen says, but product performance must be verified through trial and error. To evaluate a new solder paste, Cobar relies on real-time x-ray inspection. Each new combination of alloy, powder size and flux must demonstrate its viability under x-ray.

Is the voiding percentage within the required specification? Are any solder balls trapped under a tiny LED component? Or is there a condition known as HiP (head in pillow), where one corner of the BGA component is higher than the others and so does not make solid contact with the underlying pad? This last flaw is particularly challenging since it is not obvious in post-reflow visual inspection. The part passes initial tests, but can fail in the field up to a year later – a result no company wants to deal with. Only x-ray will reveal the answers.

That is why Mathijssen states that "an essential tool in the development of solder paste is the JewelBox-70T" real-time x-ray inspection system supplied by Glenbrook Technologies of Randolph, New Jersey. This particular system, he notes, offers multiple benefits: it has a large door and x-ray inspection area within a small footprint, enhancing "how much area you can inspect at one time." The JewelBox also allows the user to rotate and tilt the board being inspected, a valuable feature for issues such as HiP, which cannot be seen from above, but only from the side or a 45° angle.

The JewelBox that Mathijssen uses to evaluate solder paste performance is located at Infinity High Tech Solutions, an assembly manufacturing firm based in nearby Someren, The Netherlands. Thanks to a close relationship between the two companies, the system serves two purposes: conducting real-time x-ray inspection of placed components for Infinity, and supporting solder paste development for Cobar.

Both the hardware and the GTI-5000 software installed on the JewelBox are easy to use, Mathijssen adds. "Within an hour, every operator can use the system." And finally, with its "attractive pricing," even smaller companies can afford to install a JewelBox. So, whether using the system to evaluate assemblies on the manufacturing line, or to verify the performance of a new solder paste, he finds the JewelBox "a perfect solution" for real-time x-ray inspection.

Glenbrook's Jewel Box will continue to be a vital support system for Cobar's ongoing product development program, which at the present time is focused on expanding the range of particle sizes from the current T5 to the even smaller T6, for semiconductor special applications. Though T6 solder paste is not available widely at this time, Mathijssen says that "Technology advanced customers are following closely the development of T6 and beyond." Such activity on the frontier of solder paste development presents one more example of how Cobar/Balver Zinn "is not standing still."

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