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Balver Zinn Josef Jost GmbH & Co.KG
Blintroper Weg 11
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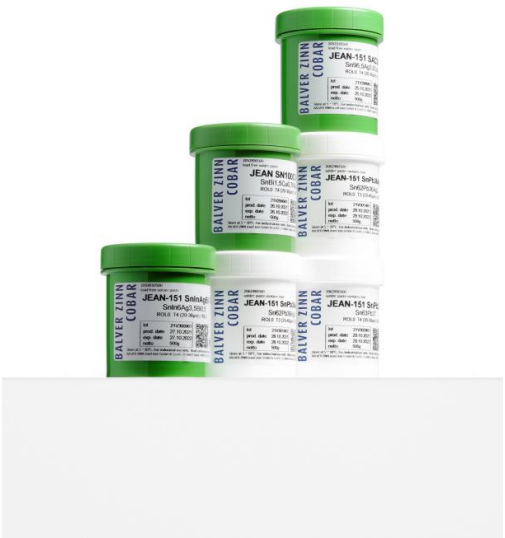
JEAN-151: The Story

Research Resolves One Issue, Opens New Opportunities

The project to develop new soldering pastes might open a wide range of possibilities for completely new dimensions.
The genesis of a unique solder paste platform with 8 different alloys and 3 powder types: JEAN-151



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Research Resolves One Issue, Opens New Opportunities

In the course of conducting research to solve one problem in screen printing, it is sometimes possible to develop a solution that not only achieves the original goal, but also offers unexpected new benefits to manufacturers of numerous surface-mounted products. An example of this is a research project that started with the aim of minimising mid-chip solder balling, which occurs during the reflow process, when solder is pushed out from the edge of a surface-mounted component and does not flow back under the component during the remainder of the reflow process.

The project solved not only the original problem, but also led to the development of a versatile new flux platform with the broadest range of applications in the industry. Before developing the flux formulation, a completely new production process had to be devised. This was the only way to meet the high demands placed on the new flux, which had to be robust, particle-free, low-reactive and, above all, versatile. The result is impressive: Currently, the new flux JEAN-151 can be combined with 8 different alloys and 3 powder sizes – T3, T4 and T5 – without modifications. This makes JEAN-151 the most versatile flux platform with the widest range of applications in the industry.

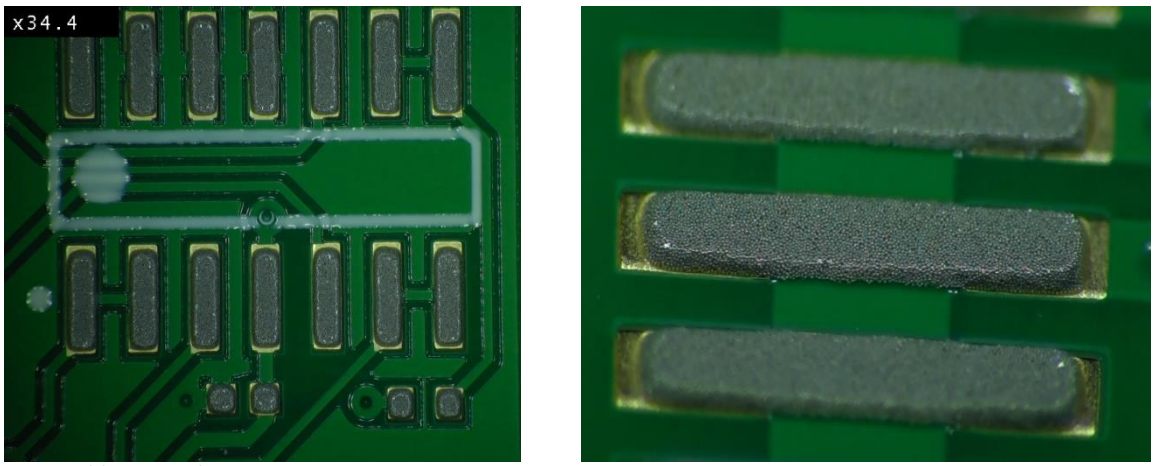

Fig. 1: Solder paste deposit

The original goal of the project was to improve contour stability, i.e. the ability of the solder paste to maintain its extruded shape and tackiness on the PCB as well as at increasing temperatures over a longer period of time (Fig. 1). If a paste does not have sufficient contour stability, it can break down as reflow temperatures rise, a condition known as 'hot slump', which increases the risk of mid-chip solder balling. Other goals of the project were to extend the lifetime of the deposited paste on the stencil and the overall lifetime of the paste; both properties should contribute to the improvement of the printing process.

The flux plays several important and crucial roles in solder paste: It should form a homogeneous suspension with the solder powder, should protect the powder from oxidation and should not be chemically reactive. This the only way to guarantee the rheological properties, the dynamic viscosity, the contour stability and thus the thixotropy of the solder paste. It should be kept in mind that when different alloys and powder types are used, this has an enormous influence on thixotropy (Fig. 2).

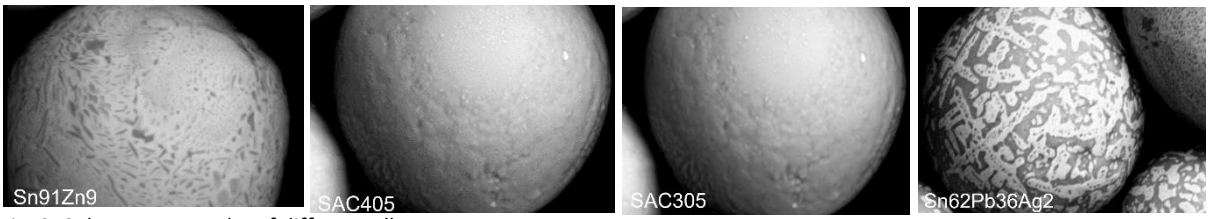

Fig. 2: Sphere topography of different alloys

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Finally, the flux should have good adhesive properties and be temperature stable, in order to allow sufficient activation up to the peak zone at the high temperatures in lead-free reflow processes. Using a combination of high and low melting resins, in conjunction with higher boiling solvents, the "hot slump" properties were improved and thus a higher temperature stability achieved.

We started with the silver-containing, lead-free standard alloy SAC305 (SnAg3.5Cu0.5), with powder grain size T4 (20 - 38 µm). SAC305 has a melting range of 217-219°C and is suitable for air, nitrogen and vapour phase applications. After JEAN-151, classified as ROL0 according to J-STD-004, passed all internal tests with SAC305 T4, it turned out that this could be the key to achieving the desired success. From then on, extensive customer evaluations were carried out at 19 different locations. The tests resulted in more than 300 images, X-rays and reports, all confirming the effectiveness of the new system.

The solder paste demonstrated stable and reproducible print characteristics with excellent print definition and contour stability, 48-hour tack, a guaranteed stencil life of 24 hours and long uncooled bottom life of 300 hours at 25-30°C. Observations included reduced voiding to the IPC-610 standard of less than 30% and good wetting of all components, including edge QFNs, in air, nitrogen and vapour phase reflow, on numerous surfaces: ENIG, both Pb and Pb-free HASL, OSP, immersion Sn and immersion Ag.

In a long-term test with 0402 components and smaller die openings, no mid-chip solder balling was detected by one test site (Figs. 3a, 3b). Furthermore, the printed paste remained stable over a nine-hour working day and had a lifetime of one month. The flux residues were clear and could be covered by a conformal coating, but could also be cleaned, if desired.

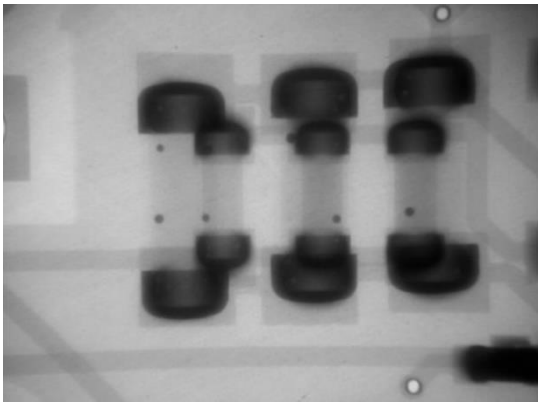

Fig. 3a: MELF components with mid-chip solder balls

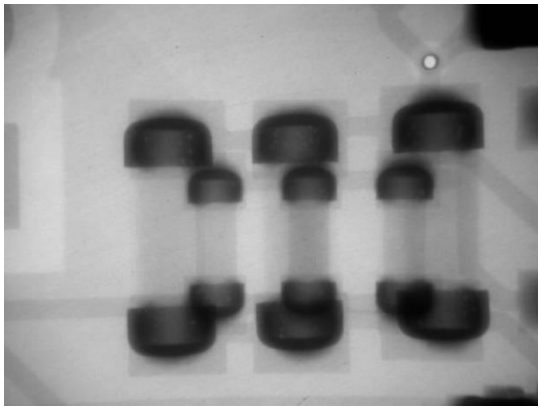

Fig. 3b: MELF components without mid-chip solder balls

But Balver Zinn / Cobar wanted to accomplish more, much more! In parallel with the official launch of JEAN-151 SAC305 T4 (with a 6-month shelf life) at Productronica 2019, both the tireless team from R&D, and the application engineers from technical support, first and foremost Henk Mathijssen, worked hard on the project. Since then, "baby" JEAN-151 SAC305 T4 has grown into a mature product portfolio with a 12-month shelf life and 8 different alloys.

JEAN-151 Story

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Balver Zinn / Cobar will present the complete portfolio at the upcoming Productronica 2021:

- JEAN-151 SAC305 T3, T4 and T5

- JEAN-151 SN100CV® T4

- JEAN-151 SnAg3.5In6NiGe (known as SABI6)

- JEAN-151 SCAN-Ge071 T3, T4

- JEAN-151 SN100C® T3, T4

- JEAN-151 SAC0307 T4

- JEAN-151 Sn62Pb36Ag2 T3, T4

- JEAN-151 Sn63Pb37 T3, T4

The alloy SAC305 (SnAg3.0Cu0.5) has become the worldwide standard alloy for the reflow process (Figs. 4a, 4b, 4c). It can be used for both high-tech and industrial applications. Currently, JEAN-151 is available in combination with SAC305 in powder sizes T3, T4 and T5. We are also working on T6.

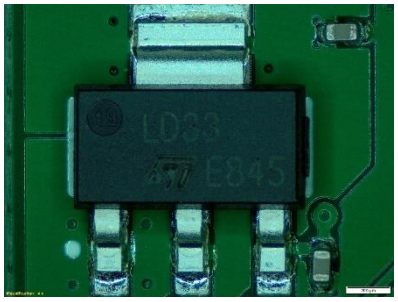

Fig. 4a: Air: JEAN-151

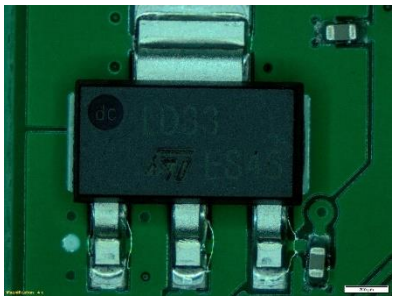

Fig. 4b: Nitrogen: JEAN-151

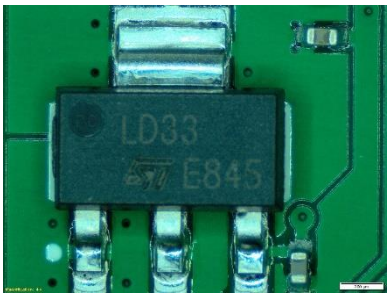

Fig. 4c: Vapour Phase: JEAN-151

SN100CV® (SnBi1.5Cu0.7NiGe) is an alloy based on SN100C®, patented by Nihon Superior. In combination with JEAN-151, SN100CV is available in powder size T4. The addition of bismuth results in a 30% increase in strength, making SN100CV® a high-strength, thermally stable alloy for high-tech and industrial applications.

SnAg3.5In6NiGe, also known as SABI alloy, is a highly reliable alloy for high-tech applications. The addition of 6% indium gives the alloy excellent shear strength properties after aging, resulting in better reliability compared to other alloys. In addition, SnAg3.5In6NiGe is suitable for heat-sensitive components and substrates due to its low melting range between 202 and 210 °C.

SCAN-Ge071 (SnAg1Cu0.7NiGe) is a nickel- and germanium-doped silver reduced alloy with a melting range of 217 - 225°C. SCANGe071 is available in powder sizes T3 and T4 and produces matte solder joints with a fine-grained, homogeneous structure. Due to its large melting range, SCAN-GE071 is ideally suited to minimise tombstone effects in vapour phase soldering. SCAN-Ge071 is the ideal compromise between SAC305 and SAC0307, and very suitable for industrial applications.

SN100C® (SnCu0.7NiGe) is a nickel-stabilised eutectic tin-copper alloy and is available in powder types T3 and T4. This silver-free alloy is the lowest cost lead-free alloy that can be combined with JEAN-151. SN100C® can be used for standard industrial and high-tech applications.

SAC0307 (SnCu0.7Ag0.3), is a low-cost alloy with low silver content and available in powder size 4 for standard applications.

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The tin-lead alloys SnPb37 and SnPb36Ag2 have been used in the electronics industry for decades; they have proven to be extremely reliable and have excellent mechanical properties. Both alloys are available in powder sizes T3 and T4. Tin-lead solders continue to be used in aerospace and military applications.

The well-balanced JEAN-151 flux formulation, when used in combination with the currently qualified 8 alloy options, allows a wide process window. Independent of the alloy or powder size used, printing speeds from 30 to 120 mm/s are possible. Higher speeds might require fine-tuning of the process. Even 6 mil (0,15 mm) stencil apertures (6MRE) are filled sufficiently with JEAN-151 SAC305 T4 solder paste at high printing speeds (Fig. 5).

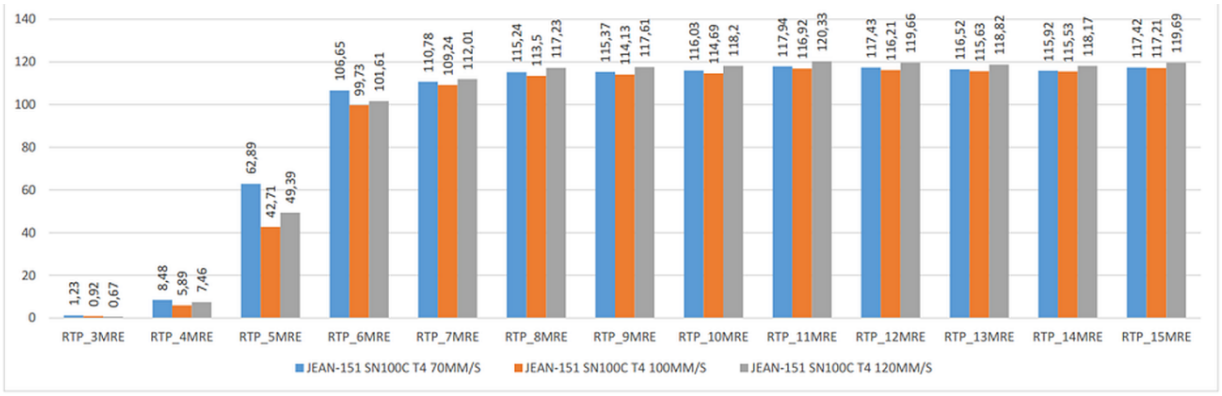

Fig. 5: Solder paste volume at different settings: Printing performance at different speeds on rectangular pads

During the process of studying the shelf-life extension of JEAN-151 solder pastes, different batches have been inspected using SPI (solder paste inspection) after the manufacturing and expiring dates. Solder paste deposits made with a 15-month-old JEAN-151 are shown below (Fig. 6). Even 9 months after expiration, JEAN-151 paste shows similar printing and soldering performance than the fresh product.

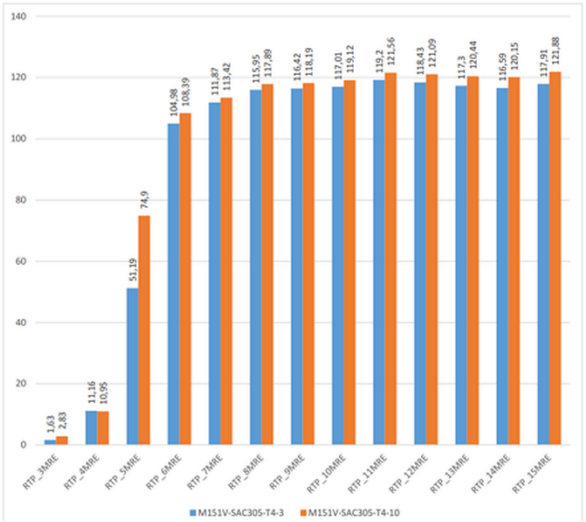

Fig. 6: Printing properties after aging / expiring: DoM 07.06.2019

With this wide range of alloy options now available on the single, versatile JEAN-151 flux platform, manufacturers can rely on consistent, improved process performance across a wide range of applications. For Cobar Balverzinn, the development of a new flux originally designed to solve one process problem - solder ball formation in the centre of the chip - and its subsequent expansion to support the widest possible range of different alloys, demonstrates the value of continued research.

Indeed, the story does not end at this point; as new demands continue to emerge in the marketplace, ongoing research continues to meet the new requirements. As surface mount manufac